Infraorbital Nerve Block for Isolated Orbital Floor Fractures Repair: Review of 135 Consecutive Cases

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Background: Orbital blowout fractures can be managed by several surgical specialties including plastic and maxillofacial surgery, otolaryngology, and ophthalmology. Recommendations for surgical fracture repair depend on a combination of clinical and imaging studies to evaluate muscle/nerve entrapment and periorbital tissue herniation.

Methods: The aim of this study was to verify the applicability of regional anesthesia when repairing orbital floor fractures. A retrospective chart review was performed for isolated orbital floor fractures treated at the Department of Maxillofacial Surgery in Florence between May 2011 and July 2012. The study included 135 patients who met the inclusion criteria: 96 subjects were male (71%) and 39 were female (29%). The mean age was 45.3 years, ranging from 16 to 77 years.

Results: The results revealed that isolated anterior orbital floor fractures can be safely repaired under regional and local anesthesia. Regional and local anesthesia should be combined with intravenous sedation when the fracture involves the posterior floor. The surgical outcome was comparable to the outcome achieved under general anesthesia. There was a lower rate of surgical revisions due to concealed malposition or entrapment of the inferior rectus muscle (19% vs 22%). However, this result was not statistically significant ($P > 0.05$).

Conclusions: There are several advantages to surgically repairing isolated orbital floor fractures under regional and local anesthesia that include the following: surgeons can check the surgical outcome (enophthalmos and extrinsic ocular muscles function) intraoperatively, thereby reducing the reoperation rate; patient discomfort due to general anesthesia is eliminated; and the hospital stay is reduced, thus decreasing overall healthcare costs. *(Plast Reconstr Surg Glob Open 2014;2:e97; doi: 10.1097/GOX.0000000000000039; Published online 20 January 2014.)*

Orbital blowout fractures can be managed by several surgical specialties including plastic and maxillofacial surgery, otolaryngology, and ophthalmology. Orbital floor fracture management has changed significantly over the past decades with the introduction of new materials (porous polyethylene and titanium plates) and different fixation methods.[1–6] Recommendations for surgical fracture repair mostly depend on a combination of clinical examination (diplopia, enophthalmos, visual acuity, impaired ocular movements) and imaging studies (computed tomography) to evaluate muscle or nerve entrapment.[3] Concomitant evaluation of symptoms, signs, and radiographs reduces ambiguity and confusion due to local edema and/or subcutaneous em-

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physema, which may pose clinical doubts because of transitory diplopia and lead to overtreatment.[3,6] The goal of surgery is to reposition the herniated orbital fat within the orbit and restore the residual bone defect.[6,7] In this study, we examined case records of patients suffering from isolated orbital floor fractures and who were treated in our level I trauma center under regional anesthesia (infraorbital nerve block).

METHODS

Study Design

The primary advantage of local anesthesia is its ability to numb a specific area without impacting the patient's consciousness. Recent studies share the professional opinion that most, if not all, cosmetic surgery procedures can be safely performed under local anesthesia with intravenous sedation.[8–12] Specifically, we evaluated the efficacy of the infraorbital nerve block for repairing orbital floor fractures because this nerve is often involved in such injuries, leading to some degree of numbness.[13] Moreover, the infraorbital nerve provides sensibility to the orbital floor. The nerve runs in the infraorbital sulcus, which crosses the floor of the orbit together with the infraorbital artery and vein. Furthermore, we verified patients' comfort in the postoperative period because of the utmost importance to obtain further parameters useful to validate the applicability of present technique.

Data Collection

A retrospective chart review was performed for isolated orbital floor fractures treated at the Department of Maxillofacial Surgery in Florence (Level I Trauma Center) between May 2011 and July 2012. Patients were reviewed and included in the study when they met at least one of the inclusion criteria preoperatively and intraoperatively (Table 1). The following demographic information was collected from medical records: gender, age, presenting symptoms, date of injury, date of surgery, faculty surgeon, surgical approach, type of reconstruction, and postoperative complications (Table 2). Subjects suffering associated facial injuries were excluded to avoid confounding. Indications for surgery were enophthalmos (>2 mm), severe diplopia (defined as a downward gaze), limited upward gaze, and an orbital floor defect greater than 25%.[14,15] All included orbital floor fractures were of the blowout type including impure blowout and pure blowout. Comminuted fracture subtypes were also excluded for consistency because these repairs never required surgical reconstruction with biomaterials. Porous polyethylene Medpor (Porex Surgical, College Park, Ga.) was used in all cases to achieve proper reduction. The material is biocompatible and durable, and it is available in thin (1.5 mm) and ultrathin (0.85 mm) sheets, which are easy to customize for the defect and can be redoubled when further correction is required.[3,4,16,17] Hence, the indication to use Medpor was related to the defect size.

One hundred thirty-five adult subjects met the inclusion criteria for this study. Ninety-six were male (71%) and 39 were female (29%). All patients underwent surgery for isolated monolateral orbital floor fractures. There were 93 right (68.8%) and 42 left (31.1%). The mean age was 45.3 years, ranging from 16 to 77 years. Motor vehicle collisions, assaults, and falls were the most frequent mechanism of injury (81%). The remaining injuries were due to sports, logging, and pedestrians (19%). Patient comorbidities included hypertension (30%), diabetes type 2 (15%), and anticoagulant therapy (3%) for cardiac disease. All attempts were made to perform surgery under regional anesthesia within 5 days from the date of injury. All patients received a prophylactic dose of intravenous antibiotics preoperatively or

Table 1. Inclusion Criteria for Chart Review

Preoperative criteria
Unilateral orbital floor fractures
Diplopia
Enophthalmos
Decreased visual acuity
Impaired ocular movements
Intraoperative criteria
Surgical procedure under regional anesthesia
Repair with alloplastic material (porous polyethylene)
Subciliary or transconjunctival approach

Table 2. Preoperative and Postoperative Signs/Symptoms of Patients

Primary Preoperative Signs/Symptoms	n = 135 (%)	Postoperative Signs/Symptoms at 1 Month	n = 135 (%)
Diplopia	68 (50.3%)	None	83 (61.4%)
Ecchymosis	114 (84.4%)	Infraorbital numbness	36 (26.6%)
Enophthalmos	24 (17.7%)	Up-gaze diplopia	54 (40%)
Enophthalmos not assessable (edema/emphysema)	99 (73.3%)	Ectropion	5 (3.7%)
Conjunctival hemorrhage	90 (66.6%)	Enophthalmos	5 (3.7%)
Herniation of tissue in orbital floor	122 (90.3%)	Postoperative mydriasis	3 (2.2%)
Limited upward gaze	54 (40%)	Ischemic optic neuropathy	1 (0.7%)
Infraorbital nerve dysfunction	126 (93.3%)		

1 g amoxicillin clavulanate intraoperatively, and 8 patients who reported a penicillin allergy received 600 mg of clindamycin. Regional anesthesia was achieved by blocking the infraorbital nerve. The needle was inserted approximately 1 cm inferior to the infraorbital foramen, advanced upward toward the foramen, and directed superolaterally to avoid passing through the foramen into the orbit. A regional infraorbital nerve block was reinforced by injection into the lower eyelid to achieve proper hemostasis and reduce potential ocular complications associated with bleeding.[13] A total of 10 ml of bupivacaine/adrenaline (1:200,000) was injected in all cases and was associated to conscious sedation using intravenous injection of remifentanyl (0.1–0.2 μg/kg/min) when necessary. Epinephrine decreased the rate of systemic absorption, reduced the risk of systemic side effects, prolonged the duration of action of the anesthetic, and improved hemostasis. Three milliliters of sodium bicarbonate was added to neutralize the acidity of the local anesthetic and to reduce the burning sensation associated with anesthetic administration.[13] Orbital floors were reconstructed using porous polyethylene grafts in all cases, and the graft was shaped to the size and contour of the defect. The biomaterial was first soaked in sterile physiological solution (NaCl 0.9%). The material was then inserted below the periosteum without screw or suture fixation after reducing herniated periorbital tissue. At this time, clinical examination was performed by evaluating 3 parameters considered essential to a successful reconstruction as shown in Table 3. Surgery was considered completed if the patient met at least 2 of the 3 parameters; in particular, extrinsic ocular muscle function should have been always maintained to avoid inferior rectus muscle entrapment conjoined to diplopia and/or enophthalmos resolution. On the contrary, Medpor implant was revised in size, shape, and position till proper outcome. Then the anterior edge of the orbital periosteum was closed with a 5/0 absorbable suture, and the skin was sutured without any drains using a 6/0 nonabsorbable suture. Postoperative antibiotics were administered intravenously until hospital discharge and then continued for a total of 6 days following surgery. Intravenous corticosteroids were administered either intraoperatively or for 2 days postoperatively. All patients were given standard discharge instructions including an emergency call number to report atypical postoperative symptoms. All patients were instructed to keep the operated eye unpatched and to perform 2-hour vision checks measured at greater than count fingers vision. Analyzed outcomes included reoperation and postoperative complications persisting longer than 4 weeks and not present before injury. A subciliary approach was performed in 119 (88.1%) patients, and a transconjunctival incision was used in 16 (11.8%) patients depending on the risk of ectropion, which was clinically evaluated before surgery with the eyelid pinch test. Complications included ectropion, enophthalmos, paresthesia, anterior ischemic optic neuropathy, up-gaze diplopia, and postoperative mydriasis as listed in Table 2.

Outcomes were analyzed by a 1-way analysis of variance test, followed by a Student-Newman-Keuls multiple comparison post hoc test; $P < 0.05$ was considered significant.

The present study was approved by the Local Ethical Committee. Written informed consent was obtained from each subject.

Patients Comfort Evaluation

Postoperative data were collected on 3 moments: immediately postoperatively (within 1 h from the end of surgery), the day after surgery, and 1 week postoperatively. Patients received 2 standardized 100-mm Visual Analogic Scale (VAS) (one for pain and one for discomfort) on each control as successfully used in previous studies. Discomfort was defined as "sensation other than pain" (nausea, vomiting, and headache) and the VAS showed "no pain" on the left side and the "most pain experienced by the patient in his/her life" on the right side and similarly for discomfort (Fig. 1). On the first postoperative day,

Table 3. Intraoperative Clinical Examination

Parameter	Reliability Under Regional Anesthesia
Enophthalmos	Always
Diplopia	Almost always. Anyway not reliable if present in the postoperative following orbital floor reconstruction
Extrinsic ocular muscles function	Always in case of anterior orbital floor fractures
	Difficult to assess in case of posterior orbital floor fractures repair under regional anesthesia conjoined to conscious sedation

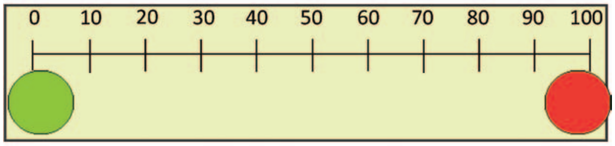

Fig. 1. Visual Analogic Scale. Patients placed a pen-mark across this horizontal line to indicate the intensity of pain and discomfort. The right end of the line (red-inched) represents the most severe pain experienced in his/her life and the left end (green-inched) represents no pain at all. The VAS used in the present study was linear, with zero assigned to no pain and 100 to the highest pain felt.

Table 4. Signs/Symptoms of Surgical Revision

Postoperative Signs/Symptoms at 1 Month	*n* (%)	Surgical Procedures at 3 Months Postoperative	Outcome
Ectropion	5 (3.7%)	Canthopexy	Resolved
Enophthalmos (aesthetic)	5 (3.7%)	Further porous polyethylene	Two partially resolved (40%) Three not resolved (60%)

patients received a 3-point preference scale on surgery: 1—"I was comfortable going home the day after surgery. There was no reason for me to stay longer in the hospital"; 2—"I was concerned about leaving the hospital the day after surgery. I would have felt more comfortable if I had stayed one night more, but it worked out fine"; 3—"I should have stayed one night more, I was in considerable pain and discomfort at home." Similarly, at 1 week postoperatively, each patient was asked if they were satisfied or not with their overall experience and the 2 possible responses were 1) "I was completely satisfied" and 2) "I was dissatisfied."[18]

RESULTS

Reconstructive Outcomes

Surgery was performed within the first 5 days (mean = 3.1 d; range, 1–5 d) from the date of injury. The overall hospital stay ranged between 1 and 3 days (average, 2.6 d). All 135 patients underwent surgery with an infraorbital nerve block and subciliary anesthesia combined with conscious sedation when necessary. The anesthesia was effective within 7 minutes (range, 3–11 min). The majority of the subjects (n = 107; 79.2%) did not report discomfort and actively cooperated during the intraoperative examination by the surgeon, who examined the subject for enophthalmos, extrinsic ocular muscles function, and diplopia. Twenty-four patients (17.7%) suffering a posterior orbital floor fracture reported minor discomfort without surgical intervention. These patients underwent surgery under regional and local anesthesia combined with conscious sedation. Intraoperative general anesthesia was necessary in 4 cases (2.9%) of posterior orbital floor fracture and was performed due to excessive patient discomfort. Comorbidities did not influence the operation except for a slight increase in bleeding, which was controlled intraoperatively. Surgical outcomes at the 1-month follow-up are reported in Table 2. Fifty-four patients (40%) suffered up-gaze diplopia and were referred to an ophthalmologist after orbital magnetic resonance imaging showed displacement of the origin of the inferior rectus muscle. Three patients (2.2%) suffered postoperative mydriasis, and 1 patient (0.7%) complained of anterior ischemic optic neuropathy with only partial spontaneous recovery. Five patients (3.7%) presented with iatrogenic ectropion and were successfully treated with lateral canthopexy. Five patients (3.7%) suffering cosmetic enophthalmos underwent further insertion of porous polyethylene with only 2 partial recoveries (40%) (Table 4). Surgical revision was performed after 3 months. Both diplopia and enophthalmos correlated most closely with fracture severity regardless of treatment. Although infraorbital nerve dysfunction was present in 126 patients following injury (93.3%), the condition was usually mild, and most patients (98%) eventually recovered completely. No patient experienced avascular necrosis, irreversible muscle dysfunction, and retrobulbar hemorrhage. Orthoptic assessment, including sequential Hess chart and fields of binocular single vision, was used to monitor the recovery of those patients who were potentially unlikely to return to normal ocular balance. Long-term (>6 mo) follow-up was obtained for complicated cases. Patients were instructed not to blow their noses for approximately 10 days. Antibiotics and anti-inflammatory medications were administered during the postoperative phase to accelerate the resolution of orbital inflammation and edema. This therapy proved effective for resolving upward gaze diplopia, which, although not disabling, manifested in 54 patients (40%). Clinical and radiographic results of the procedures are shown in Figures 2–19. Twenty emergency calls were received within the

Fig. 2. Fracture of the right orbital floor. Frontal view of a 79-year-old man.

Fig. 3. Postoperative results at 10 mo.

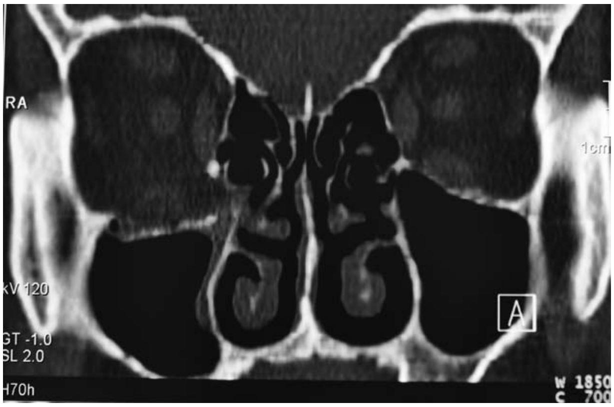

Fig. 4. Coronal CT scan of the fracture. See the herniated periorbital tissue of the right eye into the maxillary sinus.

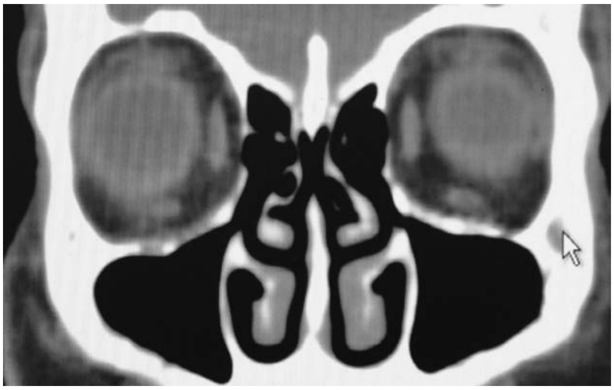

Fig. 5. Postoperative result at 10 mo following bone fracture repair with Medpor under regional anesthesia.

first 3 postoperative days involving questions about medications and medical advices. The reoperative rate following orbital floor fracture repair under regional anesthesia was lower compared to surgical repair under general anesthesia in our Level I Trauma Center (19% vs 22%). However, this result was not statically significant ($P > 0.05$).

Fig. 6. Clinical result showing the impaired ocular motility in the preoperative.

Fig. 7. Return to the normal ocular motility 10 mo postoperatively.

Fig 8. Fracture of the right orbital floor. Frontal view of a 23-year-old woman.

Patients Comfort Evaluation

Results from the survey showed an average pain and discomfort score of 12.98 and 11.89, respectively, in the immediate postoperative. The day after surgery, the score was 4.81 and 5.34, respectively, while 1 week after surgery, the score was 0.50 and 2.43, re-

Fig. 9. Postoperative results at 8 mo.

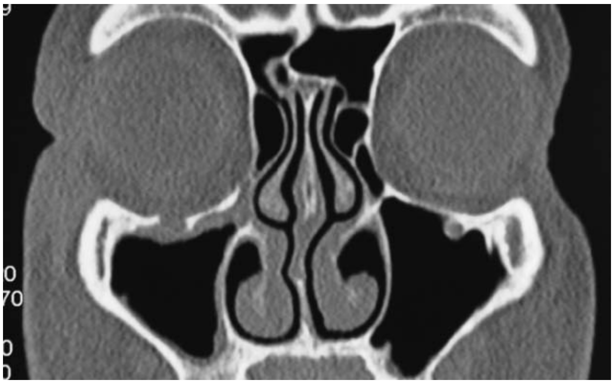

Fig. 10. Coronal CT scan of the fracture. Note the herniated periorbital tissue of the right eye into the maxillary sinus.

Fig. 11. Postoperative result at 8 mo following bone fracture repair with Medpor under regional anesthesia.

spectively (Table 5). We did not record a VAS score > 50 in any case. The highest VAS score was 50 and 45 for pain and discomfort, respectively, in the immediate postoperative; VAS score 20, both for pain and discomfort, the day following reconstructive surgery; VAS score was 0 for pain and 20 for discomfort 1 week after surgery (Table 5). The results from the patient's general preference and overall satisfaction with the surgical experience were as follow: in the 3-point preference scale, 126 of 135 (93.3%) questions the

Fig. 12. Clinical result showing the preoperative abnormal ocular motility.

Fig. 13. Postoperative normal ocular motility charged to the inferior rectus muscle 8 mo later.

patient reported: "I was comfortable going home the day after surgery. There was no reason for me to stay longer in the hospital." In 9 instances (6.6%), the response was "I was concerned about leaving the hospital the day after surgery. I would have felt more comfortable if I had stayed one night more, but it worked out fine." None of the patients selected: "I should have stayed one night more in the hospital, I was in considerable pain and discomfort at home." All patients reported that they were "satisfied with the overall experience." According to previous studies, satisfaction is driven by the difference or discordance between expectation and experience and patients

Fig. 14. Fracture of the left orbital floor. Frontal view of a 48-year-old man.

Fig. 15. Postoperative results at 9 mo.

who were extremely anxious and not bothered with surgery would be more satisfied than those who were not concerned and extremely bothered.[18]

DISCUSSION

In 1957, Smith and Converse suggested the term "blowout" to refer to an isolated fracture of the orbital floor.[1] Blowout fractures are further classified as pure (orbital rim not involved) and impure (orbital rim involved), and pure blowout fractures are categorized as trapdoor (the bone fragment is partially attached to intact bone with frequent incarceration of the periorbita) or punched-out (the fractured bone segment is detached on all sides with infrequent incarceration of the periorbita).[2–4] Typically, orbital floor fractures do not occur in isolation but are associated with other facial fractures.[3] Their management is shared by different specialties, such as ophthalmology, plastic surgery, and otolaryngology. The management of these fractures has been debated for many years, and recommendations for treatment have been addressed in part by Burnstine.[14,15] Nonetheless, no one has described the appropriate anesthesia for surgically repairing these fractures. Rather, most articles focus on the surgical outcome.[18–22] Diplopia, enophthalmos, and limited extraocular movements are indications for surgical treatment. Although diplopia is present in most cases, it can resolve within a few days with the resolution of traumatic edema, muscle contusions, and neuropraxia, with the exception of an actual entrapment of the inferior rectus muscle or of the periorbital tissue.[14] This issue can be resolved by combining clinical examination and coronal CT scanning, which provide information on herniation, muscle entrapment, dislocation, and de-

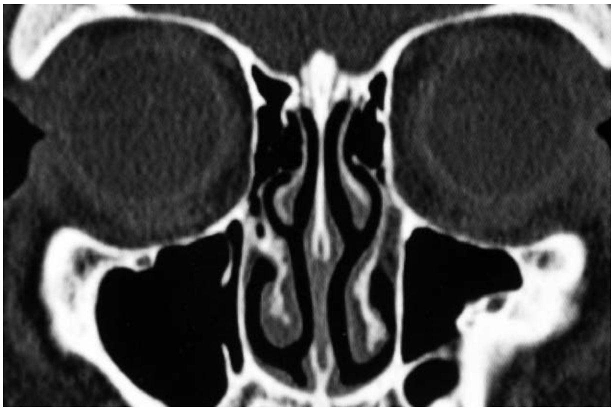

Fig. 16. Coronal CT scan of the fracture. Note the herniated periorbital tissue of the left eye into the maxillary sinus.

Fig. 17. Postoperative result at 9 mo following bone fracture repair with Medpor under regional anesthesia.

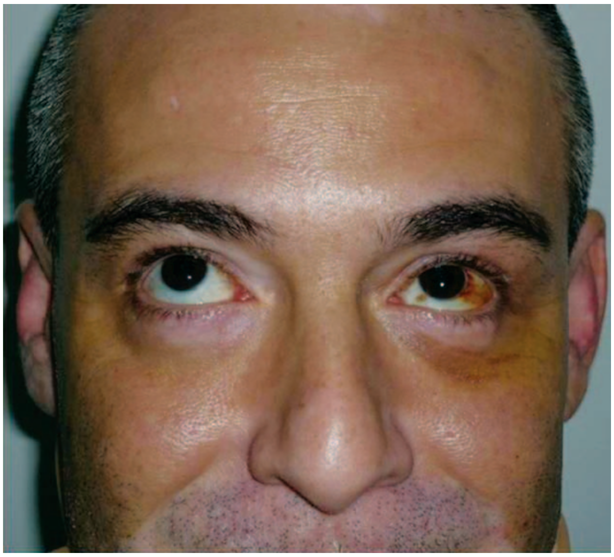

Fig. 18. Clinical result showing the preoperative abnormal.

Fig. 19. Postoperative normal ocular motility charged to the inferior rectus muscle 9 mo later.

tails concerning the rim of the fracture.[15] The goal of treatment is the restoration of orthoscopic vision and visual acuity. Early fracture repair is associated with improved outcomes compared with a delayed repair approach within 3 weeks.[14,15,23–25] Several autologous, alloplastic, and allogenic materials are available for orbital floor fracture repair.[25,26] The choice depends as much on surgeon preference as on implant characteristics.[5,19] Here, we reviewed the personal case records of patient who underwent orbital floor fractures repair with Medpor to collect a uniform cohort to draw robust conclusions. Usually, we repair orbital floor fractures using biomaterials for defects involving the anterior and/or posterior floor till subtotal reconstruction supposing a remaining bone support; on the contrary, we harvest bone grafts from the calvaria, and in these cases, surgery was performed under general anesthesia. Until now, no one has described repairing an orbital floor fracture under regional anesthesia with an infraorbital nerve block. From the present retrospective review, the complication rate following orbital floor fracture repair under regional anesthesia with conscious sedation when necessary is comparable to the result obtained under general anesthesia in our Level I Trauma Center and in the literature.[1,3,5,7,17,18,20,23] However, the decreased reoperative rate for surgical repair under local anesthesia compared to that under general anesthesia was not statically significant ($P > 0.05$). Topical injections and nerve blocks render insensitivity to pain in the affected area only.[11,13] The patient is relaxed, comfortable, and virtually unaware of the procedure due to light medication, but the whole body is not paralyzed.[8,9] Complication rates are greater under general anesthesia, and patients often have a sore throat, are fatigued, and are more likely to feel nauseated or to vomit. Furthermore, the recovery period is considerably longer.[10,12] A nerve block is a much safer alternative to general anesthesia because it does not put the body under stress.[11] Most importantly, fewer drugs are needed, hence recovery is faster, and more procedures can be performed in a single day.[12] Systemic toxicity is rare with regional anesthesia and can be prevented using the smallest dose possible and aspirating before injection into the extraneural or paraneural spaces. Anesthesia from a nerve block

Table 5. VAS Score Summary

	Mean VAS Score	Score ≥ 50	Highest Score
Immediately postoperative (within 1 h)			
Pain	12.98	0	50
Discomfort	11.89	0	45
The day after surgery			
Pain	4.81	0	20
Discomfort	5.34	0	20
One week after surgery			
Pain	0.50	0	0
Discomfort	2.43	0	20

lasts longer than local infiltration and does not cause swelling or alter the surgical field.[13] Overall patients' endurance and satisfaction of the procedure represent a further point of discussion. In particular, the highest VAS score for pain at any time was 50 (range, 0–50) and the highest VAS score for discomfort 45 (range, 20–45). Presumably, the average VAS score for discomfort was higher than the average VAS score for pain because an almost constant involvement of the infraorbital nerve in the dynamic of the trauma experienced and nervous traumatism can take several months to achieve complete recovery. Nonetheless, the data collected are slightly lower than other previously published data regarding general orbital surgery performed under general anesthesia.[18] Somehow this last point gives further support to the present work in addition to the lower rate of surgical revision deriving from the management of orbital floor fractures repair under local anesthesia.

CONCLUSIONS

There are several advantages to surgically repairing isolated orbital floor fractures under regional and local anesthesia that include the following: surgeons can check the surgical outcome intraoperatively, thereby reducing the reoperation rate; patient discomfort due to general anesthesia is eliminated; and the hospital stay is reduced, thus decreasing overall healthcare costs. Most patients tolerate orbital reconstructive surgery comfortably, safely, and with minimal pain suggesting that reconstruction of the orbital floor performed under local anesthesia is safe and well tolerated.

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PATIENT CONSENT

Patients provided written consent for the use of their images.

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