Journal of Cranio-Maxillo-Facial Surgery 43 (2015) 1583–1588

Contents lists available at ScienceDirect

Journal of Cranio-Maxillo-Facial Surgery

journal homepage: www.jcmfs.com

A new option for the reconstruction of orbital floor defects with heterologous cortical bone

Bora Ozel [a,*], Kemal Findikcioglu [b,1], Billur Sezgin [c,2], Kirdar Guney [d,3], Ismail Barut [b,4], Selahattin Ozmen [e,5]

[a] Kirikale Yuksek Ihtisas Hospital, Department of Plastic, Reconstructive and Aesthetic Surgery, Turkey
[b] Gazi University Faculty of Medicine, Department of Plastic, Reconstructive and Aesthetic Surgery, Turkey
[c] Koç University Hospital, Department of Plastic, Reconstructive and Aesthetic Surgery, Turkey
[d] Konya Regional Training and Research Hospital, Department of Plastic, Reconstructive and Aesthetic Surgery, Turkey
[e] VKV American Hospital, Department of Plastic, Reconstructive and Aesthetic Surgery, Turkey

ARTICLE INFO

Article history:
Paper received 6 March 2015
Accepted 18 June 2015
Available online 4 July 2015

Keywords:
Blowout fracture
Heterologous cortical bone
Lamina
Orbital floor

ABSTRACT

Background: The orbital floor is one of the most frequently injured areas of the maxillofacial skeleton during facial trauma. A retrospective analysis of patients who have undergone treatment of orbital floor fractures with heterologous cortical bone is presented.
Methods: This retrospective study was carried out with 21 patients over a period of 4 years between 2010 and 2014. All patients with a traumatic orbital floor defect who underwent reconstruction with heterologous cortical bone were included. The operations were carried out under general anesthesia for all patients. A subciliary incision was used in 20 patients and an infraorbital approach was used in one patient. All patients underwent follow-up examinations clinically as well as radiologically, at 1, 3, 6 and 12 months postoperatively. Computed tomographic scans were taken at the postoperative 6th month, and at the first postoperative year if needed.
Results: Preoperatively, the physical examination revealed diplopia in 17 patients (80.9%), gaze restriction in 14 patients (66.6%), enophthalmos in six patients (28.5%), and infraorbital nerve paresthesia in two patients (9.5%). None of the patients showed impaired visual acuity preoperatively or postoperatively. Diplopia and gaze restriction resolved postoperatively in all of the patients. All patients had a negative intraoperative forced duction test demonstrating free globe movement. Enophthalmos showed complete resolution in the postoperative period. In one of the two patients with preoperative infraorbital nerve paresthesia, this resolved at the postoperative fifth month. Scleral show appeared in six patients but resolved completely within 3–8 weeks with massage. There was no graft extrusion, resorption or displacement during the follow-up period.
Conclusions: Tecnoss Semi Soft Lamina is a good alternative for the reconstruction of blowout fractures due to its plasticity and biocompatible structure. Without donor site morbidity, it is a safe and appropriate heterologous bone graft material for maxillofacial applications such as orbital floor reconstruction. We cannot recommend its use for near-total, wide orbital floor defects as it may not provide enough support in such circumstances.

* Corresponding author. Kirikkale Yuksek Ihtisas Hospital, Department of Plastic, Reconstructive and Aesthetic Surgery, Baglarbası street lokman hekim, Kırıkkale, Turkey. Tel.: +90 5057881911; fax: +90 3182340606.
E-mail addresses: boraozel2007@yahoo.com (B. Ozel), plastikkemal@gmail.com (K. Findikcioglu), biilursezgin@hotmail.com (B. Sezgin), kirdarguney@yahoo.com (K. Guney), isobarut25@hotmail.com (I. Barut), selozmen@gmail.com (S. Ozmen).
[1] Gazi University Faculty of Medicine, Department of Plastic, Reconstructive and Aesthetic Surgery, 14th Floor, Besevler, 06500, Ankara, Turkey. Tel.: +90 5334478071.
[2] Erzurum Regional Training and Research Hospital, Department of Plastic, Reconstructive and Aesthetic Surgery, Erzurum, Turkey.
[3] Konya Regional Training and Research Hospital, Department of Plastic, Reconstructive and Aesthetic Surgery, 4th Floor, 06770, Konya, Turkey. Tel.: +90 5337271334.
[4] Gazi University Faculty of Medicine, Department of Plastic, Reconstructive and Aesthetic Surgery, 14th Floor, Besevler, 06500, Ankara, Turkey. Tel.: +90 5066928819; fax: +90 5325835166.
[5] American Hospital, Department of Plastic, Reconstructive and Aesthetic Surgery, Güzelbahçe Street 20, 34365, Istanbul, Turkey. Tel.: +90 5057947012.

http://dx.doi.org/10.1016/j.jcms.2015.06.029
1010-5182/

1. Introduction

The orbital floor is one of the most frequently injured areas of the maxillofacial skeleton during facial trauma (Yavuzer et al., 2004). Blow-out fractures, which were first described by Smith and Reagan (1962), constitute a substantial percentage of the maxillofacial trauma presenting to the emergency department. The mechanism of a blow-out fracture has been described by Converse and Smith as an increase in the hydrostatic pressure induced by trauma to the globe (Converse et al., 1956), and two possible mechanisms have been proposed to explain blowout fractures: hydraulic theory and bone conduction theory. The hydraulic theory involves the direct transmission of pressure from the ocular globe and intraorbital content to the periocular structures, which eventually leads to blowing out of the orbital floor. The second mechanism, which is generally less favored, involves indirect transmission of pressure from the orbital rim along the bone to the floor (Baino, 2011). Orbital floor fractures can lead to a lot of problems, including unfavorable aesthetics, diplopia, gaze restriction, enophthalmos, and hypoesthesia or anesthesia of the area innervated by the infraorbital nerve (Sakakibara et al., 2009; Piombino et al., 2013).

Clinical indications for fracture repair are based on the patient's symptoms and generally include severe diplopia, entrapment of extraocular muscles causing gaze restriction and enophthalmos greater than 2 mm (Baino, 2011; Hammer et al., 1999). Some authors prefer immediate intervention following the resorption of the periorbital edema, while other authors report that better results may be achieved with a delaying strategy, which may avoid an unnecessary surgical intervention (Rinna et al., 2009). The goals of orbital floor fracture repair are to free prolapsed orbital fat, muscle (especially the inferior rectus muscle), or tissue from the fracture defect and to span the defect (Baino, 2011).

Deciding on the material that is the best fit for orbital floor reconstruction has been a controversial topic. The literature contains a vast number of studies using several types of autologous materials (such as cranial cortical bone, iliac bone, olecranon, conchal auricular cartilage, dura mater, and fascia lata); alloplastic materials (such as polydioxanone, collagen membranes, polyethylene, methyl methacrylate, and titanium implants); and allogenic materials (such as lyophilized dura mater and lyophilized cartilage) (Tabrizi et al., 2010; Yeşiloğlu et al., 2014).

In this study, we present our experience with heterologous cortical bone for the treatment of orbital floor fractures and discuss the potential advantages and disadvantages of this alloplastic material.

2. Materials, methods and patients

Patients that were admitted to the plastic surgery clinic for orbital floor fractures between 2010 and 2014 were evaluated and all patients who underwent reconstruction with heterologous cortical bone were included in this study.

The most common cause of the orbital floor fractures was motor accidents (80.9%), followed by sport accidents (14.2%), and direct pounding on the face (4.76%) (Table 1). Pure blowout fractures were found in 16 patients (76.1%), while five patients (23.8%) had accompanying maxillofacial fractures. After a thorough physical examination, an ophthalmology consultation was requested for patients with any type of visual problem. The extent of enophthalmos was measured with Hertel exophthalmometry using 0.5 mm units. Significant enophthalmos, with more than a 2.0-mm difference between the two eyes clinically, was found in six patients.

All patients were evaluated with axial and coronal plane maxillofacial computed tomography (CT). The size of the bony defect was categorized into one of three groups: less than 1 cm^2; 1–2 cm^2; and larger than 2 cm^2. The defects were measured preoperatively with the CT scan and were confirmed intraoperatively for each patient. Seventeen patients (80.9%) had an orbital floor defect smaller than 1 cm^2, while four patients (19.1%) had a defect between 1 and 2 cm^2. Patients who had an orbital floor defect larger than 2 cm^2 were considered as near-total orbital floor defects and were not included in the study (Table 2).

Surgery was carried out under general anesthesia. A subciliary incision was used in 20 patients, while an infraorbital incision approach was used in one patient. After the incision was made, the infraorbital rim and the orbital floor were exposed by subperiosteal dissection. After sufficient exposure was achieved, entrapped soft tissue was repositioned into the orbit and small bony fragments were removed. The aluminum foil part of a suture pack was used as a template to determine the size and shape of the orbital floor defect. Once the size and shape of the defect was determined, the preparation of the heterologous cortical bone graft was initiated.

For heterologous cortical bone, we used a laminar, cortical, equine bone graft (Tecnoss Medical Devices, Giaveno, Italy) with dimensions of 35 × 35 × 1 mm. As the laminar graft was available only in dehydrated form, the first step of the process was to hydrate the graft. The lamina was hydrated in a sterile surgical tub for 5 min in sterile physiological solution at room temperature, as recommended by the manufacturer, and was later shaped according to the template with sterile scissors until the desired size and shape was reached for the reconstruction of the orbital floor defect. While the dehydrated form of the heterologous bone graft is rather stiff, the hydrated form can easily be cut and shaped. Care was taken to leave a margin of 3 mm beyond the dimensions of the defect in order to achieve reliable placement of the graft over the defect. No fixation was performed and the incised periosteal edges were sutured together at the infraorbital rim region to prevent lamina displacement. The forced duction test was used before and after inserting the lamina intraoperatively to confirm satisfactory extrinsic ocular movement.

All patients underwent follow-up examinations clinically as well as radiologically; at 1, 3, 6 and 12 months. Computed tomographic scans were taken at the postoperative 6th month, and at the first postoperative year if needed.

2.1. Patient 1

A 21-year-old man sustained an injury to the right orbital area in a tennis match accident (Fig. 1). Clinical examination revealed considerable periorbital ecchymosis, subconjunctival hemorrhage, gaze restriction and diplopia. Preoperative CT scans showed right orbital floor fracture (1.4 cm^2) with orbital content prolapse into

Table 1
Patient characteristics.

Patient demographics	
Number of patients	21
Sex (male/female)	16/5
Age, years (range)	33.7 (9–57)
Causes	
Traffic accident	17 (80.9%)
Sports accident	3 (14.2%)
Falling from a height	1 (4.7%)
Defect size	
<1 cm^2	17 (80.9%)
1–2 cm^2	4 (19.1%)
>2 cm^2	Excluded