

The Application of Autogenous Bone for the Reconstruction of Traumatic Defect of Orbital Floor

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Abstract: To study the effects of reconstruction of orbital floor defects with autogenous bone, 20 patients with orbital floor fractures were treated via peri-orbital mini-incision, and orbital floor defects were reconstructed with autogenous bone. The results showed that 20 cases recovered well. There was no infection, optic neuropathy, diplopia and enophthalmos. In general, the data of the study suggest that collagen membrane is an ideal material for orbital reconstruction.

Keywords: Orbital Floor Fracture, Orbital Floor Reconstruction, Enophthalmos, Autogenous Bone

1. Instruction

Traumatic defect of orbital floor would lead to facial deformity and dysfunction, including diplopia, eye retraction, eye movement disorders and *et al.* Further, zygomatic complex fractures, maxillary fractures and nasal orbital sieve composite fractures are often accompanied with orbital fracture. Once this area is damaged, injuries of patients become complex, making it one of the difficulties in the treatment of facial fractures [1]. Since 2013, there were 20 cases of zygomatic complex fractures accompanied with orbital bone defects in our department. By the reconstruction of orbital bone with autogenous bone (maxillary sinus anterior wall and iliac bone piece), we significantly corrected the deformity and dysfunction, resulted in satisfied clinical effects.

2. Method

2.1. Clinical Data Collection

Since Jan 2013, patients with zygomatic complex with orbital bone defect from the department of Stomatology in the First Affiliated Hospital of Jinan University were included in the study. Inclusion criteria: (1) with symptoms of visual acuity, eye movement and location abnormalities and

infraorbital nerve numbness; (2) CT scanning showed orbital floor fractures or orbital hernia went into the maxillary sinus; (3) can be reviewed six months later. There were 20 cases applied orbital floor reconstruction: 18 male and 2 females; aged from 19 to 42, average 27; all cases showed infraorbital margin; 13 cases showed lateral eye and neurological dysfunction; trauma time ranged from 3 days to 1 month; cause of trauma, 14 cases from traffic accident, 5 from fight and 1 from fall.

2.2. Examination

Record the preoperative data of facial deformity, eye position and function, occlusion situation, CT images, size of fracture, facial scar and nerve function. Patients were followed up six months later, postoperative data were collected and compared with preoperative data to evaluate the clinical effects.

2.3. Operational Methods

Conventional anesthesia surgery, small facial incisions were applied: eyelid margin, eyebrow combined with mouth gingival sulcus incision. When performing the zygomatic complex fracture surgery, the reconstructions of orbital bone defect were also performed. In patients with orbital floor probe, different parts of autogenous bones were selected

according to the serious situation of zygomatic fracture and orbital floor fracture. For those with light zygomatic fractures shift and fracture < 1.5 cm, maxillary sinus anterior bone wall was used for the reconstruction; for those with eye movement, visual and infraorbital nerve dysfunction, with fracture \geq 1.5 cm, decompression was applied for extraocular muscles and infraorbital nerve, falling orbital soft tissues were accurately relocated. Iliac bone pieces were used for the reconstruction. With titanium plate and micro-nail for the fixation, layered suture, small films were placed for drainage. General antibiotic treatment, stitches were removed 5-7 days after the surgery.

2.4. Statistical Analysis

The data were analyzed by SPSS 20.0, paired t-test for

statistical analysis, $p < 0.05$ showed significant differences.

3. Results

Postoperative follow-up was applied for the long-term observation of the surgical effects. Six month later, the data of facial deformity, eye position and function, occlusion situation, CT images, size of fracture, facial scar and nerve function were recorded and compared with preoperative data. The evaluation standard is shown in Table 1. 80% (16/20) of patients were recovered, 20% (4/20) of patients improved, 0 cases showed invalid. No complications were found because of orbital floor bone reconstruction. The prognosis data were shown in Table 2. Representative cases were shown in Figure 1.

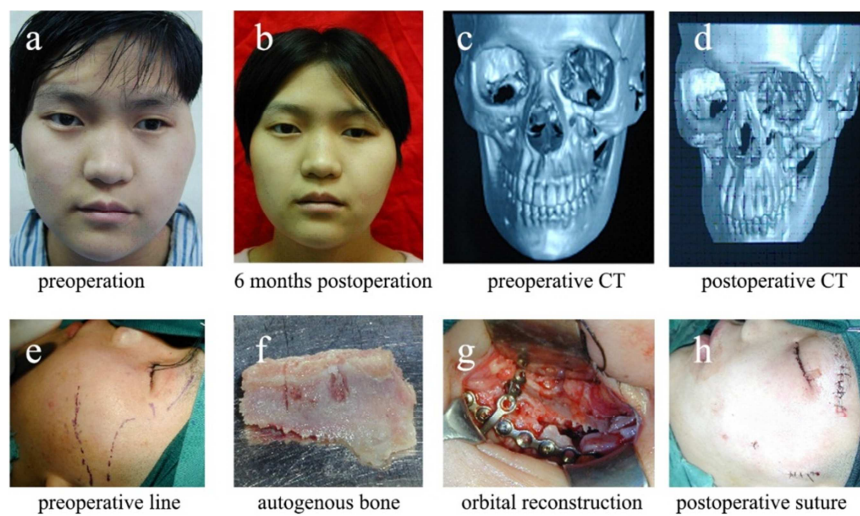


Figure 1. Presentative case.

Table 1. The evaluation standard for clinical effect.

Effects	Facial appearance	Eye position and function	Occlusion
Recovered	Symmetry	Normal appearance Normal pupil horizontal position Normal eye movement	Normal
Improved	Basically normal	Basial appearance Pupil horizontal position down Restricted eye movement	Slightly wrong occlusive deformity
Invalid	asymmetry	Eye subsidence Pupil horizontal position down Eye movement is limited	Obvious wrong occlusive deformity

Table 1. Continued.

Effects	Imaging evaluation	Opening degree	Scar	Facial paralysis
Recovered	Fracture line alignment Completely healed bone ends No bone absorption Normal shape	Normal	No	No
Improved	Fracture line alignment slightly worse Bone fracture healing slightly worse Have a slight bone resorption The shape is normal	Slightly restricted	Not obvious	Not obvious
Invalid	Fracture line alignment Bad bone fracture healing Bone absorption more obvious Asymmetric shape	Severely limited	Obvious	Yes

Table 2. *The prognosis data.*

Effects	Cases	Percentage (%)
Recovered	16	80
Improved	4	20
Invalid	0	0
In total	20	100

4. Discussion

Complex zygomatic fractures combined with orbital floor defect often induces the content of hernia go into ethmoid or maxillary sinus, making the eye ball move down and finally leading to diplopia [2, 3]. Current ideal surgeries to reconstruct must fulfill the following requirement: (1) restore the integrity of the orbital bone structure; (2) reset the orbital contents, release eye muscle incarceration, correct diplopia and eye retraction. Thus, to correctly calculate the size, shape and position of the defect becomes the most difficult problem. Researchers [4] indicated that each 1 cm increase of orbital contents, eye prominence would move forward 0.47-1.00 mm, which cannot be clinically referenced. The clinical treatment currently relies mainly on eye judgement, making the effect of large discrepancy. Materials for reconstruction include two types: autogenous and non-biological materials [5-7]. The commonly used autografts include: iliac, skull, costal cartilage, nasal septum cartilage and so on. And the non-biological materials including: titanium mesh, PLLA, PGA, teflon, polyethylene, hydroxyapatite and so on. Non-biological materials are easy to shape and able to provide solid support, the surgical time is short, but often accompanied with disadvantages of implanting displacement and infection. Medical silicone also is easy to reform, but with not enough hardness and are easy to deform or shift off. Polyethylene has good biocompatibility, toughness and stability, easier to shape and to obtain accurate three-dimensional shape [8]. Aitasalo and colleagues [9] used bio-active glass for the reconstruction of orbital defects, considering its antibacterial activity and biological activity, but hard to shape and hard to absorb. Absorbable polymers (PGA, PLLA, PDS) can be used for orbital defect reconstruction, no antigenicity, but the degradation time is longer, foreign body reaction may appear and the mechanical strength would decrease with the degradation. Titanium is widely used for the reconstruction, with extremely stable physical and chemical property, good biological compatibility and can be long-term placed in human body, however, this material may not be good for the development of adolescent. In general, to select the appropriate material for the reconstruction is a college work for surgeons [4].

Recent years, more and more doctors use autogenous bones for the orbital reconstruction. And we got satisfied effect in the study using autogenous bones. Kronig and colleagues [10, 11] suggested that using autologous bones to construct the orbital floor can correct enophthalmos and acquire excellent function and aesthetic shape, can decrease the enlarged orbital volume, remove ocular subsidence deformity. Autografts shown no exclusion, and directly fit the orbital structure. However, there

are also some disadvantages of using autogenous bones: need secondary surgical field, hard to shape and increased secondary drama [12-14]. Currently, quantitative surgical designing system under the guidance of medical 3D imaging and rapid 3D printing prototyping technique has been deployed [15], trying to explore the best treatment for the complex orbital floor fractures and to fix the difficulties of maxillofacial deformity, enophthalmos, eye subsidence and other problems.

Conflict of Interest

The authors declare no conflict of interest.

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