A Use of Poly-L-Lactide, D-Lactide Sheet on Posterior Orbital Floor Fracture

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Abstract: We present the cases of orbital posterior wall fractures that were fixed with poly-L-lactide, D-lactide (PLDLA) sheets. Poly-L-lactide, D-lactide sheet (0.5-mm thickness) was shaped exactly to fit to the area of orbital floor, and then an extended 1 cm was bent across on the infraorbital rim. That part was fixed with 2 absorbable screws to prevent the sheet from crumpling. Orbital floor fractures of 6 patients (3 posterior–one-half defects and 3 posterior–two-thirds defects) were repaired using PLDLA sheets. Diplopia in 5 patients before surgery was improved, usually within 6 months postoperatively. Clinical enophthalmos was not appreciated in any patient. However, preoperative exophthalmometry measured -1.3 ± 0.3 mm and postoperatively -0.4 ± 0.2 mm, respectively. Poly-L-lactide, D-lactide sheet is applicable to safely repair the orbital posterior floor fracture.

Key Words: Orbital fracture, biodegradable implant, poly(lactic acid), diplopia

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Orbital fractures are not uncommonly associated with midfacial trauma. The prime objective of surgical repair of the fractured orbital floor is to retrieve the normal floor with autogenous or alloplastic material so that any entrapped periorbital soft tissues may be released and prevented from herniation into the maxillary sinus. Fixation of the implant to the inferior orbital rim prevents the implant on the orbital floor from dropping or migration into the maxillary sinus.[1]

Although many investigations and cases reported usage of the poly-L-lactic acid (PLLA) sheet, only 2 cases reported fixation of PLLA/polyglycolic acid sheet to prevent migration and to reinforce the suspension on the orbital floor fractured.[2] In our previous experiment, we confirmed that poly-L-lactide, D-lactide (PLDLA) sheet fixed to the infraorbital rim was sufficient to cover one half or two thirds of the posterior orbital floor fracture.[1]

We present a technique of fixation of the PLDLA sheet onto the infraorbital rim in case of posterior orbital floor fracture.

MATERIALS AND METHODS

Patients

The orbital floor fractures were repaired with the 0.5-mm-thickness PLDLA sheet (Inion Co, Tampere, Finland) in 103 of 218 cases. The following operative technique was applied to 6 patients (age range, 21–35 years; 4 left side and 2 right side; 3 cases of posterior–one-half defect and 3 cases of posterior–two-thirds defect).

Operative Technique

A template of the orbital floor was made of the PLDLA sheet (0.5-mm thickness; Inion Co), and an extra 1 cm was extended to roll over the inferior orbital rim (Fig. 1). The PLDLA sheet is a copolymer composed of L-lactide, D-lactide, and trimethyl carbonate. Trimethyl carbonate has a strong impact on the malleability of the sheet and contributes to the sheet's ease of use. The PLDLA sheet was manipulated easily by warming at 60°C and bent to adapt to the inferior orbital rim. The extended brim was fixed to the inferior orbital ridge with two 4- or 6-mm absorbable screws so as not to crumple and migrate into the maxillary sinus. The screws were placed 6 mm below the inferior orbital rim (Fig. 2).

CLINICAL REPORT

A 29-year-old man sustained an orbital floor fracture on the left side by slipping. He exhibited periorbital ecchymosis, edema, and diplopia. Hertel exophthalmometry read 18 and 17 mm, respectively. Computed tomography (CT) showed the left orbital floor fracture involving two thirds of the posterior wall. The periorbital soft tissue was herniated into the maxillary sinus (Fig. 3, left). The orbital floor was explored, and the entrapped soft tissue was released. A template of the orbital floor was made of PLDLA sheet, and an additional 1 cm was extended so that the brim might cover the inferior orbital ridge. The template of PLDLA sheet was warmed to 60°C and bent to adapt to the inferior orbital rim. Two absorbable screws were placed 6 mm below the inferior orbital rim. Postoperatively, the diplopia was improved. Hertel exophthalmometer read 16 and 16 mm, respectively. Postoperative CT revealed no herniation of periorbital soft tissue in the maxillary sinus (Fig. 3, right).

RESULTS

Diplopia in 5 patients disappeared postoperatively in 6 months. No enophthalmos ensued in any patient postoperatively. Hertel exophthalmometry read preoperative -1.3 ± 0.3 mm and postoperative

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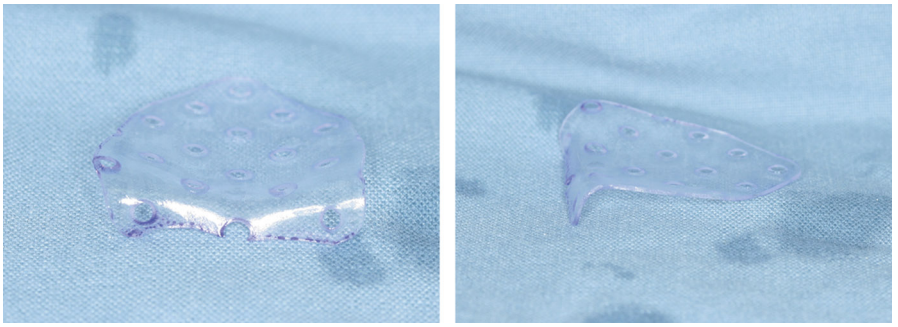

FIGURE 1. Poly-L-lactide, D-lactide sheet shaped to the orbital floor. An extra 1 cm was extended for fixation onto the inferior orbital rim. Left, View from above. Right, Lateral view.

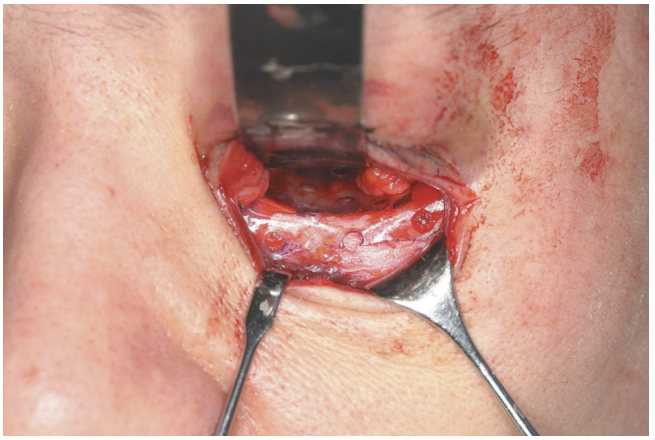

FIGURE 2. Poly-L-lactide, D-lactide sheet was warmed at 60°C, bent over inferior orbital ridge, and then fixed with two 4- or 6-mm absorbable screws at 6 mm below inferior orbital rim.

−0.4 ± 0.2 mm. In 1 patient, hypoesthesia developed postoperatively (Table 1).

DISCUSSION

A large defect of more than 50% of the orbital floor in blowout fracture results in too short of an edge to hold the sheet implant. An adequate and stable placement of the implant is maintained with nail fixation. Shifting or dropping of the implant into the sinus cavity is not infrequent. It is technically difficult to insert screws on the remaining thin edge around the defect of the orbital floor to hold the implant.[3]

Enislidis et al[2] reported 2 cases with pure orbital floor fractures (2.4 and 2.9 cm^2), which were fixed with 1.5 mm PLLA/polyglycolic acid sheet and 2 absorbable screws onto the infraorbital rim to prevent the implants from shifting and to reinforce suspension. The defect range of the floor was not described in their article. In our 6 cases, 3 were posterior–one-half defects, and another 3 were posterior–two-thirds defects.

In our previous experiment, PLDLA sheet was molded to fit to the sunken orbital floor, and a 1-cm extended anterior brim of the sheet was rolled over the inferior orbital rim and fixed with a screw. For one-half orbital floor fractures, the supporting strength of the PLDLA sheet to sag 5 mm was 2.46 ± 0.14 N. The supporting

FIGURE 3. Coronal views of preoperative and postoperative CT.

TABLE 1. Fixation of PLDLA Sheet on Infraorbital Rim in Orbital Floor Fracture

			Exophthalmometry Reading, mm										
			Pre		Post		D		H				
Patient	Sex/Age, y	Injured Side	Rt/Lt	Difference*	Rt/Lt	Difference	Pre	Post	Pre	Post	Follow-Up, mo	Defect	Size, cm^2
1†	M/35	Rt	13/13	0			+	+	−	−		Posterior 2/3	3.1
2	M/34	Rt	11/12	−1	11/12	−1	+	−	−	−	1	Posterior 1/2	1.5
3	M/35	Lt	12/10	−2	12/11.5	−0.5	+	−	−	−	2	Posterior 2/3	3
4	M/23	Lt	18/17	−1	14.5/14.5	0	+	−	−	−	11	Posterior 1/2	1.3
5	M/29	Lt	18/17	−1	16/16	0	+	−	−	−	10	Posterior 2/3	3
6	M/21	Lt	17.5/17	−0.5	17.5/17.5	0	−	−	−	−	5	Posterior 1/2	1.8
Mean				−1.1 ± 0.2		−0.3 ± 0.2					5.8		2.3

*Injured − normal.
†Patient 1 was lost to follow-up.
D indicates diplopia; F, female; H, hypoesthesia; Lt, left; M, male; Rt, right.

strength of the PLDLA sheet to sag 10 mm was 6.9 ± 0.14 N. For two-thirds orbital floor fractures, the supporting strength of the PLDLA sheet to sag 5 mm was 1.79 ± 0.24 N. For 10 mm of sagging, the supporting strength of the PLDLA sheet was 5.61 ± 0.29 N. For sagging of 15 mm, the supporting strength of PLDLA sheet was 8.99 ± 0.16 N. The PLDLA sheet was irreversibly bent when the force reached 8 to 9 N. The PLDLA sheet was adequate for reconstruction of one-half and two-thirds defect of the posterior orbital floor fractures.[1]

Rozema et al[4] used a polymerized PLLA for repair of the orbital floor defect of blow-out fracture in goats and found that the plate had progressive bone formation in 19 weeks. In 78 weeks, the plate was fully covered by bony change. In our previous study of the orbital fracture, the postoperative complication rate was 17.9%. There was no statistically significant difference among the materials used in such complications as diplopia, hypoesthesia, and enophthalmos, and also, there was no significant difference between the porous polyethylene sheet (MEDPOR) and absorbable sheet.[5]

We contend that PLDLA sheet is ideally suited for repair of the defect of the orbital posterior floor.

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