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Surgical management of upgaze diplopia in patients after posttraumatic orbital floor reconstruction

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ABSTRACT

Objective: The most common complication of otherwise successful reconstructive surgery of a fractured orbital floor is persistent diplopia. For patients with troublesome double vision in upgaze, a reasonable solution is offered by strabismus surgery. The aim of our study is to examine the results of extraocular muscle surgery in cases of diplopia that persisted in upgaze after posttraumatic orbital floor reconstruction.
Material and methods: In this study we present a retrospective series of 24 patients with troublesome vertical diplopia in upgaze. In all cases, the surgery consisted of a posterior fixation suture placement on the contralateral superior rectus muscle with or without its recession. Full orthoptic examination was conducted before and 3 months after the surgery.
Results: Postoperatively 19 patients (79%) were diplopia free and 6 (21%) had vertical diplopia in extreme upgaze. The field of binocular single vision improved threefold. None of the patients reported diplopia in the primary position or in any position other than upgaze.
Conclusion: Vertical incomitant strabismus and diplopia in upgaze persisting after orbital reconstructive surgery may be corrected surgically. Contralateral posterior fixation of the superior rectus muscle, with or without its recession, appears to be an effective procedure for use in these patients.

1. Introduction

The most common complication of otherwise successful reconstructive surgery of a fractured orbital floor is persistent diplopia (Biesman et al., 1996), a condition that affects 5%–18% of patients who have undergone this surgery (Kerr, 2004; Ceylan et al., 2011; Loba et al., 2012). Usually double vision is experienced during upgaze, extending over various areas and sometimes into primary position. Diplopia is less common in other gaze directions (Morax and Pascal, 1984; Gosse et al., 2010).

Although some cases require a revision of the orbital floor by a maxillofacial surgeon (Kozakiewicz and Szymor, 2013), no such procedure is indicated in others in whom no implant malposition or persistent herniation of orbital tissue into the maxillary sinus is revealed by postoperative imaging. The cause of ocular misalignment in such patients is known to be ipsilateral hypotropia, which in turn is caused by a restricted inferior rectus (Biesman et al., 1996). This incomitance is greatest in upgaze but is sometimes also present in primary position. The typical treatment for such patients is a period of observation for spontaneous improvement. However, for those patients who experience sustained diplopia in upgaze, a reasonable solution is offered by strabismus surgery, the goal of which is to broaden the field of binocular single vision and to improve ocular alignment in upgaze without affecting other gaze directions.

The aim of our study is to examine the results of such extraocular muscle surgery in cases of diplopia that persisted in upgaze after posttraumatic orbital floor reconstruction.

2. Materials and methods

During a 6-year period, 264 patients were referred to the Strabismus Outpatient Clinic with residual diplopia and abnormal ocular motility following reconstructive surgery for orbital fracture.

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Routinely a 6-month observation period was carried out for spontaneous resolution of symptoms. Patients suspected of failed tissue release or implant malposition underwent a postoperative computed tomographic (CT) scan and were referred back to the maxillo-facial surgeon for reoperation. Such patients were further observed postoperatively.

After the observational period, 33% (87) of the patients still experienced diplopia in various gaze directions. In most cases, diplopia was limited only to the edges of the peripheral gaze and did not affect daily activities. Troublesome double vision in upgaze was reported by 30 patients to whom surgical treatment was proposed. Of these patients, 24 consented to the surgery (17 male and 7 female; mean age, 39.6 ± 12.4 years). A more detailed profile of the characteristics of the group is given in Table 1.

Orthoptic assessment was performed before surgery and 3 months postoperatively in each patient. Ocular rotations, the type and direction of diplopia, and the vertical angle of strabismus measured by prism and cover test were noted in prism diopters [Δ]. Hess charts were plotted in each case as well as Binocular Single Vision Field (BSV) (Medmont M900). A passive duction test was performed in the theater under general anesthesia.

The type of surgery was single-step and similar in all cases. In order to restore vertical comitance in upgaze, the procedure of choice was placement of a 14-mm posterior fixation suture on the contralateral superior rectus muscle. In 14 cases (58%), a small recession was added. The amount of recession was adjusted in accordance with the angle of deviation in primary position (none up to 3Δ; 2 mm, 3Δ to 5Δ; 3 mm, 6Δ to 14Δ; 4 mm, 15Δ and more).

The results were subject to statistical analysis with Statistica 10.0, using a t-test for paired measurements ($p < 0.01$). The methods applied in the study adhered to the Declaration of Helsinki and were accepted by the Board of Ethics of the Medical University of Lodz (RNN/144/09/KE).

3. Results

During surgery, a restriction of inferior rectus muscle on the side of the injury was confirmed by passive force duction test in all cases. No major complications occurred during the procedure in any patient. No upper lid retraction was noted, but prolonged lid swelling (up to 5 days) was reported after the surgery in 4 cases.

Before the surgery, the mean vertical deviation in upgaze was found to be 19.6 ± 8.9Δ, ranging from 10Δ to 45Δ, in primary position 4.99 ± 0.78Δ, ranging from 0Δ to 16Δ, and 1.20 ± 2.17Δ in downgaze, ranging from −1.5Δ to 7Δ. When comparing the orthoptic measurements obtained before and 3 months after surgery, a significant reduction of mean VD was revealed in upgaze ($p = 0.000$). Vertical deviation in the primary position changed significantly ($p = 0.000$) only in patients who underwent additional recession of the superior rectus. Mean recession was 2.43 ± 0.62 mm correcting 2.9 ± 0.5Δ/mm. Mean angles of deviation and BSV before and after surgery are summarized in Table 2.

The rate of success, understood as a vertical angle of less than 5Δ in upgaze, was 66.5%. Undercorrections were noted in six cases (21%) and overcorrections in three (12.5%). Subjective evaluation showed that 19 patients (79%) were diplopia free and 6 (21%) had vertical diplopia in extreme upgaze. The field of binocular single vision (BSV) improved threefold with a mean postoperative BSV loss of less than 10%. Postoperatively, none of the patients reported diplopia in the primary position or in any position other than upgaze. An example of the ocular alignments and Hess charts before and after surgery is presented in Figs. 1 and 2.

Table 1
Selected group characteristics (n = 24).

Type of fracture	
Orbital floor	24 (100%)
Medial wall	7 (29%)
Orbital rim involvement	11 (46%)
Number of orbital surgeries	
One	20 (83%)
Two	4 (17%)
Type of implant	
Polypropylene sheet	17 (71%)
Titanium mesh	5 (21%)
Bone graft	2 (8%)
Time from trauma to first reconstruction	
14th day	10 (42%)
>14 days	14 (58%)

4. Discussion

Orbital reconstruction surgery is intended to correct cases of limited elevation of the affected eye, a hallmark of orbital floor fractures, by freeing muscles and connective tissue from the fracture and repositioning them from the maxillary sinus. Nevertheless, although reconstructive surgery may appear to be carried out correctly, vertical incomitance and thus diplopia may still persist in some cases. The cause of diplopia may be attributed to the presence of tissue adhesions, implant malposition, or improper tissue reposition (Kushner, 1982; Van Eeckhoutte et al., 1992; Biesman et al., 1996). Computed tomographic imaging is sometimes helpful in identifying the problem (Jazwiecka-Koscielniak and Kozakiewicz, 2014). However there is often no apparent cause, and the patient is left to await the spontaneous resolution of symptoms. A 6-month waiting period is generally accepted as sufficient time for such spontaneous recoveries to occur, especially in small deviations (Van Eeckhoutte et al., 1992). In the present study, 27% of patients with persistent diplopia required eye muscle surgery, a proportion similar to that observed previously (Loba et al., 2012).

Generally, there are several approaches to improving ocular alignment and diplopia in patients with incomitant vertical strabismus. Ipsilateral inferior rectus recession, followed if necessary by resection of the superior rectus on the same side, is recommended by Van Eeckhoutte et al. (1998), who report good results in all but one patient, who was overcorrected. Kerr also describes recession of the inferior rectus, but with the use of adjustable sutures, resulting in an alignment in primary position and improvement in upgaze. However, the study notes that large recessions of the inferior rectus might negatively influence depression and thus should be linked with contralateral inferior rectus recession. An alternative procedure advocated by the author is based on a recess–resect procedure on the affected side to split the amount of surgery to both vertical recti (Kerr, 2004).

After reconstructive surgery for orbital floor fractures, the inferior rectus muscle on the side of the injury is usually fibrously changed and its function is impaired. Some weakness of the inferior

Table 2
Mean angles of deviation before and after the surgery.

Angle in diopters (Δ)	Before surgery	After surgery	p-Value
Upgaze	19.6 ± 8.9	2.58 ± 2.97	0.000
Primary position (recession group)	8.38 ± 3.96	1.18 ± 1.81	0.000
Primary position (no recession group)	0.25 ± 0.26	0.22 ± 0.25	0.797
Downgaze	1.20 ± 2.17	0.52 ± 0.95	0.129
BSV loss [%]	40.3 ± 16.5	9.4 ± 6.3	0.000

BSV, loss of binocular single vision field (%).