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Original research

The predictive factors of diplopia and extraocular movement limitations in isolated pure blow-out fracture

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Abstract:

Purpose: To evaluate the predictive factors for development of diplopia and extraocular movement (EOM) limitations in the patients with isolated pure blow-out fracture.

Methods: One hundred thirty-two patients with isolated pure blow-out fracture were included. The diagnosis was done with computed tomography scan. Possible predictive factors were analyzed with logistic regression. The cases that underwent surgery were assigned in the surgical group, and other cases were assigned in the non-surgical group. Receiver operating characteristic (ROC) curve analysis was used in the surgical group to evaluate the power of time interval from trauma to the surgery to predict persistence of 6 months postoperative diplopia and EOM limitation.

Results: At the first visit, 45 of 60 cases (75%) in the surgical group and 15 of 72 cases (20.8%) in the nonsurgical group had diplopia. After 6 months follow-up, 7 cases (11.7%) in the surgical group and 1 case (1.4%) in the nonsurgical group had persistent diplopia. Type of fracture was significantly associated with first visit diplopia ($p = 0.01$) and EOM limitations ($p = 0.06$). In the surgical group, type of fracture ($p = 0.02$ for both) and time interval from trauma to the surgery ($p = 0.006$ and 0.004, respectively) were significantly associated with 1 month diplopia and EOM limitations. Only time interval from trauma to the surgery ($p = 0.04$) was significantly associated with 3 months EOM limitation. In the ROC curve analysis, if the surgery was done before 4.5 (sensitivity = 87.5% and specificity = 61.3%) and 7.5 (sensitivity = 87.5% and specificity = 66.9%) days, risk of 6 months postoperative diplopia and EOM limitation was reduced, respectively.

Conclusions: In the early postoperative period, a higher rate of diplopia was observed in the patients with combined inferior and medial wall fractures and longer time intervals from trauma to the surgery. The best time for blow-out fracture surgery was within 4.5 days after the trauma.

Keywords: Blow-out fracture; Isolated pure blow-out fracture; Diplopia; Extraocular movement limitations

Introduction

Between complications of the blow-out fracture, diplopia and extraocular movement (EOM) limitations are common symptoms and signs that may persist even after successful fracture surgery.[1] These complications may be due to entrapment of the muscle or perimuscular soft tissue in the fracture, direct injury to the muscle, hemorrhage in muscle or orbit, muscle edema, and ocular motor nerve palsies.[1,2]

Isolated pure blow-out fracture was defined as the "fracture of one or more orbital walls without the fracture of orbital rim or other facial bones".[1] Many studies evaluated the factors influencing the incidence rate of diplopia and EOM limitations in blow-out fracture cases with different inclusion criteria and different results.[1–14] For example, Parks and colleagues evaluated the relationship between type of fracture and postoperative diplopia and found that diplopia was more commonly observed in inferior and inferomedial wall

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fractures.[1] On the other hand, Ceylan and colleagues compared cases with early and delayed fracture repair and found no difference in the incidence of postoperative diplopia between the two groups.[2] In this study, the effect of multiple factors on diplopia and EOM limitations in the patients with isolated pure blow-out fracture was investigated in a prospective study.

Methods

In a prospective interventional case series approved by the Institutional Review Board of the Farabi Eye Research Center, 142 consecutive patients with isolated pure blow-out fracture between February 2011 and December 2013 in the Oculoplastics clinic of Farabi Eye Hospital were included. The patients with zygomaticomaxillary or orbital rim fracture, history of strabismus or diplopia before trauma, history of previous strabismus surgery, traumatic intraocular damage, and those who did not return for follow-up were excluded from the study. The study and data collection were compliant with the principles of the Declaration of Helsinki. Informed consent was obtained from all patients.

In the history taking, age, gender, type of trauma (assault, motor vehicle accident, falling), time interval from the trauma to the first visit, and time interval from the trauma to the surgery were noted. All patients were asked about binocular diplopia in primary position, up or down gaze, and right or left gaze. The presence of binocular diplopia was also objectively evaluated by the examiner with the question: Do you see this pen as two? If the diplopia was eliminated after closing one eye, the diagnosis of binocular diplopia was confirmed. The cases with binocular diplopia in primary position (far or near) or 30° up, down, right or left gaze were analyzed in the diplopia category. Infraorbital hypoesthesia was checked in all patients with clinical examination. The degree of enophthalmos was assessed in all patients with a Hertel exophthalmometer. The far (6 m) and near (33 cm) deviations in primary position and down gaze were measured with prism and alternate cover test while the prism was placed in the front of the injured eye. In the cases with poor visual acuity in one eye or severe limitation, the deviations were measured with Krimsky method. For analysis, far deviation + near deviation/2 was used as the patient's deviation. Limitation of ductions in horizontal and vertical gazes was measured using a 5-point scale (0 to −4), with 0 representing no limitation and −4 representing no movement beyond midline. All deviation measurements were done by one trained orthoptist that was blinded to the purpose of the study. Complete ophthalmologic examinations were also done for all patients.

The orbital computed tomography (CT) scan was done in all cases to confirm the diagnosis. According to the CT scan findings, the fractures were classified into: isolated medial wall fracture, isolated inferior wall fracture, and combined inferior and medial wall fracture.

The indications of surgery in this study were: 1- enophthalmos >2 mm; 2- extensive fracture involving more than half of the inferior wall in the orbital CT scan; 3- persistent diplopia in primary position or 30° up- or down gaze; 4- evidence of the entrapment of extraocular muscle in the fracture in orbital CT scan; 5- unresolving oculocardiac reflex (necessitating immediate surgery). The cases with one of these indications underwent surgery. All surgeries were done within 2 weeks from the first visit.

All surgeries were done by one of two authors (A.K. and B.E) by transconjunctival approach. Forced duction testing was done in the beginning and the end of the operation under general anesthesia. The implant used in all patients was porous polyethylene (Medpore, Porex Surgical Products, Newnan, GA). The dimensions of the Medpore were selected according to the size of fracture and degree of enophthalmos.

The patients were followed in 1 month, 3 months, and 6 months after the first visit. Similar to the first visit, the cases with diplopia in primary position or 30° up, down, right, or left gaze were analyzed in the diplopia category. Deviations in the primary position and down gaze were also measured in each visit.

Statistical analysis was performed with SPSS version 20 (SPSS Inc., Chicago, IL). The Chi-square test was used to assess the differences in the incidence of diplopia between subgroups. Multivariate logistic regression models were used to model diplopia and EOM limitation as a function of age, gender, type of trauma, type of fracture, enophthalmos >2 mm, infraorbital hypoesthesia, time interval from the trauma to the first visit, and time interval from the trauma to the surgery. In the 1, 3, and 6 months visits, the logistic regression was separately performed for the surgical and non-surgical subgroups. Receiver operating characteristic (ROC) curve analysis was used in the surgical group to evaluate the power of time interval from the trauma to the surgery to predict 6 months postoperative diplopia and EOM limitation. The level of significance was 0.05 for chi-square and ROC curve and 0.1 for logistic regression.

Results

From 142 cases, 10 cases did not return for follow-up and were excluded. Therefore, 132 patients were used for analysis. The preoperative characteristics of the patients are summarized in Table 1. The mean age of the patients was 30.49 ± 11.68 years. The mean time interval from trauma to the surgery was 18.57 ± 28.05 days. Sixty cases (45.5%) required surgery for fracture repair. The findings of diplopia and EOM limitations are shown in Table 2. The pre- and postoperative number (percentages) of the patients with each type of deviation and the mean and standard deviation of horizontal and vertical deviations are presented in Table 3. The frequencies of the first visit and 1, 3, and 6 months visits diplopia in the surgical and non-surgical groups are shown in Table 4.

The surgical complications of visual loss, infection, or exposure of the Medpore, mydriasis and lid malposition did not occur in any patient that underwent surgery. The enophthalmos was eliminated in all patients that underwent surgery due to this problem.

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