Journal of Cranio-Maxillo-Facial Surgery 43 (2015) 1010–1016

Contents lists available at ScienceDirect

Journal of Cranio-Maxillo-Facial Surgery

journal homepage: www.jcmfs.com

Diplopia and ocular motility in orbital blow-out fractures: 10-year retrospective study☆

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ARTICLE INFO

Article history:
Paper received 24 February 2015
Accepted 27 May 2015
Available online 10 June 2015

Keywords:
Orbital trauma
Blow-out fracture
Diplopia
Management outcome

ABSTRACT

Objective: To investigate diplopia (binocular single vision [BSV] test) and ocular motility (uniocular field of fixation [UFOF] test) characteristics in blow-out fractures of the orbit and their value in fracture management.

Material and methods: Patients with isolated blow-out fractures treated from 2000 to 2010 were included. BSV scores were stratified into three categories: low BSV category (0–60); moderate BSV category (61–80), and high BSV category (81–100). UFOF scores were also divided into three categories: low score (60–240), moderate score (241–270), and high score (271–365) categories.

Results: A total of 183 patients (106 surgically and 77 conservatively managed) met the inclusion criteria. There was no significant improvement in BSV postoperatively in surgically managed patients with preoperatively high BSV, whereas there was significant improvement ($p < 0.05$) for the high BSV category in the conservative group. Preoperative BSV was found to be significantly related ($p < 0.05$) to post-operative BSV, subjective diplopia outcome, follow-up time, and number of follow-up visits. However, improvement of BSV score in the surgical group was not found to be significantly correlated with subjective outcome in relation to diplopia. Preoperative UFOF score has no influence on subjective outcome in relation to diplopia. Surgical timing, approach, and choice of implant material were not found to be statistically related to final diplopia outcome, follow-up time, or number of follow-up visits.

Conclusions: BSV is better correlated with diplopia outcome, follow-up time, and number of follow-up visits than is UFOF. On the basis of this study, surgical intervention would not be recommended for blow-out fracture cases with BSV score >80% for correction of diplopia alone.

1. Introduction

Management of isolated orbital blow-out fractures remains a topic of controversy (Alinasab et al., 2012). General consensus suggests that surgical intervention is indicated in cases of persistent diplopia, enophthalmos, or large defects, which may result in late enophthalmos (Turnbull et al., 2007). However, the criteria for diplopia, as an indication for surgery, as described in the literature is predominantly subjective, for example; 'persistent troublesome diplopia', 'severe', or 'visually handicapping diplopia.' (Cole et al., 2007; Biesman et al., 1996). Conversely, enophthalmos has more objective management criteria, with intervention suggested for enophthalmos of 2 mm or more and fracture defect greater than 2 cm^2 or more than 50% (Putterman, 1991). In addition, it is generally accepted that when surgical intervention is indicated, early intervention, as far as the patient's condition permits, is advocated. Such general protocols have been adopted in numerous clinical studies investigating the evaluation and treatment of blow-out fracture (Hawes and Dortzbach, 1983; Jaquiery et al., 2007).

Despite the adoption of such criteria, surgical outcome, in terms of ocular motility and diplopia, in the last 2 decades has been less than ideal (Harris, 2006), with persistent postoperative diplopia frequently reported (Hosal and Beatty, 2002).

Ocular motility disturbances in orbital injuries are usually assessed by Hess chart. The reliance of orbital trauma studies on Hess charts, only, makes diplopia subjectively represented and difficult to evaluate (Sveinsson, 1973). Attempts have been made to

☆ This study was a part of PhD project funded by Almustansiriya University and sponsored by Newcastle University and NHS.
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http://dx.doi.org/10.1016/j.jcms.2015.05.022
1010-5182/

quantify the Hess chart (Aylward et al., 1992; Furuta et al., 2006), although these have not been widely adopted. Furuta et al. (2006) used Hess area ratio (HAR) measurement to express the ocular motility in numerical values by comparing the Hess chart values between the affected and healthy sides. The authors reported that most of the patients with HAR% of >85% experienced no diplopia.

It is hypothesised that the lack of such unifying quantitative clinical measures for the assessment of diplopia has hampered the progression in management of blow-out injury of the orbit (Hammer et al., 1995; Van Eeckhoutte et al., 1998).

The terms "diplopia" and "ocular motility disturbance" have been used frequently in orbital fracture studies interchangeably (Egbert et al., 2000; Lee et al., 2005). Diplopia is the clinical manifestation of ocular motility disturbance. For the measurement of diplopia, a binocular single vision (BSV) test using a Goldmann Perimeter has been recommended for the routine evaluation of orbital trauma patients, providing a simple reliable method for quantifying diplopia (Kim and Woo, 1999; Banks, 2007).

The uniocular field of fixation (UFOF) test provides an additional quantitative assessment of ocular motility, plotting the primary field of action of each of the six individual ocular muscles, again using a Goldmann perimeter (Haggerty et al., 2005). This test has been used in ocular motility assessment for Graves ophthalmology patients with different methods (Steel et al., 1995; Haggerty et al., 2005); however, its use in orbital trauma has not previously been reported. The aim of this retrospective study was to investigate the value of two objective measures, BSV and UFOF, in the management of blow-out fractures of the orbit.

2. Material and Methods

Patients attending the Orthoptic Department, Royal Victoria Infirmary, Newcastle upon Tyne, following orbital trauma in the period 2000–2010 inclusive were identified from a patient database. Patients' records were obtained and hand searched for the following information: demographic information; date of injury, presentation, and subsequent attendances; clinical findings; orthoptic examination; orbital surgery; ophthalmology examination; and BSV and UFOF scores.

Included in the study were patients who had a computed tomography (CT) – confirmed blow-out fracture involving orbital floor and/or medial wall, who were managed surgically or conservatively, in the period 2000–2010 inclusive, with recorded preoperative and postoperative BSV scores available. Excluded were patients who sustained orbital fractures involving orbital margins identified either pre- or perioperatively.

Orthoptic examinations included weighted BSV (Sullivan et al., 1992) and UFOF tests for both affected and unaffected sides. UFOF scores were taken as the sum score for the 6 extraocular muscles (Haggerty et al., 2005). Departmental policy for patients undergoing surgery was to have at least two BSV measurements performed by an orthoptist, one taken shortly after presentation and the other postoperatively. For conservatively managed patients, one orthoptic examination was requested. At the time of the first orthoptic visit, patients were also examined by an ophthalmologist.

For statistical analysis BSV scores were stratified into three categories: low BSV category (0–60); moderate BSV category (61–80), and high BSV category (81–100). UFOF scores were similarly stratified into low score (60–240), moderate score (241–270), and high score (271–365) categories.

At the final orthoptic review, a subjective assessment of diplopia was made by the orthoptist, categorising patients as "asymptomatic," "not concerned by diplopia," "symptomatic," and "requiring further measures." Further measures included provision of prism glasses and strabismus surgery.

Collected data were analysed using SPSS version 17 software. Statistical analyses were performed using the Wilcoxon signed ranks test to determine the statistical difference between data that was not normally distributed. The Pearson correlation was used to test statistical correlation between interval data, and the χ^2 was used to determine the statistical relation for nominal data. Correlation analysis between ordinal data was performed using the Spearman test.

3. Results

Of 391 patients identified from the orthoptic database, 259 patients were recorded as having isolated blow-out fractures. Surgery was performed in 152 patients, leaving 107 patients who were conservatively managed. A total of 183 patients (106 surgically and 77 conservatively managed) were included in the study. However, only 87 patients (70 from the surgical group and 17 from the conservative group) had complete follow-up data (Fig. 1). This might be related to a failure to record data correctly in the patient records. Failure to record information accurately also affected the quality of the available follow-up data for surgical patients, with 56 of 70 patients having complete data to discharge.

The patients ranged from 9 to 80 years of age, with a median age of 35 years. Of the patients, 19 were female and 68 were male.

As shown in Fig. 2, diplopia was the most common presenting complaint, with a low incidence of enophthalmos at presentation in this group. Reported ophthalmic injuries included corneal abrasion, conjunctival chemosis, hyphema, traumatic mydriasis, peripheral retinal haemorrhage, and commotio retinae.

Table 1 shows the timeline of patient management. More than 50% of the surgical cases were treated within the first 2 weeks of the injury (Fig. 3), and 12.5% were treated more than 1 month after the injury. Most of these were late presenters. The surgical approach for the vast majority of the cases was the first skin crease incision. The conjunctival approach was the least-used approach (7% of the cases) in this sample (Fig. 4). A Silastic sheet was the most common implant material, followed by titanium mesh. Bone graft was used in less than 9% of the cases. Only two cases were managed without placement of implant material (Fig. 5). Surgical timing and

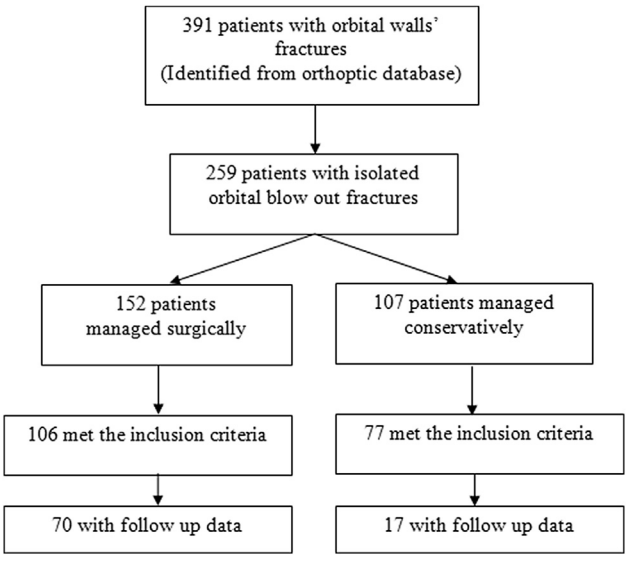

Fig. 1. Flow chart with included patients' groups