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British Journal of Oral and Maxillofacial Surgery 57 (2019) 898–903

BRITISH Journal of Oral and Maxillofacial Surgery

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Flattening of the orbital lower eyelid fat as a long-term outcome after surgical treatment of orbital floor fractures

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Accepted 28 July 2019
Available online 16 August 2019

Abstract

Our aim was to report the incidence of asymmetry of the lower eyelid (that manifests itself as flattening of the eyelid fat) as a long-term complication of the surgical approach of unilateral fractures of the orbital floor. We retrospectively reviewed the aesthetic appearance of the lower eyelid in 43 patients after repair of such fractures. Long-term asymmetry seen as asymmetrical flattening of the eyelid fat was evaluated and graded qualitatively as mild, moderate, and severe. We studied its relations to the surgical approach, patient's age and sex, and postoperative time; 20 of the 43 had flattening of the lower eyelid fat. There were significantly more patients with flattening of the fat after a transconjunctival approach than after transcutaneous ones ($p = 0.03$). We found a statistical likelihood of the development of flattening of the fat when patients were between 40 and 60 years old at the time of operation ($p = 0.006$). Increasing age at the time of the study was related to increased severity ($p = 0.0019$), with the greatest significance over 55 years old ($p = 0.006$). We found no relation to patients' sex, or duration of operation. To our knowledge this is the first time that flattening of the eyelid fat has been described as a long-term complication after a particular approach to orbital floor fractures. The transconjunctival incision was more likely to be associated with this long-term outcome. Patients over 40 years old are also at risk of developing flattening, and this is more severe when the patient is over 55. A short follow-up period is not sufficient for the evaluation of the aesthetic outcome of traditional approaches to fractures of the orbital floor in the lower eyelid.

Keywords: eyelid; eyelid malposition; orbital fracture; transconjuntival; transcutaneous; orbital fat; approach

Introduction

The choice of the surgical approach to the repair of fractures of the orbital floor depends on the extension of the fracture, the presence of a previous wound, and the surgeon's preference. Each surgical approach has its potential complications related to unfavourable cicatricial healing of the lower eyelid.[1–3]

The transcutaneous approaches (subciliary, subtarsal, and infraorbital) have been associated with different degrees of conspicuousness of the scar, ectropion, and loss of the vertical dimension of the eyelid.[1] With these approaches the orbital periosteum is reached and dissected to expose the fracture, usually without violating the septum or the capsulopalpebral fascia.[4]

The transconjunctival incision can be approached by a preseptal or a retroseptal route, and has sometimes been associated with fibrosis and vertical shortening of the tarsal plate and entropion. With the transconjunctival approach, the conjunctiva and the capsulopalpebral fascia are either incised preseptally (so as not to violate the orbital fat) or ret-

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https://doi.org/10.1016/j.bjoms.2019.07.023

roseptally (through the orbital fat) to reach the fracture. This approach has gained in popularity because it provides good intraoperative visibility of the orbital floor, an inconspicuous scar, and a lower rate of complications than transcutaneous approaches.[1,5–8]

Among the papers that we reviewed, there was a lack of information about the aesthetic impact of the scar on the long-term appearance of the eyelid after surgical treatment, probably because patients with orbital floor fractures are followed up for a short period of time (typically less than 12 months) particularly in the absence of early complications such as diplopia or malposition.[3] As far as we know, flattening of the lower eyelid fat has not been reported before as a long-term complication after surgical approach of orbital floor fractures.

The aim of this study was to report asymmetry of the lower eyelid (that manifested itself as flattening of the eyelid fat) as a long-term complication after surgical approach of fractures of the orbital floor. We also analysed the relation between this outcome and the surgical approach used, each patient's age and sex, and the development of the condition during follow up.

Methods

We retrospectively reviewed the aesthetic appearance of the lower eyelid as a result of an incidental finding in a previous study of patients whose fractures of the orbital floor had been reconstructed in our department. We obtained institutional review board approval (reference number 3734) for the protocol.

Forty-three patients who had been operated on for unilateral orbital fractures were re-evaluated after a minimum of a year's follow up. We excluded patients with bilateral fractures, or previous lesions of the eyelid, or orbital operations on the contralateral side. Patients' clinical charts were reviewed and data about sex, age, time since operation, and surgical approach were collected. The choice of the surgical approach was governed by the fracture's extension and the surgeon's preferences, and included infraorbital (or inferior orbital rim), subtarsal (lower or mideyelid), subciliary (lower blepharoplasty), previous laceration, and transconjunctival (retroseptal).

After obtaining signed consent, the patients were interviewed and examined for asymmetry and malposition of the eyelid (entropion, ectropion, enophthalmos, and retraction). Photographs were obtained at the time of the study; if previous photographs were available, they were used for comparison. The unoperated side was used as the control and enophthalmos was measured with Hertel exophthalmometry.

Lower eyelid asymmetry, which manifested itself as flattening of the lower eyelid fat, was evaluated by two surgeons who were not involved in the patient's treatment. When it was present, it was classified as mild, moderate, or severe compared with the appearance of the unoperated side. We defined mild asymmetry when the difference in the tear trough was perceptible on close inspection but not conspicuous. When the asymmetry was evident, and altered the overall facial appearance, we defined it as moderate. We described it as severe if asymmetry was visible without effort and noticeably altered the overall facial appearance.

We studied the relation of the surgical approach, patients' age, sex, and duration of postoperative follow up to the outcome of the lower eyelid flattening and its severity.

Statistical analysis

We used R environment (version 3.1.1, CRAN, Vienna, 2014) for the statistical analyses. Normality was assessed with the Kolmogarov-Smirnov test, and the selected parametric and non-parametric tests for assessment of the significance of differences were Fisher's exact test, the chi squared test, the Mann-Whitney *U* test, Student's *t* test, or the Kruskal-Wallis test. Probabilities of less than 0.05 were accepted as significant.

Results

The study sample comprised 43 patients with a mean (SD) age of 49 (2) years old (range 14-81) and a mean follow-up period of 5 (2) years after unilateral reconstruction of an orbital floor fracture. Thirty-eight patients were male with a mean (SD) age of 49 (3) years old and five were female (mean (SD) age 56 (7) years).

In 25 patients a transconjunctival approach was used, nine patients had a subciliary approach, five a subtarsal approach, two an infraorbital approach, and two were operated on through a previous laceration. No patient had enophthalmos on Hertel exophthalmometry. No entropion was seen. Ectropion was observed in five with a subciliary approach and one with a previous laceration ($p = 0.03$). Eyelid retraction was also regarded as an outcome in six patients: two who had a subciliary approach, three whose approach was transconjunctival, and one with a previous laceration (there was no significant difference among these). No ectropion or eyelid retraction needed repair.

Long-term postoperative flattening of the lower eyelid fat on the operated side was present in 20/43 patients, of which nine patients had mild, seven had moderate, and four had severe asymmetry (Figs. 1–3). Flattening of the fat of the lower eyelid was perceptible in 15/25 patients with a transconjunctival approach, 3/ 9 with a subciliary approach, 1/5 with a subtarsal incision, and 1/2 patients who had a previous laceration. It was absent in the two patients with infraorbital incisions. Neither the incidence of flattening nor its severity was significantly independently related to the surgical approach (Tables 1 and 2).

When the incisions were grouped as "transcutaneous" or "transconjunctival" there was no statistical relation between age and approach ($p = 0.158$). However, transcutaneous

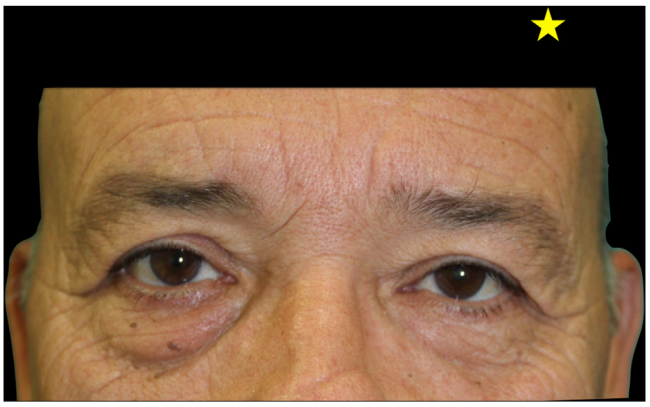

Fig. 1. Patient with moderate flattening of the fat of the lower eyelid (frontal view). Yellow star points to the operated side.

Fig. 2. Patient with severe flattening of the fat of the lower eyelid (frontal view). Yellow star points to the operated side.

approaches were slightly more common in patients under 40 years old, and had a higher rate of ectropion (p = 0.03). Transconjunctival approaches were more predominant in patients over 40 years old and had a higher rate of asymmetrical flattening of the lower eyelid fat (p = 0.03).

Fig. 3. Patient with severe flattening of the fat of the lower eyelid (distal view). Yellow star points to the operated side.

Patients' age was not normally distributed (p = 0.03), so the Mann-Whitney *U* test was used and showed a relation between age and the incidence of asymmetry of the lower eyelid (p = 0.02). In addition, increasing age at the time of the study was related to increased severity of the asymmetry (p = 0.02), with increased significance in patients over the age of 55 years (p = 0.006). There was a significant relation in the development of flattening of fat when patients were between 40 and 60 years old at the time of operation (p = 0.006) (Tables 1 and 2).

There was no significant relation between a patient's sex and the incidence of severity of asymmetry. The duration of postoperative follow up was similar in each age group and had no significant relation with the asymmetry of the eyelid or its severity. Although several patients were aware of the asymmetry, none of them were concerned enough to have the opposite side operated on.

Discussion

After reconstruction of a fractured orbital floor patients are usually followed up for 12 months.[4] Long-term follow up is uncommon unless complications such as diplopia or malposi-

Table 1
Statistical relations between age, time since operation, surgical approach, and the incidence of flattening of the lower eyelid.

	No flattening (n = 23)	Flattening (n = 20)	Total (n = 43)	p value
Age (years):				
<40	11	1	12	0.002*
>40	12	19	31	
<40	11	1	12	
40–60	5	10	15	0.006*
>60	7	9	16	
<60	16	12	28	0.512*
>60	7	8	15	
Approach:				0.03*
Transcutaneous	13	5	18	
Transconjunctival	10	15	25	
Mean (SD) time since operation (months)	53 (6)	47 (2)		0.751**
Mean (SD) age (continuous, years)	43 (4)	59 (2)		Z = −2.387 0.017**

* =chi squared.
** =Mann Whitney.

Table 2
Statistical relations between age, time since operation, surgical approach, and the severity of flattening of the lower eyelid.

	Absent/mild severity (n = 32)	Moderate/severe severity (n = 11)	Total (n = 43)	p value
Age (years):				
<40	12	0	12	0.017*
>40	20	11	31	
<50	18	1	19	0.007*
>50	14	10	34	
<55	21	2	23	0.006*
>55	11	9	20	
<60	23	5	28	0.112*
>60	9	6	15	
Approach:				0.066*
Transcutaneous	14	4	18	
Transconjunctival	18	7	25	
Mean (SD) time since operation (months)	53 (6)	47 (2)		0.751**
Mean (SD) age (continuous, years)	46 (3)	61 (3)		Z = −2.353 0.019**

* =chi squared.
** =Mann Whitney.

tion of the eyelid develop during the immediate postoperative period. This means that there is a lack of information about the aesthetic impact on the long-term appearance of the eyelid.

Ridgway et al showed in their meta-analysis that the transcutaneous surgical approaches for repair of fractures of the orbital floor are still the most commonly used among plastic and maxillofacial surgeons.[1] However, transconjunctival approaches have been shown to have lower complication rates than transcutaneous approaches.[5–8] During the last decade there has been a trend toward smaller and more aesthetic incisions to guarantee better cosmetic results when repairing the orbital floor in orbital fractures or orbital fat in blepharoplasty, and this has resulted in an increase in the popularity of the transconjunctival approach.[1,9] At the beginning it was reserved for younger patients, but it has increased in popularity for all ages because it gives more direct access to orbital fat with no visible scar.[9] Segal et al reported better aesthetic results and a bigger decrease in scleral show when doing a transconjunctival blepharoplasty. They suggested that this was the result of a partial recession of the lower eyelid retractors near the fat pockets that allowed the orbicularis oculi muscle to raise the lower eyelid.[6]

Most authors have described a higher rate of entropion with the transconjunctival approach,[1,3,8] particularly with the preseptal incision, because it is closer to the tarsal plate and this can lead to deep lamellar scarring.[10] However, just one author compared preseptal with retroseptal, and found no significant differences between the two techniques regarding malposition of the eyelid.[11] Despite this, when we use a transconjuntival approach we always do it retroseptally. We prefer this approach because of its lower complication rate and the fact that exposure of the orbital floor is achieved more easily.

The aging process of the eyelid combines the elongation of the lower eyelid with the ptotic malar position and the protrusion of the orbital fat.[9] This lengthening of the lid is greatest in patients in their 40 s.[12] The orbital fat herniates beyond the orbital rim as the orbital septum weakens, the orbicularis muscle atrophies, and the skin becomes lax.[9,13] In our series, patients over 40 years old were at higher risk of developing eyelid asymmetry. As we mentioned before, this might be related to the fact that these patients are at the risk of age-related orbital protrusion of fat in the unoperated eye as Branham, and Fezza and Massry, described.[9,12]

The incidence of long-term postoperative eyelid fat flattening seems to be lower when the approach incision used is infraorbital, and it increases progressively in the subtarsal, subciliary and transconjunctival approaches, being up to 15 of 25 patients in the latter.

We found no significant differences when comparing them individually, but did when they were grouped as transcutaneous and transconjunctival approaches, although further studies are needed. There are several hypotheses that could explain why this happens, and we find it difficult to be sure that there is just one mechanism. The fact that the transcutaneous approaches have a lower risk of developing this complication than the transconjunctival approach leads us to think that the asymmetry may be secondary to a reinforcing fibrosis from the incision into the palpebral retractors that will decrease herniation of fat in the long-term, and delay protrusion of fat on the operated side. Meanwhile, on the unoperated side, the natural aging process of weakening of the orbital septum allows the orbital fat to prolapse.

Atrophy of the orbital fat pad should also be considered as another possible aetiology for this asymmetry of the eyelid. Atrophy of suborbicularis oculi fat or atrophy of an already prolapsed fat pad by the time of operation, may explain why the asymmetry is also present with transcutaneous approaches.

Manson et al considered that a composite injury to bone, and ligamental support allowing displacement and change in the shape of soft tissue secondary to scar contraction, is far more important that fat atrophy alone in the pathogenesis of complications of an orbital fracture.[14] The fact that in

Fig. 4. Patient with mild flattening of the fat of the left lower eyelid. It was taken four years after operation. Yellow star points to the operated side.

Fig. 5. Patient with severe flattening of the fat of the left lower eyelid. It was taken two years after Fig. 4.

our series asymmetry seems more common after a transconjunctival approach makes us think that orbital-supporting ligamental manipulation or scarring should be considered as an important factor in the incidence of eyelid asymmetry.

The fact that in one of our cases the asymmetry was not present four years after the operation, but could clearly be seen when the patient was re-evaluated after six years, shows that the development of asymmetry does not progress in a linear fashion. Instead, it is more likely to be dependent on the stage of the periorbital aging process. Patients may not develop this asymmetry for many years until reaching their fifth decade of life, when it rapidly progresses (Figs. 4 and 5). This is because only the unoperated lower eyelid will show this sign of aging.

Another consideration to be taken into account as a possible cause is the traumatic injury itself. Injury to the orbital fat with herniation into the paranasal sinus will cause devascularisation and scarring, resulting in decreased fat volume. Over time this loss of fat volume will become more evident as the natural aging process on the contralateral side proceeds. In our study the results from a control group of patients who did not have their orbital floor fractures repaired would have supported our contention that the cause of the asymmetry was the surgical intervention. However, patients with small fractures that did not require repair would have been a poor control compared with those with large fractures, and we have no patients with fractures that met the criteria but were not repaired.

To our knowledge this flattening of the lower eyelid fat has not been previously described as an outcome in patients with orbital floor fractures because of the lack of long-term follow up. We know that the lack of preoperative control, the small number of patients, and the paucity of reproducible subjective evaluation might be limitations of this paper. Other possible factors related to the different approaches should also be considered such as the placement of the transconjunctival incision (retroseptal compared with preseptal) or the use of a cold scalpel compared with electrocautery. Further studies with tools such as 3-dimensional photography, or multicentre prospective and longer series, should be made to investigate the aetiology of this outcome thoroughly.

Conclusion

Twenty of 45 patients who had reconstruction of a fracture of the orbital floor developed long-term eyelid asymmetry that manifested itself as flattening of the lower eyelid fat. The approach that showed a stronger relation with this long-term outcome was the transconjunctival. Patients over 40 years old are at risk of developing this, more severely when the patient is over 55 years old. A short follow-up period is insufficient for evaluating the aesthetic outcome of traditional approaches to fractures of the orbital floor in the lower eyelid.

Ethics statement/confirmation of patients' permission

The Institutional Review Board gave their approval (reference number 3734). Patients' permission has been obtained.

Conflict of interest

We have no conflicts of interest.

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