

Ocular motility alterations in orbital fractures: pre-post evaluation in maxillofacial surgical treatment

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SUMMARY: Ocular motility alterations in orbital fractures: pre-post evaluation in maxillofacial surgical treatment.

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Purpose. *The study aims to investigate the ability of maxillofacial surgery to reduce strabismus and improve ocular clinical symptomatology in patients with fracture of the medial or lateral floor of the orbit, or both, and to evaluate such abilities relative to the temporal distance between trauma and surgery.*

Patients and methods. *25 patients with traumatic diplopia were evaluated by CT, Goldman manual field of view, Hess-Lancaster test, eye examination and orthoptic examination, before and after surgery.*

Results. *We observed: a statistically significant reduction of the de-*

viation angle, both from close and long distance ($P = 0.0054$ and $P = 0.0051$ respectively) with a 38% reduction of the deviation from short distance and 54% from afar; a regression of diplopia in 20% of the surgically treated cases (CL from 0 to 39%), significant at the Mc Nemar test; a negative correlation with the time elapsed between the onset of the fracture and maxillofacial surgery ($R = -0.26$), even if the analysis did not show a statistical significance of the data ($P = 0.2$). However, it is evident that the maximum improvement is observed only in cases operated within 5 months of the trauma, while the failures (worsening or persistence of diplopia) were observed only in the cases operated later.

Conclusion. *We can state that the intervention reduces strabismus and improves ocular symptomatology, as it statistically significantly reduces cases of diplopia; furthermore, it would seem preferable to intervene early, especially when damage to a muscular structure is suspected, even if the data do not allow definitive conclusions in this regard.*

KEY WORDS: Orbital fractures - Ocular motility alteration - Maxillofacial surgery.

Introduction

The orbito-facial traumas represent particular clinical situations that allow for a certain waiting before the actual intervention, even if they are part of real urgencies, with the consequent request for an initial and rapid evaluation. This time, variable according to the cases, can be used to perform more in-depth instrumental investigations (X-ray, spiral CT, three-dimensional CT) and evaluations on possible alterations of ocular motility following the trauma.

The improvement of radiological diagnostic procedures has increased the incidence of fractures of the medial wall of the orbit.

The frequency of oculo-motor alterations in orbital-traumatic injuries has been estimated to be over 30%. Frequently, a muscular deficit is due to a ligament-muscular lesion or a mechanical dislocation of the ocular globe; the most frequent ocular functional complication is diplopia (1-10).

The study of ocular motility alterations is therefore of great interest in orbital-facial traumas: immediately after the trauma for the diagnostic value of lesion localization and for the eventual surgical indication, in the post-operative course for the unpleasant symptoms, and finally to highlight any iatrogenic lesions (11-15).

In more than 90% of cases the therapeutic intervention is essential to reduce the fracture, restore the

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orbit integrity and release possibly incarcerated muscles, to reduce or eliminate the most serious symptoms, such as diplopia, and to compensate possible ocular dislocation (16-20).

The purpose of our study was to perform an evaluation on a group of 25 patients suffering from traumatic diplopia following isolated fractures of the orbital medial wall or floor, or of both walls (defined as mixed fractures) by analyzing changes in ocular motility before and after maxillofacial surgery. It was also proposed to statistically evaluate the restoration of single binocular vision in the primary and secondary position, thus evaluating the validity of the intervention, and how the interval of time spent between the trauma and the intervention affects said validity.

Patients and methods

For this study we examined 25 patients who had reported fractures involving the orbital cavity after cranio-facial trauma and that also had diplopia.

These patients were examined before and after maxillofacial surgery.

Each of them was subjected to CT, Goldman manual perimetry, Hess-Lancaster test, eye examination and orthoptic examination.

According to Freund et al. (1), CT is superior to MRI in the visualization of the orbital floor and ethmoidal sinuses; on the contrary, MRI is superior to CT in the demonstration of the optic nerve, of the orbital fat and of the ocular globe; the two methods are equivalent in the visualization of the medial and lateral orbital walls, of orbital roof, of the extrinsic ocular musculature, of the frontal and maxillary sinuses. In the study of the same authors, however, MRI showed herniation of intraorbital fat in a greater number of patients compared to CT; this is an important fact, considering that today diplopia is supposed to be caused not only by the muscular incarceration, but also by the scar tissue reaction of the orbital septums which, through the periorbital fat, support the ocular extrinsic muscles at the periorbita. Furthermore, CT cannot demonstrate herniation of intra-orbital tissues due to prosthetic artefacts. MRI is therefore necessary as a diagnostic completion if there are doubts after the CT scan, which remains the first choice in medial orbital wall fracture.

The manual visual field of Goldman is useful for the functional assessment of the damage; the lumi-

nous aim used was that of 4 mm² of surface and of 1000asb of luminance.

Of all these exams, the Hess-Lancaster test and the orthoptic examination were particularly taken into consideration.

The Hess-Lancaster test allows for an objective response from the affected muscle or muscles.

The orthoptic examination performed included: Krimsky corneal reflex test, prismatic cover test, study of the stale position of the head, Bielchowsky, examination of ocular motility), diplopia examination .

To test the percent proportions, the z test was applied; for parametric data (D deviation prismatic) the Student test for paired data was applied. P (peaked) values of less than 0.05 were considered significant. For the correlation coefficient calculation Spearman test was applied.

Results

The mean age of the patients was found to be 43.18 ± 20.9 (D.S) years; 17 males and 8 females. The mean temporal distance from the intervention in which the postoperative evaluation was performed was found to be 5.72 months (Table 1).

TABLE 1 - MEAN AGE OF PATIENTS; MEAN TEMPORAL DISTANCE FROM THE INTERVENTION.

Patients (n.)	25
Mean age	43.18
St. deviation	20.9
M/F ratio	17/8
Mean gap from surgery	5.72 months

In the pre-operative visit, of the twenty-five patients with fracture of the orbit 63% had vertical type diplopia, 21% had horizontal diplopia and only 16% of the patients did not have diplopia.

In 89% of cases, enophthalmos occurred a few days after the trauma, while on the eye, eyelid bruising, hyperemia and conjunctival chemosis appeared in 63% and 70% of cases, respectively.

Anesthesia of the infraorbital nerve has frequently been observed. In 31% of cases, patients also had

PAC, in 15% ptosis and in 10% sign of Bielowsky.

In the pre-operative examination, the Hess test resulted in 89% of cases markedly altered and only in 10% slightly altered.

After the surgery, to which all twenty-five patients were subjected, the restoration of single binocular vision was found only in 62% of cases; 31% of patients had a noticeable improvement in vertical and horizontal diplopia and only in 15% of cases remained unchanged.

These findings were confirmed by the Hess test, which in 90% of cases showed an almost complete recovery of the hypofunction of the affected muscle; however, in the remaining 10%, the test remained unchanged (Table 2).

TABLE 2 - RESULTS OF THE INTERVENTION.

Maxillofacial surgery results	
Improvement	22 cases (88%)
Worsening	1 case (4%)
Unchanged	2 cases (8%)

Three different analyses were applied to investigate the ability of the intervention to reduce strabismus and improve ocular clinical symptomatology, and to evaluate these abilities relative to the preconsciousness of the intervention.

Applying the Student's t test for paired data we observe a statistically significant reduction of the deviation angle, both from afar and near (respectively $P = 0.0054$ and $P = 0.0051$) with a reduction of 38% of the deviation for close and 54% for distance (Tables 3, 4).

A regression of diplopia is observed in 20% of the surgically treated cases (CL from 0 to 39%). The reduction is significant at the Mc Nemar test (Table 5).

The correlation by ranks shows a negative correlation with the time elapsed before the intervention, i.e. the interval between the onset of the fracture and the maxillofacial surgery ($R = -0.26$). The analysis does not show a statistical significance of the data ($P = 0.2$); however, it is clear from the following table that the maximum improvement (i.e. the disappearance of diplopia) is observed only in cases operated within 5 months from the trauma, while the failures (the worsening or persistence of diplopia) are observed only in cases operated later than 5 months after the fracture (Table 6).

TABLE 3 - REDUCTION OF THE DEVIATION ANGLE FOR CLOSE AND FAR DISTANCE.

	Before surgery		After surgery	
	Deviation		Deviation	
%	100		76	
	Horizontal deviation	Vertical deviation	Horizontal deviation	Vertical deviation
%	36	96	28	76

Percentages of cases with reduction of deviation

TABLE 4 - COMPARISON BETWEEN PRE AND POST OPERATIVE OF ANGLE DEVIATION VARIATION FOR CLOSE AND FAR DISTANCE.

	Before surgery		After surgery	
	Near	Far	Near	Far
Media	6.36	6.60	3.96	3.04
DS	9.44	9.34	6.99	5.18
		Mean reduction	2.40	3.56
		% reduction	38%	54%
		Paired t-test	$P=0.0051$	$P=0.0054$

Reduction of deviation

TABLE 5 - DIPLOPIA REGRESSION.

	Before surgery			After surgery		
	Diplopia			Diplopia		
	Horizontal only	Vertical only	Horizontal+vertical	Horizontal only	Vertical only	Horizontal+vertical
% (n)	0	60 (15/25)	36 (9/25)	0	48 (12/25)	28 (7/25)
% (n)		96 (24/25)			76 (19/25)	
Mc Nemar test: χ^2 14.4; P<0.001						

TABLE 6 - WORSENING OF DIPLOPIA AS A PERCENTAGE OF THE INTERVENTIONS CARRIED OUT AFTER 5 MONTHS FROM THE TRAUMA.

	Trauma-surgery gap	
	< 5 months	> 5 months
Great improvement	5	0
Improvement	0	16
Slight improvement	0	1
Unchanged	0	2
Worsening	0	1
Surgical success %	100%	85%
Surgical failure %	0%	15%
Fisher test: P: 0.5		

Discussion

From the analysis of the functional examinations we can state that the Hess screen, performed before and after the operation, has not always shown a perfect return to the integrity of ocular motility, even if the maxillo-facial surgery has significantly reduced the deviation angle (38% from close distance and 54% from afar) and the percentage of cases with diplopia (average reduction 20%).

Although there was no significant correlation between the result of the intervention and the time gap between the trauma and the intervention itself, it has been observed that the maximum improvement

(i.e. total reduction of deviation) is only found in the earlier performed cases, within 5 months of the trauma, while the failures are observed only in the cases operated later than 5 months from the fracture.

In particular we had better results from the functional point of view in all those patients operated in the thirty days following the traumatic event that had determined the fracture and the consequent diplopia; in these patients there was a total recovery of binocular vision.

The data also allow us to underline that in patients operated in a later period, after the trauma, it is possible to establish muscle sequelae of synergistic and antagonist muscles, often accompanied to an abnormal position of the head with consequent contracture of the neck muscles.

Conclusion

With our data, we can state that the intervention reduces strabismus and improves eye symptomatology, as it statistically significantly reduces cases of diplopia. Furthermore, it would seem preferable to intervene earlier, especially when damage to a muscular structure is suspected, even if the data do not allow definitive conclusions in this regard.

Conflict of interest

The Authors declare that they have no competing interests.

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