Effect of Timing of Surgery in Patients Undergoing Correction for Post-Traumatic Diplopia

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Abstract: ***Background and objective**: Major clinical outcomes related to orbital fractures are impaired vision, compromised ocular motility and diplopia, cosmetic disturbances like enophthalmos & hypoglobus and infraorbital paresthesia. Clinical decision making in patients with orbital fracture is always challenging and it has been debated for many decades. Specific guidelines for the interval between trauma and surgery has not been established and is controversial. Early recognition and treatment has been considered optimal for orbital reconstruction in patients with clinical and radiological features of fracture. Laceration and traumatic contusion of extra-ocular muscles and associated post traumatic oedema lead to limited or restricted ocular motility. In 1970s it was believed that these contusion and oedema will subside within 2 weeks and conservative approach of treatment was practiced. Moreover risk of late surgery related orbital fibrosis will result in unfavourableoutcome of treatment. Sometimes conditions may not be conducive for early treatment like medical status, socio-economic standards, available operating room time, legal matters, insurance related matters etc which may influence clinicians in decision making for surgery. Advancements in diagnosis with CT scan made accurate assessment of the extent of fractures possible and to assess presence or absence of herniated tissue. This lead to CT based treatment protocols in 1980s and 1990s. After this period focus of the debate has shifted towards surgery for those patients who may benefit from early intervention. **Objective**: To assess the effect of timing of surgery (within 1 week and after 1 week) on correction of post-traumatic diplopia as measured by HESS chart. **Methods**: Patients undergoing correction for post traumatic diplopia are included in our study. Patients are divided into two groups, early and late. Early group patients going correction of post traumatic diplopia within 1st week of trauma and late group are those patients going correction after 1st week of trauma. Diplopia is evaluated by diplopia charting and muscle overaction & underaction evaluated by HESS chart method. **Results and discussion**: Out of 37 patients surgically treated 14 patients out of 16 patients in early group have complete resolution of diplopia and one patient had palsy of orbital muscles and one patient did not recover. In late group out of 21 patients 16 patients had compelte resolution of diplopia and 4 patients did not show complete recovery and one patients had mild improvement in diplopia without complete recovery. On the basis of available data the present study suggest that surgical intervention in early group patients have more postoperative improvement in diplopia and enophthalmos compared to late group, but still it is insufficient to support guidelines of early surgical intervention in cases were late treatment is advisable due to slow resolving diplopia, traumatic brain injury or other morbidities that lead to late report to health setup. **Conclusion**: In comparison with diplopia improvement post operatively early group patients have more number of patients of complete recovery after surgical correction than late group and also its same for enophthalmos. But still there is insufficient data due to limited time bound study and require more research and studies in this subject.***

Keywords: Diplopia; Orbit; Timing; trauma; Hess chart; Diplopia chart

1. Introduction

Fractures involving the orbit are common and complex in nature. Orbital skeletal fractures often leads to diplopia due to interruption of the smooth & coordinated movements of orbital muscles. These are due to the mechanical entrapment of the involved muscle or nerve paresis. Restriction of globe movementleads to change in visual axis of eye ball and leads to diplopia. These restriction ofeye movements may be due to oedema and contusion of muscles which usuallyresolves within 2 weeks or actual entrapment/herniation of muscles in the fracture. Fracture management of the orbit are challenging to manage and demands precise clinical acumen and timing. They deserve special consideration because the management by the surgical or observational methods may result in compromised vision and/or globe position. Most of the orbital fractures occur in males in theirsecond decade of life.30 (1,2) Most of the fractures of orbit are blow out in character and often involve thinorbital floor and medial wall. Proper anatomic reconstruction of the orbit is difficult and often demands careful clinical and radiological examination. The advancements in technology and widely available CT scan based guidelines regarding treatment of orbital fractures has led to controversy and confusion in timing of management. Clinical decision making for management of orbital fractures are alwayschallenging and difficult. There are no specific guidelines given in literature regarding interval between surgery and trauma. Most of the surgeons prefer observation for 2 weeks for oedema to subside and better clinical examination and decision making forthe management. But these are not true for white blow out fractures in pediatric trauma which hardly presents with clinical signs of trauma and often demand immediate surgery due to risk of permanent muscle damage, diplopia and oculocardiac reflex. The unique anatomical and mechanical features of pediatric orbital fracture differentiate them from their adult counterparts. The clinical presentations may also be distinct at different groups because of the complexity in development of orbital and maxillofacial anatomy in

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children. These features, together with concerns for future growth and development demands surgeons to differentially manage the pediatric trauma [5].CT based diagnosis has led to accurate assessment of the extent of fractures and to find out the presence or absence of herniated tissue which is not possible to identify easily with clinical examination and plain radiographs. From 1980, CT based guidelines regarding diagnosis and management of orbital fracture became popular.[40] There is always a question of debate regarding timing of intervention in orbital fractures & associated diplopia. Some surgeons prefer to delay the procedure, wait foroedema to subside for better judgement of the actual condition. The post traumaticoedema causes difficulty in clinical judgement regarding diplopia assessment. This isthe reason most surgeons prefer watchful waiting period of atleast 2 weeks for oedema to subside. But as the time passes there will be progressive development offibrosis across the fracture segment and can lead to difficulty in muscle movementsand that itself can lead to diplopia of late origin. The development of fibrosis also leads to difficulty in exploration during surgery and its outcome. The delayed repair of the orbital fractures although effective, is indeed moretechnically challenging. Therefore, patients who present early, and predictably requiresurgery because of multiple fractures or significant restriction of globe, should be operated on in a time bound manner, perhaps within 1 to 2 weeks, to facilitate a favourable outcome1. At present two different school of thought exists regarding the timing of intervention in management of post traumatic diplopia. There are no specific guidelines at present regarding the timing of intervention and the controversy has been well debated. The purpose of this study is to evaluate whether early recognition and treatment or late intervention is optimal for orbital reconstruction in patients with clinical and radiological features of orbital fracture.

2. Methodology

A observational prospective study of 20 months duration done in the Department of Oral and Maxillofacial Surgery, Govt. Dental College,Trivandrum and Regional Institute of Ophthalmology (RIO), Trivandrum.

Inclusion Criteria:
Patients who are undergoing surgical intervention for diplopia correction and ready to give consent for study purpose will be selected.

Exclusion Criteria
- Patient with orbit fracture but not associated with diplopia.
- Patient not willing for the study.

Sample Size Calculation

$$N = \frac{[Z\alpha/2+Z1\text{-}\beta]^2\,[P1(100\text{-}P1)+P2(100\text{-}P2)]}{(P1\text{-}P2)2}$$

$[Z\alpha/2+Z1\text{-}\beta]^2 = 7.9$
For α=0.05
β=0.2
P1 = proportion of diplopia in early correction
P2 = proportion of diplopia in late correction
Sample size= 80

Sample size was not calculated based on formula because orbital trauma surgery in the study setting is less. Administrative data shows an average of 20 casescould be studied in 1 year time. Sample size for my study is arbitrarily fixed minimum 20 in each group.

Study Group
GROUP 1 – patient undergoing early surgical treatment (within 1st week).
GROUP 2 – patient undergoing late surgical treatment (after 1 week).

Procedure
Patient with orbit fracture evaluated clinically and radiologically.Orbital fracture patients undergoing surgical reconstruction for diplopia management is included.Diplopia evaluated by diplopia charting and muscle overaction and underaction chart by HESS chart in Ophthalmology Department (RIO).In-patients made into two groups

Group 1- Patients undergoing early surgical intervention (within 1 week)Group 2- Patients undergoing late surgical intervention (after 1 week)Diplopia evaluation by diplopia charting and muscle overaction & underaction by HESS chart.

Diplopia Chart
is the record of subjective separation of diploic or double images in the nine positionsof gaze. It can be plotted charted in patients who can cooperate and can appreciate double vision and with incomitant or comitant deviation.

Two methods:
1. Simple method
2. Electronic devices (Hess n lees screens)

The method:
The patients should be comfortable with his head erect and should preferably be stillthroughout the examination. The test is preferably be carried out in dark room. A redglass is put in front of one of eyes (red in front of right, R for R, is convention and simple). It is desirable to use Armstrong goggles since these are shaped to fit the orbital margin and therefore patient would be looking only through the coloured medium. The examiner holds the torch (vertical source of light) at around 0.5 to 1 m, it is very important to mention the distance on the chart. This source of light could be horizontal if the complaint is of vertical separation of images. The light is held directly in front of the patient at first. If the patient sees a single image, the examiner must establish whether it is a fused image, if suppression is present or if one image is obscured, for example by patient's nose bridge. If there is no double vision in primary position, the position in which double vision appears and is maximal to be noted. If patient notes a double image, the relative position of these images is noted. The light is now carried to the right and then to the other 8 positions of the gaze. In each gaze position patient must be asked whether the images are parallel or tilted; if torsion is present colored pencils can be given to an observant patient to show the separation in torsion. Also, in each gaze patient should be asked the amount of separation subjectively and its increase in a particular gaze.

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Interpretation of diplopia chart:
1. The position in image diplopia appears
2. The position in which separation of images are greatest

In the direction of the action of paralyzed muscle the double vision or the separation would be greatest because of the underaction of the muscle and overaction of the 5tantagonist muscle or yoke muscle.

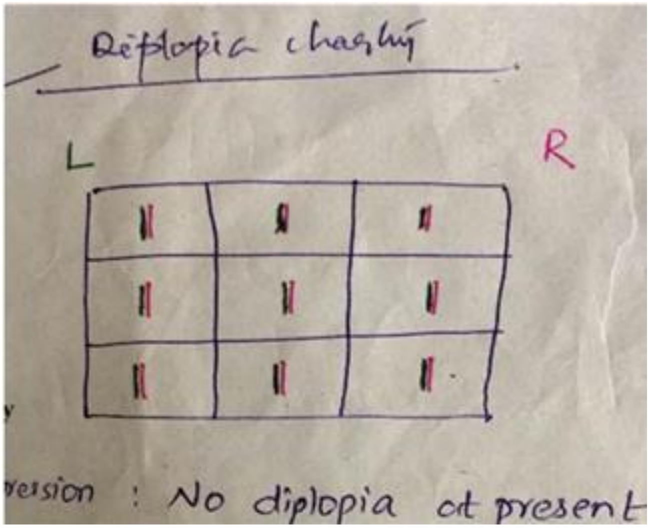

Figure 1: No diplopia (There is no separation of images suggest no diplopia)

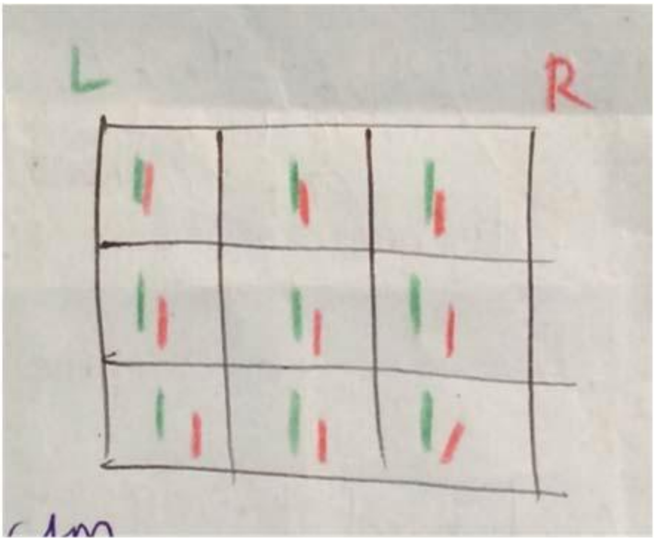

Figure 2: Diplopia (Maximum separation of images on medial side of left eye suggest medial rectus palsy/ underaction)

Hess Chart

The Hess screen test was designed by Walter Rudolf Hess in 1908 with subsequent modifications. Hess was a famous neurophysiologist who was awarded the Nobel Prize in 1949 for his research into the functional organization of the vegetative nervous system.

The original test used a black screen on which was marked a square-meter tangent scale. The tangent nature of the coordinate lines converts equidistant points, seen in a virtual sphere like a perimeter, into a two-dimensional chart. The test relies on color dissociation using red/green complementary filters. This maximizes the ocular deviation. A red target is illuminated or projected at the juncture where each tangent line crosses. A green light is projected by the patient and each plot is recorded. The test is repeated for the opposite eye resulting in a chart showing an inner and outer range of ocular rotation for each eye. Hess used red/green color dissociation in all his versions, including the more recent screens. The patient wore complementary red and green glass lenses mounted in a spectacle frame. Other screen tests were designed or modified after Hess, the best known being the Lancaster red-green test, initially called the Lancaster-Hess test and the Lees screen. With the advent of electricity and the introduction of plastics, new equipment became available. By the late 1960s, the screen was gray, wall-mounted, and available in an electrically operated version. The red and green glass lenses were replaced with Armstrong goggles, made from Kodak Wratten complementary red and green filters. These were molded to conform better to the midface and were held on by an adjustable elastic band.

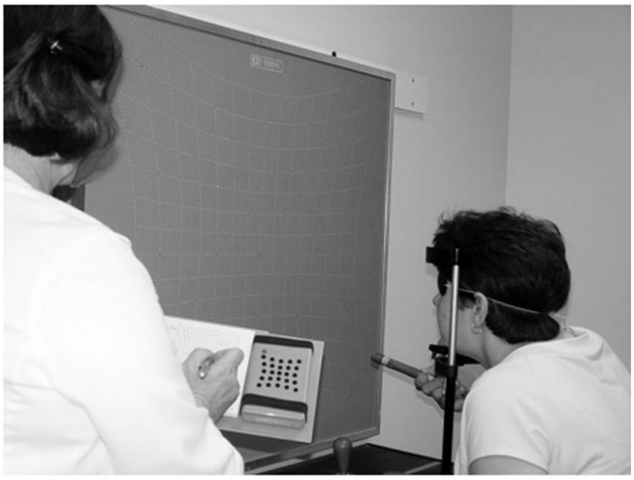

Figure 3: Hess screen

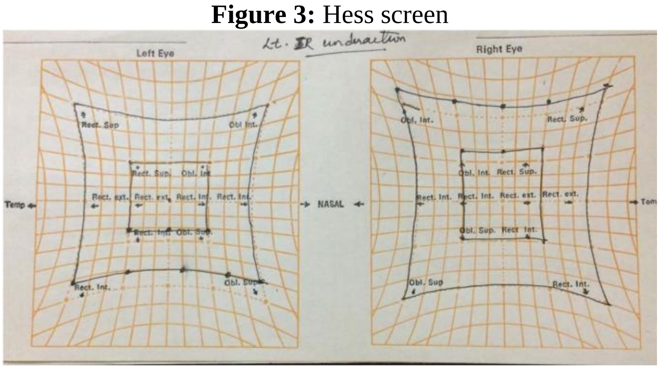

Figure 4: Hess charting

Table 1: Percentage distribution of the sample according to age

Age	Count	Percentage
<=20	14	37.8
21 - 40	11	29.7
>40	12	32.4
Mean ± SD	29.2 ± 13.5	

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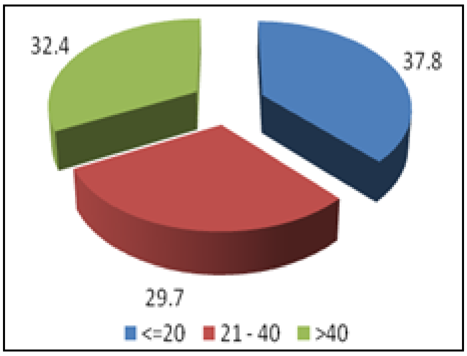

Figure 1: Percentage distribution of the sample according to age

Table 2: Percentage distribution of the sample according to gender

Gender	Count	Percentage
Male	33	89.2
Female	4	10.8

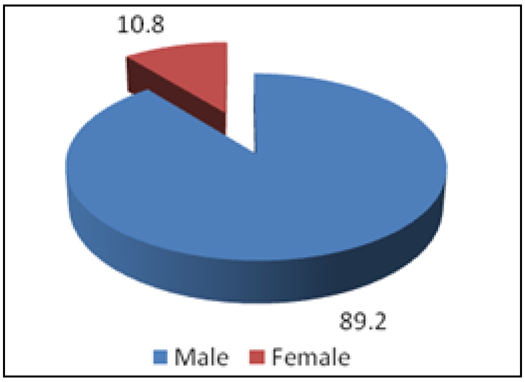

Figure 2: Percentage distribution of the sample according to gender

Table 3: Percentage distribution of the sample according to chief complain

Chief complaint	Count	Percentage
Double vision	32	86.5
Pain and difficulty in eye movement and opening	5	13.5

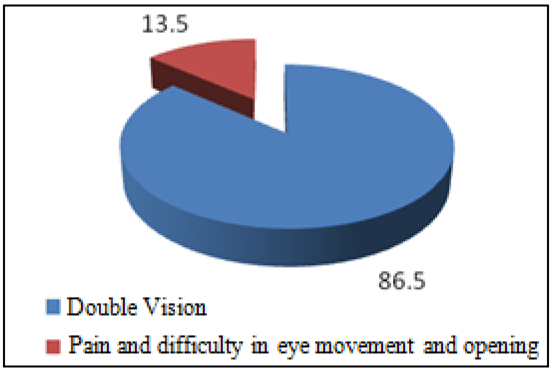

Figure 3: Percentage distribution of the sample according to chief complain

Table 4: Percentage distribution of the sample according to etiology

Etiology	Count	Percentage
RTA(Road Traffic Accident)	33	89.2
Sports injuries	3	8.1
Fall	1	2.7

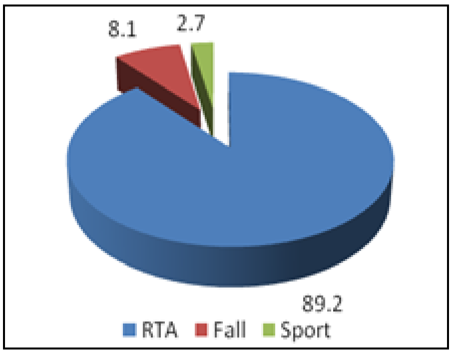

Figure 4: Percentage distribution of the sample according to etiology

Table 5: Percentage distribution of the sample according to no. of bony wall involved

No. of bony wall involved	Count	Percentage
One	16	43.2
Two	16	43.2
Three	5	13.5

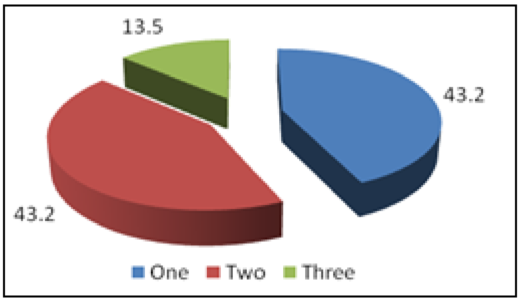

Figure 5: Percentage distribution of the sample according to no. of bony wall involved

Table 6: Percentage distribution of the sample according to enophthalmos

Enophthalmos	Count	Percentage
Yes	22	59.5
No	15	40.5

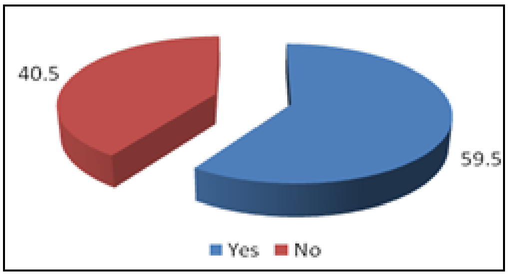

Figure 6: Percentage distribution of the sample according to enophthalmos

Table 7: Percentage distribution of the sample according to subconjuctival haemorrhage

Subconjuctival haemorrhage	Count	Percentage
Yes	29	78.4
No	8	21.6

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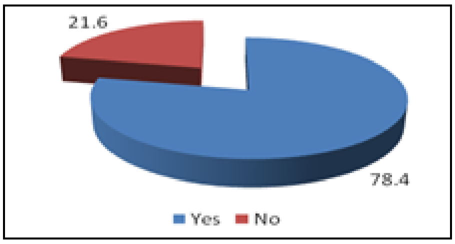

Figure 7: Percentage distribution of the sample according to subconjuctival haemorrhage

Table 8: Percentage distribution of the sample according to restricted eye movements

Restricted eye movement	Count	Percentage
Yes	36	97.3
No	1	2.7

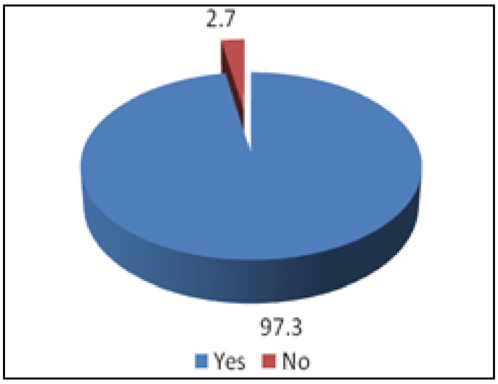

Figure 8: Percentage distribution of the sample according to restricted eye movements

Table 9: Percentage distribution of the sample according to periorbital oedema

Periorbital oedema	Count	Percentage
Yes	27	73.0
No	10	27.0

Table 10: Percentage distribution of the sample according to other fractures

Other fractures	Count	Percentage
Yes	16	43.2
No	21	56.8

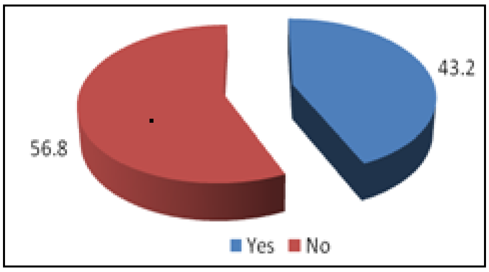

Figure 10: Percentage distribution of the sample according to other fractures

Table 11: Percentage distribution of the sample according to timing of surgical intervention

Surgical intervention	Count	Percentage
Early (Within 1week)	16	43.2
Late (After 1 week)	21	56.8

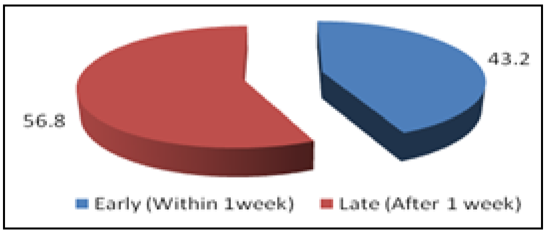

Figure 11: Percentage distribution of the sample according to surgical intervention

Table 12: Percentage distribution of the sample according to exact day of surgery

Exact day of surgery	Count	Percentage
<10	17	45.9
10 - 20	7	18.9
>20	13	35.1
Mean ± SD	21.8 ± 34.3	

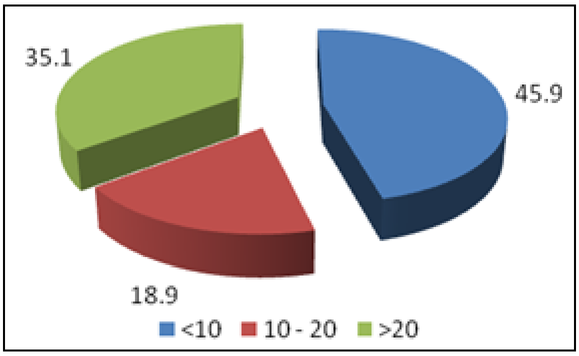

Figure 12: Percentage distribution of the sample according to exact day of surgery

Table 13: Percentage distribution of the sample according to the result achieved

Result	Count	Percentage
Resolved	30	81.1
Not resolved	6	16.2
Improved	1	2.7

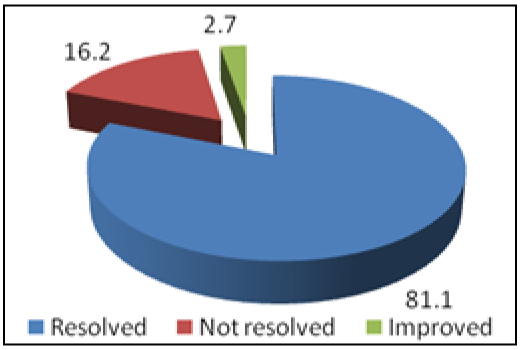

Figure 13: Percentage distribution of the sample according to the result achieved

Table 14: Percentage distribution of the sample according to the reconstruction material used

Reconstruction material	Count	Percentage
Titanium Mesh	34	91.9
Bone graft	3	8.1

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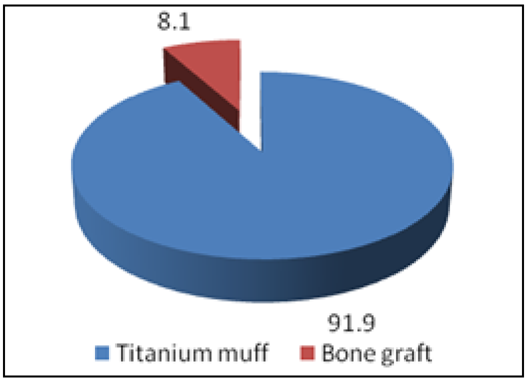

Figure 14: Percentage distribution of the sample according to reconstruction material

Table 15: Percentage distribution of the sample according to enophthalmos resolved

Enophthalmos resolved	Count	Percentage
Yes	15	68.2
No	7	31.8

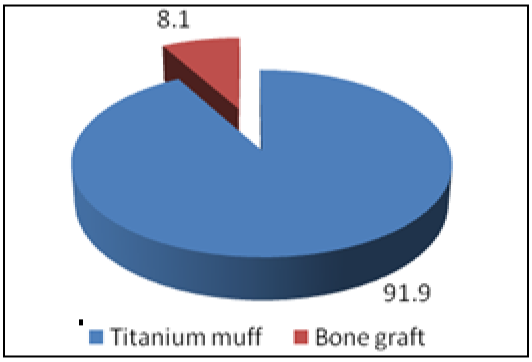

Figure 15: Percentage distribution of the sample according to enophthalmos resolved

Table 16: Comparison of result based on surgical intervention

Result	Early (Within 1week)		Late (After 1 week)		χ^2	p
	Count	Percentage	Count	Percentage		
Resolved	14	87.5	16	76.2	1.15	0.564
Not resolved	2	12.5	4	19.0		
Improved	0	0.0	1	4.8		

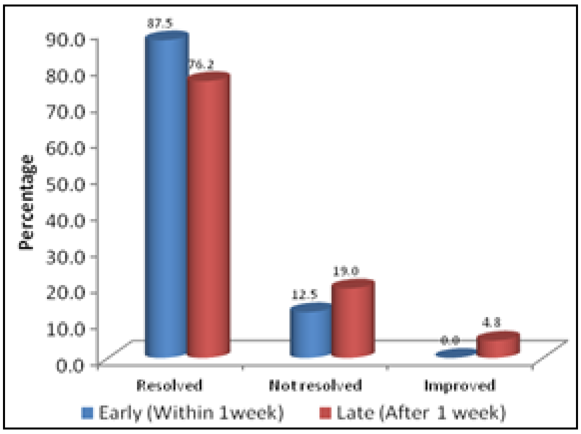

Figure 16: Comparison of result based on surgical intervention

Table 17: Comparison of enophthalmos resolved based on surgical intervention

Enophthalmos resolved	Early (Within 1week)		Late (After 1 week)		χ^2	p
	Count	Percentage	Count	Percentage		
Yes	7	87.5	8	57.1	2..163	0.141
No	1	15.5	6	42.9		

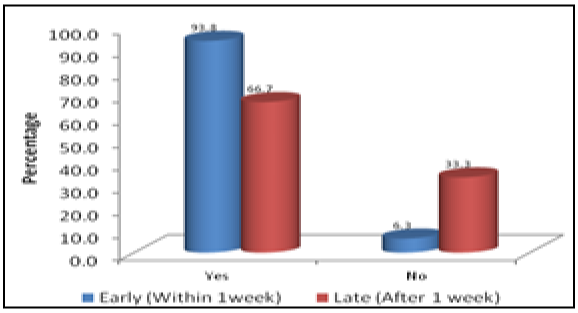

Figure 17: Comparison of enophthalmos resolved based on surgical intervention

Table 18: Comparison of result based on age

Result	<=20		>20		χ^2	p
	Count	Percentage	Count	Percentage		
Resolved	13	92.9	17	73.9	2.14	0.343
Not resolved	1	7.1	5	21.7		
Improved	0	0.0	1	4.3		

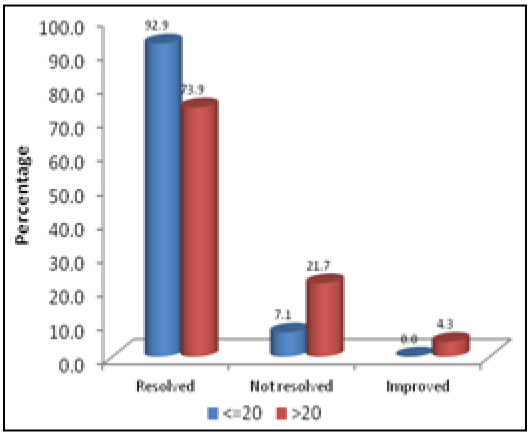

Figure 18: Comparison of result based on age

Table 19: Comparison of enophthalmos resolved based on age

Enophthalmos resolved	<=20		>20		χ^2	p
	Count	Percentage	Count	Percentage		
Yes	13	92.9	16	69.6	2.79	0.095
No	1	7.1	7	30.4		

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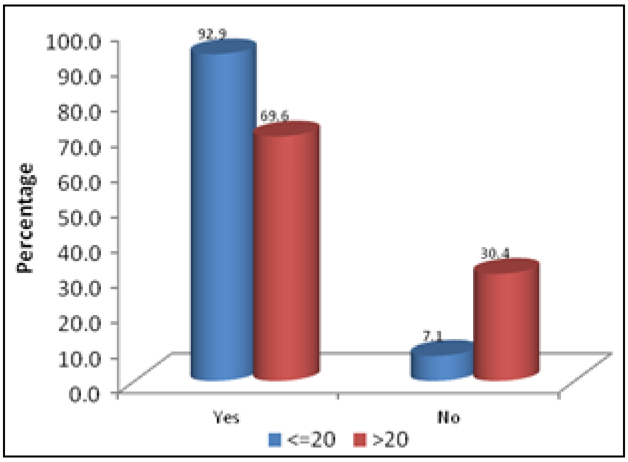

Figure 19: Comparison of enophthalmos resolved based on age

3. Discussion

Controversies regarding the timing of the orbital fracture reconstruction hasbeen well debated over last three decades. There are no specific guidelines regardingthe timing of intervention in cases of orbital fractures and the associated diplopia.

This has led to dilemma regarding proper time bound management of post traumatic orbital reconstruction. From 1980's advancements in technology and CT scan based diagnosis, a treatment protocol has evolved. CT based diagnosis has led to accurate assessment of the extent of fractures and to find out the presence or absence of herniated tissue which is not possible to identify easily with clinical examination and plain radiographs. At present two different schools of thought exist regarding the timing of intervention in management of post traumatic diplopia. Some surgeons prefer early intervention within 2 weeks of trauma and some prefer watchful observation for 2 weeks for oedema to subside and for better judgment of actual condition. K. de man et al.2 in their finding reported the average age of patients at the time of surgery for the orbital blow out fractures as 30.6 years whereas Banu M. Hosal et al.18 reported the average age of patients for surgical correction of orbital blow out fractures as 32 years. In this study that statistical analysis revealed the mean age of orbital blow out cases who had surgery as 29.2 years.The gender ratio of the orbital fractures undergone surgical correction was89.2% for male and 10.8% for female in this study. This values are consistent with the finding of Mario Francisco Gabrielli et al.26 who reported 79.1% male and 20.8% female in their study.In this study of orbital blow out fractures for surgical correction associated fractures were documented in 43.2% of cases, periorbital oedema was 73% of cases and subconjuctival haemorrhage in 78.4 of cases. In this study etiology of trauma was also recorded and it showed 89.2% ofcases of orbital fractures occurred as a sequel to motor vehicle accidents. It was also noted that sports injuries contributed to 8.1% and accident fall was 2.7%. This values are also consistent with the study of K.C.yoon et al.8. But study by Ning-chia wang et al.[12] showed assault as the etiology of injury in 43.9% of cases, motor vehicleaccidents in 23.3% and fall contributed to 17.1% and sports injuries were 9.7%. This may be attributed to the rules and regulations for the road traffic and driving in that region.Again Ning-chia Wang et al.12 observed the average time of surgical intervention as 22.9 days which was very much consistent with this present study at 21.8%. After the 37 patients with diplopia in orbital fractures subjected to surgical intervention in this study, 30 patients (81%) were recorded complete recovery from diplopia in all gazes, which is very consistent with the study of Banu M. hosal et al.18 who reported 28 patients (80%) with complete recovery of diplopia in all gazes out of the 35 cases operated. 43.2% of patients with diplopia associated with the orbital fractures had early surgery (<1 week) whereas 56.8% of the patients had delayed repair (>1 week). It was also noted that in 85.7% of cases drastic improvement in enophthalmos happened when surgical intervention was accomplished earlier (<1 week). This is very much consistent with the study of K. Verhoeff et al.4, which showed complete recovery in 73% of cases when operated prior to 2 weeks following trauma. But Albert J. Dal Canto et al.1 reported no significant difference in improvement of diplopia and enophthalmos in early surgical intervention (1-14 days) of orbital fractures compared to those cases went for late repair (15-29 days). Jun Woo Shin et al.27 reviewed 952 pure orbital fractures and concluded that there was no significant difference in both early and late intervention. This study was able to bring out significance in etiology of trauma which is noted as road traffic accidents and the association of orbital fractures in panfacial trauma. It was also categorically proved in this study that earlier surgical intervention showed high rate of complete recovery of diplopia and enophthalmos in orbital fractures. There is no statistical difference in resolving of diplopia based on age of the patients in this study. Although the study was able to bring out various incidence levels and statistical data regarding the various aspects of surgical management of diplopia in the orbital fractures but it cannot be a conclusive evidence regarding the timing of surgical intervention. This is primarily because study was time bound and had to complete in the available 37 patients in 18 months duration. This study also fall inlines with most of the available literature regarding similar study.

4. Conclusion

Within the limits of this study the following conclusions were drawn-

- Most common age group affected in orbital fracture were 2nd and 3rd decade, with a mean of 21.8 years.
- Males were most commonly affected with diplopia and orbital fractures primarily due to the higher involvement of males in road traffic accidents.
- Most common chief complaint of patients were diplopia following orbital injuries.
- Restricted eye movement following injury was almost present in all cases.
- Subconjuctival haemorrhage was one clinical feature which was present in 78.4% of the surgically managed cases.
- Orbital fractures were commonly associated with the panfacial trauma.
- Enophthalmos was present in 22 out of 37 patients managed surgically and 15 out of 22 patients had complete

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recovery. Patients underwent late intervention had less complete recovery than early group.

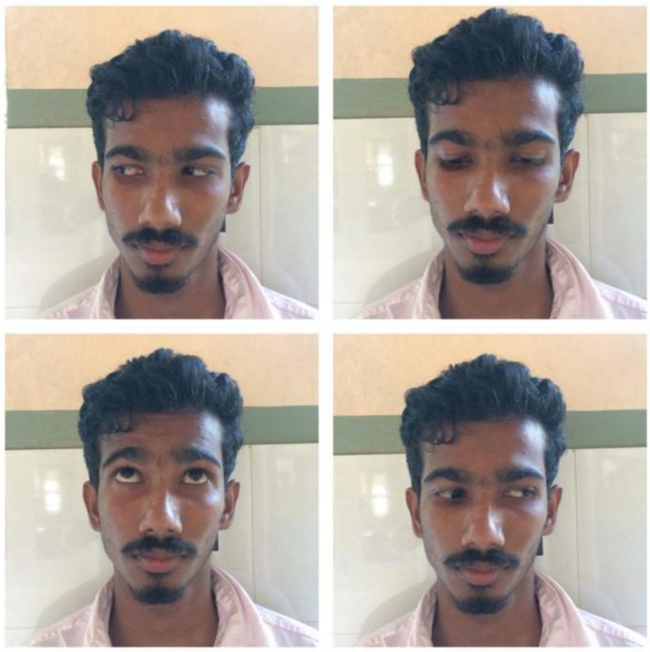
- Out of 37 patients surgically managed, early group (within 1week) patients had higher rate of complete recovery in diplopia and enophthalmos than late group (after 1 week), statistically there is no huge difference noted according to this study.
- There is no statistical difference in resolving of diplopia and enophthalmos based on the age of patients.

5. Results

In this present a total of 37 patients with recorded diplopia were surgically managed. As per the documentation and statistical analysis the following are the findings.14 patients were below the age of 20(37.8%), 11 patients were between the age of 21 to 40 years(29.7%) and 12 patients were above the age of 40 years(32.4%). Mean and SD calculated was 29±13,5. (Table-1). Out of 37 patients surgically intervene for diplopia 33(89.2%) were males and 4 were females(10.8%). (Table-2). In this study chief complain of the patients who had surgical corrections were diplopia in 86.5% (32 patients) whereas pain and difficulty in eye movements & opening constituted only 13.5%(5 patients). (Table-3). Road traffic accident accounted for 89.2% of the operated cases(33 patients), sports injuries were 8.1% (3 patients) whereas accidental fall was 2.7%(1 patient). (Table-4). Out of 37 patients surgically managed 43.2% of patients had fracture of one bony wall(16 patients) whereas another 43.2% of patients (16 patients) had two bony walls involved and 13.5% of patients(5 patients) had three bony involvement. (Table-5). Clinically 59.5% of cases (22 patients) had enophthalmosas 40.5% of cases (15 parients) did not show any signs enophthalmos. (Table-6). Subconjuctival haemorrhage as one clinical feature associated with the orbital fractures and 78.4% of the patients operated had visible subconjuctival haemorrhage. 2 to 6 % (8patients) did not show any signs of enophthalmos. (Table-7). After the 37 patients surgically treated in this study (93.7%) had restricted eye movements whereas one patient (2.7%) had no movement restriction. (Table-8). Another notable clinical feature associated with orbital trauma is periorbital oedema. 73%of patients (27 patients) had periorbital oedema whereas 27% (10 patients) did not show any signs at the time of presentation. (Table-9). 43.2% (16 patients) operated upon had other fractures (panfacial trauma cases) whereas 56.8%(21 patients) had orbital fracture only. (Table-10). The timing of surgical intervention in orbital fractures is controversial and still debated. In this study 43.3% (16 patients) had early surgical intervention (within 1 week) of trauma whereas 56.8% (21 paitents) were subjected to surgical correction late (after 1 week) of trauma. (Table-11).

Resolving the issue of diplopia was the aim of this study and surgical intervention resulted in complete recovery of diplopia in 81.1%(30 patients) whereas in 16.2% of diplopia cases (6patients), they did not recover completely whereas it was noted that surgery resulted in improvement of diplopia in one case(2.7%). (Table-13). Titanium mesh was used to reconstruct the fracture orbital wall in 91.9% of cases (34 patients) whereas 3 patients (8.1%) had bone graft reconstruction. (Table-14). Out of surgically managed cases 68.2% had enophthalmos completely resolved (15 patients) whereas in 31.8% of the cases (7 patients)mild enophthalmos peristed. (Table-15). Statistical analysis was done of the above data and according to the formula described in methodology, following results were obtained. On comparison of outcome based on surgical intervention χ^2 is 1.15 and with the p value 0.564 which is shows that diplopia resolved in early and late group is not so statistically significant but early group patient had higher number of resolved cases (87.5%) than late group intervention(76.2%). (Table-16).

On comparison of enophthalmos resolved based on surgical intervention χ^2 is 2.163 and p value is 0.141 . this shows that enophthalmos reolving in early and late group is not statistically significant but early intervention patients had higher numbers of resolved cases (87.5%) than late intervention groep(12.5%). (Table-17). On analyzing the association of outcome variable based on age, χ^2 is 2.14 and p value is 0.343 for resolved / non-resolved / improved cases. This shows that there is no statistical difference between early and late group based on age. But data shows that <20 years patients in early group had more number of resolved cases(92.9%) tha late group(73.9%) Enophthalmos resolved based on age was also analyzed and found χ^2 is 2.79 and p value is 0.095. this indicate there is no statistical difference between two groups. Early group patients had higher number of enophthalmos resolved (92.9%) compared to late group (69.6%) based on age.



Case- 1: Early Repair

Preoperative eye movements: left eye upward movement restriction

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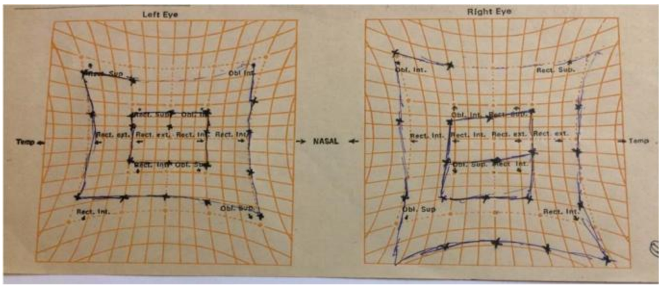
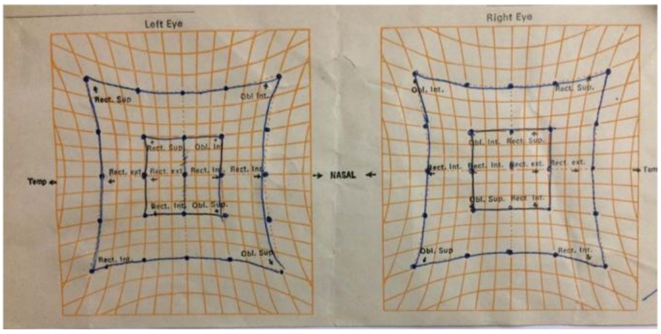


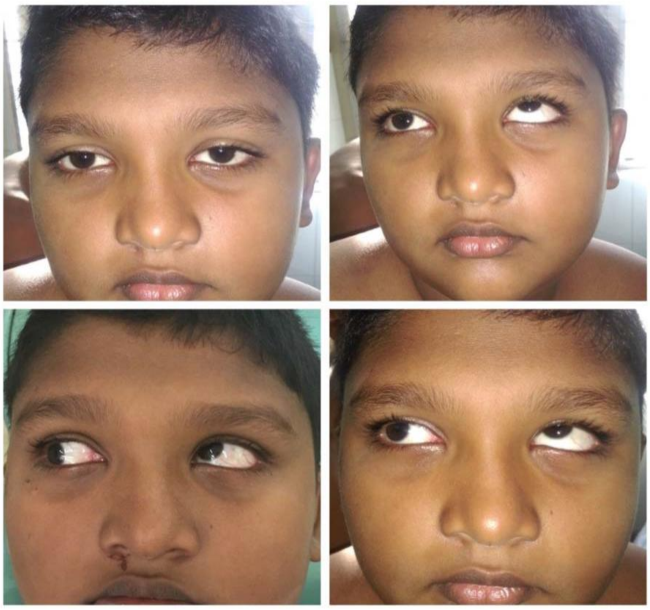
Preoperative HESS chart: Left Eye field restricted

Postoperative: normal gaze movements

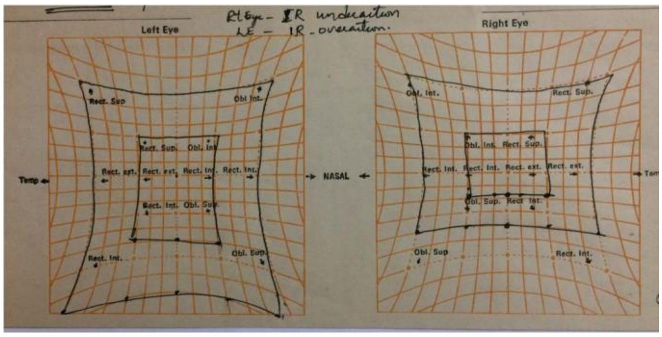


Post operative HESS chart: Normal gaze movements

Case-2: Blow Out Fracture – Early Repair



Preoperative: right eye upward gaze restriction



Preoperative HESS chart : right eye field restricted.

Postoperative: eye movements improved immediately.

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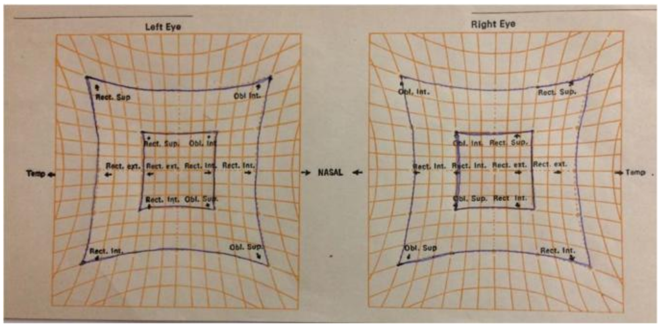

Postoperative HESS chart: Normal gaze movements

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