



## Contribution of the Association of CT scan and Ocular Trauma Score in Open Globe Ocular Injuries: Mohammed VI University Hospital Experience

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**Abstract:** *Objective:* The aim of this study was to assess the association between oculo-orbital CT scan results and Ocular Trauma Score (OTS) in open globe injuries. *Methods:* In 65 eyes with open globe injuries undergoing oculo-orbital CT, they were classified into 5 major types: intraocular foreign body/air, scleral irregularity with decreased globe volume, lens dislocation, abnormal vitreous density, choroid layer thickening, and choroidal detachment. The association between different types and the number of CT findings with OTS stages was evaluated. *Results:* The average age of patients was  $37 \pm 15.8$  years. The most common CT findings were the presence of intraocular foreign bodies (63.1%), severe scleral irregularity (18.5%), and abnormal vitreous density (23.1%). The most frequent OTS stages were III (47.7%) and II (21.5%). Univariate analysis showed that severe scleral irregularity (OR = 0.015;  $p = 0.001$ ), abnormal vitreous density (OR = 0.095;  $p < 0.004$ ), choroidal layer thickening (OR = 0.211;  $p = 0.006$ ), and foreign body (OR = 9.50;  $p = 0.004$ ) were associated with more advanced OTS stages (I and II). The discovery of more anomalies on CT was associated with severe ocular injuries, namely OTS I ( $p < 0.001$ ) with corresponding low final visual acuity. *Conclusion:* CT results can aid in predicting OTS stage and visual prognosis in open globe eye injuries.

**Keywords:** Prognosis, computed tomography, ocular trauma score, open globe eye injury.

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## INTRODUCTION

Open globe ocular traumas are among the leading causes of permanent vision loss in young patients and the working-age population [1, 2]. In polytrauma patients, detecting ocular injuries and predicting outcomes are major challenges for ophthalmic surgeons.

Managing patients with open globe ocular trauma and making decisions about necessary

interventions take into account the patient's clinical data and imaging results.

The predictive and prognostic rating scale, Ocular Trauma Score (OTS), was proposed in 2002 to streamline therapy for ocular trauma patients [3]. It is based on the Birmingham Eye Trauma Terminology system and is widely used for both open and closed globe injuries [4].

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The predictive value of CT results in patients with open globe injuries has been studied, and the correlation between CT findings and the prognosis of open globe trauma has been assessed [5, 6]. Although OTS is now the most important prognostic factor, the scale for mechanical ocular traumas, obtaining reliable visual acuity, and assessing different clinical features required for OTS can be difficult or impossible in the early hours following trauma. The association between CT results and OTS can facilitate rapid and reliable visual prognosis prediction [7, 8].

The objective of this study is to present the CT findings in 65 patients with open globe injuries and evaluate the association between different OTS stages, types, and the number of CT findings.

### METHODS AND MATERIALS

This is a retrospective study of patients admitted to the ophthalmology department of CHU Mohammed VI de Marrakech with open globe injuries due to ocular trauma, who underwent oculo-orbital CT and medical-surgical intervention during the year (January 2022 to January 2023).

Only patients with open globe injuries who underwent oculo-orbital CT were included. Patients with incomplete clinical records, poor-quality

tomographic images, pseudophakia, or aphakia were excluded.

### Data Collection

All records of hospitalized patients for ocular trauma, including initial ophthalmic consultations and details of emergency and subsequent surgical interventions, were reviewed. All clinical information, demographic data, visual acuity characteristics of ocular injuries (mechanism and location of corneal and/or scleral wounds), and associated lesions were collected. The injury zone was defined according to the Birmingham Eye Trauma Classification. Visual acuity measurements were recorded based on Snellen chart scores. Patient follow-up for at least 6 months was conducted.

### Statistical Analyses

All statistical analyses were performed using SPSS Version 26.0 (IBM SPSS Statistics for Windows, Armonk, NY). Data were presented as mean, standard deviation, range, and total percentage. The Fisher exact test was used to compare the rate of different CT findings at each stage of OTS. The association between the number of CT findings and OTS stages was determined by exact chi-square/Fisher tests. A p-value less than 0.05 was considered statistically significant.

### RESULTS

**Table 1: Main Patient Characteristics**

Age	<b>37±15.8 years</b>	
Sex	Men	54 (83.1%)
	Women	11 (16.9%)
Mechanisms of trauma	Accident de travail	46 (70.8%)
	AVP	9 (13.8%)
	Contusive	2 (3.1%)
	Aggression	4 (6.1%)
Zone	Zone I	38 (58.5%)
	Zone II	16(24.6%)
	Zone III	11(16.9%)
Types of injury	Penetration	46 (70.8%)
	Rupture	13(20%)
	Perforation	6 (9.2%)
Visual acuity on admission	NLP	6 (9.2%)
	LP/HM	35 (53.9%)
	1/200-19/200	18 (27.7%)
	≥20/200-20/50	3 (4.6%)
	≥ 20/40	3 (4.6%)
OTS stages	I 0-44	14 (21.5%)
	II 45-65	14 (21.5%)
	III 66-80	31(47.7%)
	IV 81-91	4 (6.2%)
	V 92-100	2 (3.1%)

The average age of our patients was 37 ± 15.8 years (9–69 years) with a male predominance of 83.1% (54 men to 11 women). Globe injuries consisted of penetration in 46 cases (70.8%) and rupture in 13 cases (20%). The most common cause of open globe injuries was work-related accidents (70.8%), followed by road traffic accidents in 13.8% of cases. Visual acuity (VA) on admission was dominated by light perception/hand motion (LP/HM) in 53.9% of cases, followed by 1/200–19/200 in 27.7%. The most common OTS stages were III (47.7%) and I (21.5%), and II (21.5%) (Table 1).

On CT, intraocular foreign bodies (IOFB) were observed in 41 eyes (63.1%), scleral

irregularity in 18.5%, abnormal vitreous density in 23.1%, retinal detachment in 18.5%, and choroid layer thickening in 7.7%. Fourteen (29.1%), 11 (48.9%), and 34 (18.6%) eyes had 1, 2, and 3 OTS stages, respectively. All patients underwent wound suturing in the emergency department. IOFB and traumatic cataracts associated with these different lesions were subsequently addressed. Final VA was better for OTS III stage in 52.3%, and stages I and II were 21.5% and 16.9%, respectively, with no light perception (NLP), VA ≥20/200–20/50, and VA ≥20/40 being 15.3%, 26.15%, and 52.3%, respectively (Table 2).

**Table 2: Association between Final VA and OTS Stages**

AV finale OTS Stages		NLP		LP/HM	1/200- 19/200	≥20/200- 20/50	≥20/40	Total
OTS stages	0-44	1	9	1	0	3	2	14 (21.5%)
	45-65	2	1	0	3	5	2	11 (16.9%)
	66-80	3	1	0	0	8	25	34 (52.3%)
	81-91	4	0	0	0	1	3	4 (6.2%)
	92-100	5	0	0	0	0	2	2 (3.1%)
<b>Total</b>			<b>10(15.3%)</b>	<b>1 (1.5%)</b>	<b>3 (4.6%)</b>	<b>17(26.15%)</b>	<b>34(52.3%)</b>	<b>65 (100%)</b>

Scleral irregularity and abnormal vitreous density were the most common CT findings at OTS stage I (p < 0.05). At stages II and III, IOFB and

abnormal vitreous density were the second most common result (Table 3).

**Table 3: Types of CT Findings at Different OTS Stages**

Types of CT Findings OTS stages	IOFB	Irregularity scleral	Choroid Detachment	subluxation lens	abnormal vitreous	Thickening of chorioretinal layer	Global p value
0-44 (N=32)	3 (5.6%)	9 (64.3%)	5 (35.7%)	4 (28.6%)	7 (46.7%)	4 (28.6%)	0.001
45-65 (N=22)	10(22.2%)	3 (21.4%)	1 (7.1%)	1 (7.1%)	6 (42.9%)	1 (7.1%)	0.004
66-80 (N=25)	23 (61.1%)	0	0	0	2 (13.3%)	0	-
81-91 (N=4)	4 (8.3%)	0	0	0	0	0	-
92-100 (N=1)	1 (2.8%)	0	0	0	0	0	-

**Table 4: Association between OTS stage I & III and different types of CT findings**

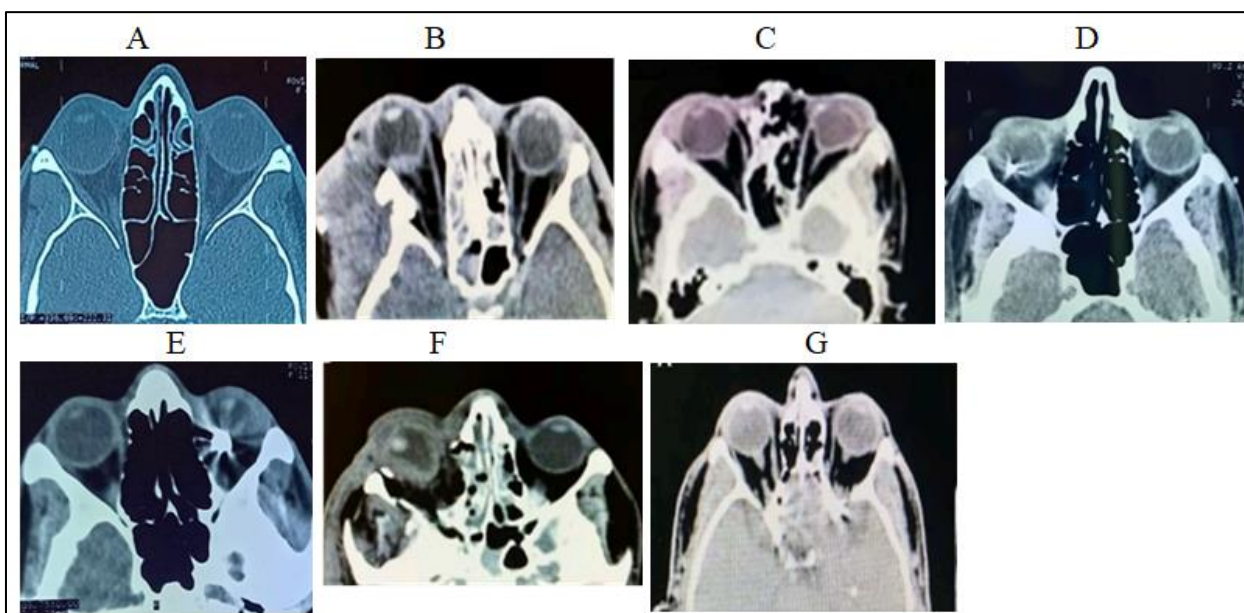
Types of CT findings	Results CT	OR	95% CI	P
Types of CT findings	IOFB	9.50	0.066-0.895	0.004
	Lens luxation	0.115	0.011-1.235	0.001
	scleral irregularity	0.015	0.002-0.155	0.001
	Abnormal vitreous	0.095	0.019-0.479	0.002
	Choroid detachment	0.055	0.412-0.83	0.002
	Thickening of chorioretinal layer	0.211	0.310-1.145	0.001

**Table 5: CT Results**

CT Results	Effective (percent)	P value
IOFB	41 (63.1%)	0.010
Lens luxation	4 (6.2%)	0.020
Choroid detachment	6 (9.2%)	0.004
Scleral irregularity	12 (18.5%)	0.001
Abnormal vitreous	15 (23.1%)	0.004
Thickening of chorioretinal layer	5 (7.7%)	0.002

**Table 6: Types of CT Findings Associated with OTS Stage 1 & OTS 3 and Final VA**

Number of CT findings	Stade OTS 1 & 3		P value	Acuité visuelle finale			Total
	Stade OTS 1	Stade OTS 3		NLP	20/200-20/50	20/40	
0	0	9 (30%)	0.766	0	0	9 (39.1%)	9
1	5 (38.4%)	13 (43.3%)	0.945	4 (40%)	3 (30%)	11 (47.8%)	18
2	2 (15.3%)	6 (20%)	0.740	2 (20%)	4 (40%)	2 (8.7%)	8
3	2 (15.3%)	2 (6.6%)	0.521	1 (10%)	2(20%)	1 (4.38%)	4
4	3 (23.1%)	0	-	2 (20%)	1 (10%)	0	3
5	1 (7.6%)	0	-	1 (20%)	0	0	1
<b>Total</b>	<b>13</b>	<b>30</b>		<b>10</b>	<b>10</b>	<b>23</b>	<b>43</b>



**Figure A and B: No associated abnormality in the eye. Figure C: Thickening of the choroid layer of the right eye. Figure D: Scleral irregularity (with decreased globe volume) and lens dislocation in the left eye. Figure E: Metallic intraocular foreign body in the right eye, Fig F: Foreign body and scleral irregularity and lens dislocation of the left eye, Figure G: Lens dislocation, scleral irregularity, and thickening of the choroid layer in the right eye**

Moreover, the analysis revealed a positive correlation between the number of CT findings and the severity of ocular trauma. At OTS I, the presence of 2 ( $p = 0.740$ ), 3 ( $p = 0.521$ ), or 4 ( $p < 0.001$ ) CT findings was associated with an increased risk of severe trauma with corresponding low final VA.

Univariate analysis showed that severe scleral irregularity ( $OR = 0.015$ ;  $p = 0.001$ ), abnormal vitreous density ( $OR = 0.095$ ;  $p = 0.002$ ), choroid layer thickening ( $OR = 0.211$ ;  $p = 0.006$ ) were associated with more advanced OTS stages (I and II), and foreign body ( $OR = 9.50$ ;  $p = 0.004$ ) was associated with OTS stage III (Table 4). The discovery of more anomalies on CT was associated with severe ocular injuries, OTS I with 4 associated anomalies ( $p < 0.001$ ). CT results were associated with OTS stages I or III (Table 6). The absence of associated anomalies found on CT indicates an advanced OTS stage IV or V.

## DISCUSSION

Our analysis reveals that the average age of our patients was  $37 \pm 15.8$  years (9-69 years) with a male predominance (54 men to 11 women). Our findings align with those of Boukrissa *et al.*, and C. Lee *et al.*, [9, 10] but differ from those of A. Fujikawa *et al.*, (average age of  $51.3 \pm 18.1$  years) [12].

The injury mechanisms clearly indicate that workplace accidents are the primary source of open globe injuries (70.8%), while road traffic accidents contribute to 13.8% of cases. Our results are similar to those of N. Beshay *et al.*, [11], while A. Fujikawa *et al.*, found that globe ruptures due to road traffic accidents dominate, followed by the presence of intraocular foreign bodies (IOFB) at 69.5% and 20.3%, respectively [12]. Our study reveals that the most common visual acuity (VA) level at presentation was light perception/hand motion (LP/HM) at 53.9%, followed by 1/200–19/200 at 27.7%. These findings are comparable to those of Amali *et al.*, [6]

and J.M Kanoff [13], who also reported significant visual impairments in patients with traumatic ocular injuries. The majority of patients have a good final VA for OTS III stage at 52.3%. Stages I and II are 21.5% and 16.9%, respectively.

In our study, the final VA with no light perception (NLP),  $\geq 20/200$ - $20/50$ , and  $\geq 20/40$  was in 15.3%, 17.15%, and 52.3% of cases, respectively. Our study shows that globe rupture was the severe mechanism with an NLP final VA in 15.3%, and IOFBs present a good prognosis after surgical removal. Our results are comparable to those of Ameli *et al.*, and A. Fujikawa *et al.*, [6, 12].

The analysis of OTS stages shows that stages III (47.7%), I (21.5%), and II (21.5%) are the most common. Our results differ from those of Ameli *et al.*, II (44.5%) and I (30.7%) [6]. However, our results are similar to those of SM Shrestha and K. Purtskhvanidze *et al.*, [8, 14].

Three lesions dominate in our series, namely the presence of IOFB, severe scleral irregularity, and abnormal vitreous density. However, it is scleral irregularity, abnormal vitreous density, and choroidal detachment that constitute low OTS factors and collapsed final VA. Our results differ from those of Ameli *et al.*, who found that scleral irregularity, abnormal vitreous density, and choroid-retinal detachment were dominant anomalies in their series at 71.9%, 56.0%, and 47.8%, respectively [6]. These differences could be explained by different traumatic mechanisms in our series.

Univariate analysis highlighted significant associations between CT findings and more advanced OTS stages. Severe scleral irregularity, abnormal vitreous density, and choroid-retinal thickening were associated with more advanced OTS stages. Our results are similar to those of Ameli *et al.*, who also showed that severe scleral irregularity (OR = 1.31;  $p = 0.04$ ), abnormal vitreous density (OR = 2.33;  $p < 0.001$ ), and choroid-retinal detachment (OR = 2.11;  $p < 0.001$ ) were associated with OTS stages (I and II) [6]. K. Purtskhvanidze *et al.*, [14], D. Yasa *et al.*, [15] also identified correlations between these factors and the severity of injuries.

All patients underwent emergency surgical intervention for wound closure. Those with traumatic cataracts, IOFBs, and other associated anomalies underwent surgical interventions later, within approximately 15 days. Patients with a negative perception of light (NLP) final VA underwent evisceration. These surgical interventions were also performed in Y. Liu's series [16].

## CONCLUSION

OTS stages and CT results in patients with open globe injuries are highly useful for assessing the severity of ocular trauma and predicting visual prognosis.

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