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Enophthalmos as a prognostic factor in blow-out fracture of the orbit. Retrospective study of over 700 cases

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Abstract: The aim of the study was to determine the influence of posttraumatic enophthalmos in orbital blow-out fracture on the treatment results. The relationship between time from injury to treatment, type of surgical reconstruction, bone graft site, type of diplopia and treatment results were evaluated. The relationship between the location of the fracture and the degree of enophthalmos was also analyzed. The study included 730 patients, 128 women and 602 men, aged 4 to 77 years, average 28 years, treated because of orbital blow-out fracture in our Department between 1975 and 2015. The study included only patients with an isolated orbital floor or medial wall fracture, so-called „pure blow-out" or „internal blow-out". Fractures of the lower rim, roof or lateral wall of the orbit, as well as the coexistence of other fractures of the facial part of the skull, were excluding citeria from the study. Complete recovery in surgically treated patients was achieved in 405 (58.8%) patients, improvement in 179 (26%) and no improvement in 105 (15.2%) patients. The degree of post-traumatic enophthalmos affects the result of the treatment. The location of the orbital fracture affects the enophthalmos, in our group of patients the largest incidence occurred in the fracture located in the orbital floor combined with medial wall. Patients who underwent surgical treatment up to 14 days after the injury achieved better results than those postponed.

Keywords: enophthalmos, posttraumatic enophthalmos, pure blowout orbital fracture, orbital fracture, diplopia.

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Introduction

Enophthalmos, defined as distal displacement of the eyeball within the orbit, is the result of a change in the proportion between the orbit content and its volume [1]. Enophthalmos can be congenital or acquired. Acquired enophthalmos occurs in cachexia, is associated with atrophy of connective tissue and periocular fat, and can also be caused by medicines. However, the most common cause of enophthalmos is injury. Apart from double vision and sensory impairment in the infraorbital area, enophthalmos is one of the three basic symptoms of an orbital fracture [2, 3].

Enophthalmos can lead to the limitation of eye movement and result in double vision. According to current knowledge, enophthalmos might be caused by several factors that can manifest at different times from injury [4–7]. Among the causes of post-traumatic enophthalmos we can distinguish: an increase in the orbital volume due to the displacement of its bony limits, herniation of periocular soft tissues outside the orbit, periocular fat necrosis, especially in trapdoor fractures, displacement of the eyeball as a result of muscle fibrosis, as well as the process of scar formation and periocular tissue fibrosis. Enophthalmos also leads to eyelid dysfunction and can impair tear distribution on the surface of the eyeball.

For over 50 years, since the publication of Converse's [8] work, there has been a discussion on the optimal way of the orbital floor fracture treatment, there are supporters of conservative as well as surgical treatment [9–14]. The optimal time from injury to surgical treatment has not been clearly defined [15, 16]. Urgent surgical intervention in orbital floor fracture is necessary in case of oculo-cardiac reflex, mainly in children, as well as in open fractures, with penetrating wounds of the soft tissues or in a developement of retrobulbar hematoma with optic nerve compression [17, 18]. Post-traumatic edema of the soft tissues can mask enophthalmos, at the same time causing diplopia, which is why some authors suggest to postpone surgical treatment and determine indications for surgery about 7 days after the injury [15, 16, 19].

Material and Methods

Retrospective analysis of medical records of 730 patients (128 women, 602 men) aged 4–77 years (average 28.8 years), treated in our Department because of the orbital fractures between 1975 and 2015 was performed. Data was collected regarding the cause of injury, fracture location, fracture type, clinical symptoms including enophthalmos, type of diplopia, time from injury to surgical treatment, treatment method, and result of treatment. The study included only patients with an isolated fracture of the floor and/or medial wall of the orbit, the so-called "pure blow-out fracture" or "internal blow-out fracture". Concomitant fractures of the lower rim, roof or lateral wall of the orbit, and coexistence of any other fractures of the facial part of the skull were excluding criteria from this study. To assess the type of double vision of patients treated in our Department, the Krzystkowa classification was used. This classification differentiates five types of diplopia, depending on the area of double vision: type 1 — diplopia in up gaze, type 2 — diplopia in up and down gaze, type 3 — diplopia in up gaze and on straight, type 4 — diplopia on straight and down gaze, type 5 — diplopia in the whole area of view. Patients were examined by an ophthalmologist using orbital chart, designed in the 1970s as a result of cooperation between our Department and the Department of Ophthalmology of our University. Ophthalmological examination was carried out after the injury, after surgery, before the patient was discharged home and then one month after the surgery. Depending on the indications, subsequent control examinations were carried out every 1–3 months. The follow up time was from 1.5 month to 18 months after surgery.

The comparison of quantitative variable values in two groups was performed using the Mann–Whitney test. Comparison of quantitative variable values in three or more groups was performed using the Kruskal–Wallis test. After detecting statistically significant differences, post-hoc analysis was performed using Dunn's test to identify statistically significantly different groups. The analysis adopted the significance level of 0.05, so all p-values below 0.05 were interpreted as indicating significant relationships. The analysis was performed in the R program, version 3.6.2. *R Core Team (2019). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/.*

The indications for surgery were as follow: persistent post-traumatic diplopia, reduced mobility of the eyeball and enophthalmos above 2 mm compared to the healthy side. Despite these generally accepted indications, each case was treated individually, and indications for surgery were assessed several days after the injury, after soft tissue edema or coexisting intraocular injuries subsided.

Surgical procedures were performed under general anesthesia, transconjunctival retroseptal approach was an access of choice, although subcilliary approach was also used, and in the case of infraorbital wounds, access through the wound was used. Subperiosteal revision of the orbital floor and medial wall was performed. Depending on the intra-operative image, release of herniated periocular tissues or tissue release with orbital reconstruction using autogenic bone graft harvested from the anterior wall of the maxillary sinus, iliac bone, frontal bone, parietal bone, or temporal bone was performed. The wound of the conjunctiva was closed by resorbable sutures, skin wounds were sutured with 5.0 or 6.0 nylon stitches. Depending on the clinical image and preferences of the surgeon during and after the procedure, 6–12 mg of dexamethasone was administered intravenously. Perioperative antibiotic prophylaxis was used. There were folowing criteria of recovery and improvement: recovery — 0–1mm of enophthalmos, lack of dipopia, full passive eye movements, improvement — decrease of degree of enpohthalmos after surgery, decrease in the area of double vision after surgery, improvement of eye movements after surgical treatment.

Results

The most common cause of orbital floor fractures in our group of patients was assault and accidental impact in the orbital area.

The most common site of the fracture was the orbital floor followed by floor and medial wall.

The relationship between fracture location and post-traumatic enophthalmos was assessed. A statistically significant relationship was found. In the group of patients with the orbital floor and medial wall fracture, the enophthalmos was greater than in other locations.

The relationship between the reduction of enophthalmos and the reduction of posttraumatic diplopia was assessed. No statistically significant relationship was found. There was a noticeable tendency that reduction of enophthalmos resulted in a reduction of post-traumatic diplopia. The specific causes of the injury, all of the locations of the fracture, relationship between fracture location and post-traumatic enophthalmos and relationship between the reduction of enophthalmos and the reduction of posttraumatic diplopia are presented in Table 1.

Table 1. Characteristics of the study group.

Characteristic	Number of patients (%)	*P* Value
Sex		—
Female	128 (17.53)	
Male	602 (82.47)	
Cause of injury		—
Assault	300 (41.1)	
Accidental impact in periorbital area	139 (19.04)	
Fall	107 (14.66)	
Injury in sports	82 (11.23)	
Road traffic accident	66 (9.04)	
Other	23 (3.15)	
Work accident	13 (1.78)	
Location of fracture		—
Floor	610 (83.56)	
Floor and medial wall	91 (12.46)	
Medial wall	29 (3.98)	
Type of fracture intraoperatively		—
With bone defect	567 (82.3)	
Linear	122 (17.7)	

Enophthalmos after injury (average in mm)	**Location**	P <0.001
1.42 ± 1.16	Floor 610 (85.9)	
0.38 ± 0.62	Medial wall 9 (1.3)	
1.67 ± 1.42	Floor and medial wall 91 (12.8)	
Reduction of enophthalmos (average in mm)	**Reduction of posttraumatic diplopia**	P = 0.129
Average ± SD		
0.98 ± 0.89	Yes (N = 424)	
0.92 ± 1.06	No (N = 265)	

The relationship between time from injury to surgical treatment and treatment result was assessed, a significant statistical relationship was found (p <0.001). In the group with complete recovery, the time from injury to treatment is significantly lower than in the group with improvement and in the group with no improvement, the shorter the time from injury to treatment, the better the treatment results. The results are presented in Table 2.

Table 2. The results of treatment depending on: time from injury to surgical treatment, bone graft donor site and type of posttraumatic diplopia.

Result of treatment	**Time from injury to surgical treatment**						**P value**
	On the day of injury N = 12 (%)	**2–14 days N = 120 (%)**	**15–30 days N = 272 (%)**	**1–3 months N = 210 (%)**	**4–6 months N = 35 (%)**	**More than 6 months N = 40 (%)**	
Complete recovery	8 (66.67)	83 (69.17)	175 (64.34)	112 (53.33)	14 (40.00)	13 (32.50)	P <0.001
Improvement	3 (25.00)	25 (20.83)	63 (23.16)	63 (30.00)	8 (22.86)	17 (42.50)	
No improvement	1 (8.33)	12 (10.00)	34 (12.50)	35 (16.67)	13 (37.14)	10 (25)	
	Bone graft donor site						
	Iliac bone N = 120 (%)		**Skull N = 141 (%)**		**Anterior wall of maxillary sinus N = 328 (%)**		
Complete recovery	67 (55.83)		50 (35.46)		236 (71.95)		P <0.001

Table 2. Cont.

Improvement	28 (23.33)		51 (36.17)		67 (20.43)		
No improvement	25 (20.83)		40 (28.37)		25 (7.62)		
	Posttraumatic diplopia						
	No diplopia N = 67 (%)	**Type 1 N = 121 (%)**	**Type 2 N = 119 (%)**	**Type 3 N = 38 (%)**	**Type 4 N = 46 (%)**	**Type 5 N = 139 (%)**	
Complete recovery	54 (80.60)	94 (77.69)	70 (58.82)	17 (44.74)	27 (58.70)	59 (42.45)	P <0.001
Improvement	9 (13.43)	15 (12.40)	27 (22.69)	19 (50.00)	11 (23.91)	47 (33.81)	
No improvement	4 (5.97)	12 (9.92)	22 (18.49)	2 (5.26)	8 (17.39)	33 (23.74)	

The result of enophthalmos treatment was evaluated. A highly statistically significant relationship was found between the size of the enophthalmos after injury and the outcome of the treatment. The analysis showed that the lower the enophthalmos, the better the prognosis. The results are shown in Table 3.

Table 3. The relationship between posttraumatic enpohthalmos and result of treatment.

Posttraumatic enophthalmos [mm]	**Result of treatment**			**p**
	Complete recovery (N = 416) — A	**Improvement (N = 187) — B**	**No improvement (N = 106) — C**	
average ± SD	1.23 ± 1.02	1.76 ± 1.23	1.69 ± 1.57	P <0.001
median	1	2	1	
quartiles	0–2	1–3	1–2	B,C >A

The influence of the type of surgical procedure on the effect of enophthalmos treatment was also assessed. In the group of patients in which the bone reconstruction was performed, the enophthalmos after injury was higher than in the group in which the release of tissues was used. The decrease of enophthalmos was significantly higher in the group in which bone graft reconstruction was performed. Results are presented in Table 4.

Table 4. The relationship between surgical procedure and the decrease of enophthalmos.

Decrease of enophthalmos [mm]	Type of surgical procedure		p
	Release of tissue (N = 100)	Bone graft reconstruction (N = 589)	
average ± SD	0.68 ± 0.68	1.01 ± 0.99	P = 0.003
median	1	1	
quartiles	0–1	0–2	

Another parameter assessed was the influence of the donor site of autogenous bone graft on the outcome of the treatment. A statistically significant relationship was found. The greatest reduction of enophthalmos was achieved in the group of patients whose orbital floor was reconstructed with an anterior maxillary sinus wall transplant. The results are shown in Table 2.

The results of treatment were also assessed depending on the type of diplopia, the best prognosis is related to double vision in up gaze (type 1) — recovery was obtained in 77.69% of patients, the lowest percentage of recovery occurred in the group of patients with diplopia in the whole scope of view (type 5) — 42.45%. The results are presented in Table 2.

Discussion

Enophthalmos is one of the three basic symptoms of an orbital floor fracture, the so-called triad of symptoms is complemented by double vision and sensory impairment in the area innervated by the infraorbital nerve [2, 3]. Enophthalmos is the result of a change in the ratio of the orbital volume to its content and, in addition to aesthetic disorders, can lead to functional disorders in the form of double vision, eyelid dysfunction and the disorder of distribution of tears on the surface of the eye and their passage to the nasal cavity [1]. The goal of treatment in the orbital blow out frature is to restore full passive eye movement and single vision, by restoring the correct position of the eye in the orbit.

Various methods of orbital reconstruction have been described to improve the position and decrease enophthalmos of the eyeball [20–23]. The choice of the method of reconstruction depends on the type and extent of fracture, enophthalmos, condition of the donor site of the bone graft, patient's age, surgeon's experience and preferences. Literature describes many types of materials that can be used to reconstruct the orbital floor [24–26]. Methods with the use of autogenic and foreign materials can de distinguished. Among foreign materials, resorbable and non-resorbable materials (silicone, polyethylene, titanium implants) are commonly used, these implants are easily available, in some cases allow to achieve good treatment results, their use allows to avoid traumatisation of the bone graft donor site [23]. These materials have also disadvantages, such as the possibility of infection, displacement in the orbit or even protrusion from the orbit. According to Kang [20], resorbable implants should maintain primary mechanical strength for 1 to 2 years after surgery to properly support the eyeball and allow the formation of a tissue scar that will be able to support the eyeball after resorption of the material. There are opinions that resorbable materials tend to bend and change their position, especially in the case of large bone defects, in addition, these materials are usually thin, they do not always provide adequate reconstruction of the shape of the bone defect and thus lead to an insufficient reduction of the enophthalmos in prolonged observation [26]. In the case of resorbable materials, the tissue scar may not be strong enough to permanently maintain the correct position of the eyeball, resulting in a recurrence of the enophthalmos [21]. The main advantage of resorbable materials is the fact, that they leave no foreign body in reconstructed orbit.

Nowadays reconstruction with the use of CT image mirroring of the healthy orbit becomes more common. The use of CAD/CAM technologies becomes more popular in everyday work. Possibility of designing patients' specific implants or printing individual templates for harvesting bone grafts gives surgeons a great tool to improve the outcome of treatment. Thanks to computer assisted surgery, procedures become less time consuming, use of patients' customized implants or templates allows more accurate reconstructions of bony damage and restore correct position of the eyeball in the orbit to decrease the level of posttraumatic enophthalmos.

Various methods of orbital floor reconstruction with the use of autogenous materials have been described, among them: bone transplantation, cartilage transplantation (e.g. harvested from nasal septum, cartilaginous part of the ribs), fat tissue grafting into the apex of the orbit [23]. The main advantage of autologous bone graft is that it may be harvested from many donor sites, is easily available, resorption rate is lower than cartilage and is strong enough to give a proper support for the eyeball and periocular tissue. According to Choi [21], bone graft from the iliac bone allows to collect a large amount of bone material for orbital reconstruction and reduction of enophthalmos, however due to its uneven and rough surface, it may be more difficult to fit bone defect compared to a transplant e.g. from parietal bone. Necessity of creating another wound, morbidity of the donor site, time consumed for graft harvesting, sometimes with involvement of second surgical team are the dissadvantages of bone grafts. In the authors' opinion, autogenous bone transplantation is the method of choice in the case of orbital floor fracture with bone defect. In our Department bone grafts are successfully used to reconstruct the orbital floor and restore proper position of the eyeball. The most commonly used is the bone graft from the anterior wall of the maxillary sinus, it is easy to process and thanks to its shape can be easily adapted to the bone defect, harvesting procedure is simple and quick. There are no significant complications at the donor or recipient site, it provides good and stable support for the eyeball. The authors also successfully use bone grafts from the iliac bone or parietal bone, especially in cases of more extensive defects or greater enophthalmos. The obtained results of treatment speak for the effectiveness of this method. While the graft is harvested from the skull, there is a risk of exposure of the dura mater, in our group of patients these were single cases. The use of autogenic material, unlike implants, does not entail additional costs.

In the literature one might find opinions [14] that retroseptal transconjunctival approach can lead to entropion, in our group of patients entropion occurred sporadically and completely disappeared after massage up to 2 months after the surgery. In contrary the use of subcilliar incision resulted more often in ectropion, which also perished after massage of the eyelid. The lack of visible scars, good insight into the operating field, and the lack of significant and permanent complications indicate that retroseptal transconjunctival approach can be regarded as an access of choice to orbital floor fractures.

There is an ongoing discussion about the optimal time from injury to surgical treatment. There are supporters of conservative treatment, arguing that even in 85% of patients treated conservatively, diplopia decreases or disappears over time [11, 12]. Among supporters of surgical treatment the opinion prevails that the earlier the surgical procedure is performed, the better the prognosis [9, 16, 17]. Given the clinical image immediately after the injury, i.e. swelling of soft tissues, often with closure of the eyelid fissure, presence of ocular hematoma, very often immediately after the injury it is not possible to carry out an accurate clinical examination, determining the indications for surgical intervention. In view of the above, it seems rational to postpone the decision for surgical intervention for several days after the injury, until the swelling of soft tissue subside. After this time, accurate assessment of double vision and enophthalmos can be performed, and transconjunctival access procedure can be safely introduced. According to some authors, surgical treatment performed within several days after injury can prevent permanent changes of the soft tissues of the orbit as a result of ischemia and fibrosis [16]. In 2002 Burnstine [27] after analyzing the literature, recommended surgical treatment up to 14 days after the accident. In our group of patients, the best treatment results were obtained in patients operated on up to 30 days after the injury, which is consistent with results of other authors, it seems that this time is the golden standard for typical orbital fractures, without oculo-cardiac reflex, retrobulbar hemoatoma with optic nerve compression or penetrating wounds in the orbital area.

Nevertheless, in the authors' opinion, the decision for surgical treatment depends on many factors, such as the clinical image, CT imaging results, the presence of systemic diseases, the presence of intraocular injuries, therefore each case requires an individual approach to determine the best treatment without dogmatic adherence to the schemes.

In our group of patients cases requiring urgent intervention (oculo-cardiac reflex in the orbital fracture in children) were not reported. The diagnostic path of the patient from the injury to the treatment unit is not without significance, in our group of patients we can notice a clear reduction in the time of patients' report after fracture of the orbital floor for treatment in our Department over the last 40 years.

Conclusions

The size of post-traumatic enophthalmos affects the result of the treatment. The location of the orbital floor fracture affects the enophthalmos, in our group of patients the largest incidence occurred in the fracture located in the orbital floor and medial wall. Patients with surgical treatment up to 14 days after the injury achieved better results than those postponed. Although number of authors advocating for the use of synthetic or titanium implants in the reconstruction of the orbit is growing, our 40 years experience shows that bone grafts are reliable and efficient way of reconstructing defects in orbital fractures.

Authors' contributions

Equal contribution of all authors.

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Conflict of interest

None declared.

Ethics

The study was conducted in accordance with the Declaration of Helsinki and was approved by Institutional Ethical Board (opinion number 1072.6120.64.2020).

References

1. *Oh S.A., Aum J.H.*: Change of the orbital volume ratio in pure blow-out fractures depending on fracture location. J Craniofac Surg. 2013; 24: 1083–1087.
2. *Bartoli D., Fadda M.T.*: Retrospective analysis of 301 patients with orbital floor fracture. J Craniomaxillofac Surg. 2015; 43: 244–247.
3. *Mehta N., Butala P.*: The imaging of maxillofacial trauma and its pertinence to surgical intervention. Radiol Clin North Am. 2012; 50: 43–57.

4. *Scolozzi P., Jacquier P.*: Can clinical findings predict orbital fractures and treatment decisions in patients with orbital trauma? Derivation of a simple clinical model. J Craniofac Surg. 2017; 28: 661–667.
5. *Dubois L., Steenen S.A.*: Controversies in orbital reconstruction — II. Timing of post-traumatic orbital reconstruction: a systematic review. Int J Oral Maxillofac Surg. 2015; 44: 433–440.
6. *Kontio R., Lindqvist C.*: Management of orbital fractures. Oral Maxillofac Surg Clin North Am. 2009; 21: 209–220.
7. *Catherine Z., Courvoisier D.S.*: Is the pure and impure distinction of orbital fractures clinically relevant with respect to ocular and periocular injuries? A retrospective study of 473 patients. J Craniomaxillofac Surg. 2019; 47: 1935–1942.
8. *Converse J.M., Smith B.*: Orbital blowout fractures: a ten-year survey. Plast Reconstr Surg. 1967; 39: 20–36.
9. *Matteini C., Renzi G.*: Surgical timing in orbital fracture treatment: experience with 108 consecutive cases. J Craniofac Surg. 2004; 15: 145–150.
10. *Chukwulebe S., Hogrefe C.*: The Diagnosis and Management of Facial Bone Fractures. Emerg Med Clin North Am. 2019; 37: 137–151.
11. *Emery J.M., Noorden G.K.*: Orbital floor fractures: Long-term follow-up of cases with and without surgical repair. Trans Am Acad Ophthalmol Otolaryngol. 1971; 75: 802–812.
12. *Young S.M., Kim Y.D.*: Conservatively Treated Orbital Blowout Fractures: Spontaneous Radiologic Improvement. Ophthalmology. 2018; 125: 938–944.
13. *Putterman A.M., Stevens T.*: Nonsurgical management of blow-out fractures of the orbital floor. Am J Ophthalmol. 1974; 77: 232–239.
14. *Farwell D.G., Strong E.B.*: Endoscopic Repair of Orbital Floor Fractures. Otolaryngol Clin N Am 2007; 40: 319–328.
15. *Jordan D.R., Allen L.H.*: Intervention within days for some orbital floor fractures: the white-eyed blowout. Ophthal Plast Reconstr Surg. 1998; 14: 379–390.
16. *Jazayeri H.E., Khavanin N.*: Does Early Repair of Orbital Fractures Result in Superior Patient Outcomes? A Systematic Review and Meta-Analysis. J Oral Maxillofac Surg. 2020; 78: e15–e16.
17. *Yew C.C., Shaari R.*: White-eyed blowout fracture: Diagnostic pitfalls and review of literature. Injury. 2015; 46: 1856–1859.
18. *Uzelac A., Gean A.D.*: Orbital and facial fractures. Neuroimaging Clin N Am. 2014; 24: 407–424.
19. *Parbhu K.C., Galler K.E.*: Underestimation of soft tissue entrapment by computed tomography in orbital floor fractures in the pediatric population. Ophthalmology. 2008; 115: 1620–1625.
20. *Kang D.*: Orbital wall restoring surgery with primary orbital wall fragments in blowout fracture. Arch Craniofac Surg. 2019; 20: 347–353.
21. *Choi J.S., Oh S.Y., Shim H.S.*: Correction of post-traumatic enophthalmos with anatomical absorbable implant and iliac bone graft. Arch Craniofac Surg. 2019; 20: 361–369.
22. *Wolff J., Sándor G.K.*: Late reconstruction of orbital and naso-orbital deformities. Oral Maxillofac Surg Clin North Am. 2013; 25: 683–695.
23. *Dubois L., Steenen S.A.*: Controversies in orbital reconstruction—I. Defect-driven orbital reconstruction: a systematic review. Int J Oral Maxillofac Surg. 2015; 44: 308–315.
24. *Palmieri C.F. Jr, Ghali G.E.*: Late correction of orbital deformities. Oral Maxillofac Surg Clin North Am. 2012; 24: 649–663.
25. *Liss J., Stefko T.*: Orbital Surgery: State of the Art. Oral Maxillofacial Surg Clin N Am. 2010; 22: 59–71.
26. *Baino F., Potestio I.*: Orbital implants: State-of-the-art review with emphasis on biomaterials and recent advances. Mater Sci Eng C Mater Biol Appl. 2016; 69: 1410–1428.
27. *Burnstine M.A.*: Clinical recommendations for repair of isolated orbital floor fractures: an evidence-based analysis. Ophthalmology. 2002; 109: 1207–1210.