

## Characteristics of eye movements in the anti-terrorist operation area's residents with potential posttraumatic stress disorder

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***Purpose** of the present paper was to study the characteristics of eye movements in individuals residing in the anti-terrorist operation area and to compare those with eye movements in healthy individuals.*

***Material and Methods.** The study involved patients undergoing outpatient examination: Study group, 120 individuals residing in the ATO zone; Control group, 80 individuals residing in Odessa and Odessa Region. The patients were selected for additional examination at presentation by doctors in outpatient department if the patient's behavior was a matter of concern for a doctor. The patients were examined accommodation, convergence, conjugate eye movements in 9 eye positions, and horizontal and vertical saccades.*

***Results.** The individuals residing in the ATO zone had conjugate eye movement disorders (44.8%), decreased mean values of accommodation (39.8%) and convergence (45%), and impaired visual acuity. Among saccade disorders, hypermetric saccades were most frequently recorded: 25% vs.6.2% in Study and Control groups, respectively,  $p = 0.0035$ .*

***Conclusion.** The individuals, residing in the ATO area had impaired visual function (visual acuity, convergence, and accommodation) comparing to those residing in Odessa and Odessa region. Significant disorders revealed in vergence and conjugate eye movements, accommodation, and saccades in Study group can be used as objective signs of PTSD.*

### Background

Studying, diagnosing, and correcting negative psychological consequences in individuals exposed to various traumatic events (accidents, disasters, war, and violence) are among the most pressing issues. The world statistics indicate that every fifth combatant, though not having been injured physically, suffers from nervous and mental disorders while this is true for every third among the wounded and disabled [1]. In 1980, M. Gorovits, a scientist, defined posttraumatic stress disorder (PTSD) as a separate nosologic mental disorder and, in the same year, the American Psychiatric Association published Diagnostic and Statistical Manual (DSM)-III where PTSD became an official psychiatric diagnosis [2]. PTSD is an abnormal variant of reliving the traumatic experience when a person focuses on it too much instead of feeling and recovering from trauma naturally [4].

The known techniques for PTSD diagnostics are semi-quantitative or qualitative and mainly presented as questionnaires or diagnostic interviews [2, 3, 5]. Being not completely objective, the performance of these techniques

depends on both examiner's expertise and examinee's willingness to 'co-operate'. A biomarker is defined as a process, substance, or a structure which can be measured in the body or its products in order to assess disease risk, to diagnose a disease, to assess disease progression and prognosis, to predict treatment outcome, and to evaluate treatment efficacy [15].

PTSD biomarkers are not being studied extensively today due to difficulties in PTSD diagnostics as well as difficulties in collecting diagnostic characteristics, upon which individuals are classified in accordance with DSM-V [16]. There are several reviews, dated 2013 and 2014, which indicate biological markers of PTSD. Although those papers have not specified ophthalmological markers of PTSD, there are single papers on this issue [14, 16].

Based on the experience of domestic and foreign scientists, the state of accommodation, pupils, eye

movements, saccades, in particular, and vergence and conjugate eye movements, varies in response to external and internal processes. Changes in the character of eye movements are noted in various diseases and psychosomatic conditions. Eye movement study makes it possible to determine cognitive functions as well. State anxiety refers to how a person is feeling at the moment and is characterized by subjective emotions including uneasiness, worry, and nervousness which are perceived when confronted with specific situations. However, these conditions are diagnosed according to the data from psychological tests and questionnaires and there are no objective criteria for PTSD.

Thus, the purpose of the present paper was to study the characteristics of eye movements in individuals residing in anti-terrorist operation area and compare those with eye movements in healthy individuals.

### Material and Methods

Eye Diseases and Tissue Therapy of NAMS of Ukraine. The number of outpatient visits of individuals residing in anti-terrorist operation (ATO) area was 2 641 in 2014, 4 019 in 2015, 4 263 in 2016, and 4 305 in 2017. Of those undergoing outpatient examination, 120 individuals were referred to additional examination to determine diagnostic criteria (biological markers) of PTSD; these patients comprised Study group. The patients were selected for additional examination at presentation by doctors in outpatient department if the patient's behavior was a matter of concern for a doctor (anxiety, depression, frustration, disconnection, fear, hypochondria, nervousness, aggression, and eyes to tear). Control Group consisted of 80 individuals of the comparable age ( $32 \pm 5.7$ ), residing in Odessa and Odessa region. The informed consent was obtained from each patient participating in the study.

Alongside with visual function tests, including visual acuity testing, refractometry, and ophthalmoscopy, the patients were examined accommodation (reserve of accommodation, RA), convergence (near point of convergence), conjugate eye movements in 9 eye positions, and the presence/absence of disorders in each eye position was registered (yes/no). Horizontal and vertical saccades were tested using a method in which a patient was shown two equidistant objects at 30 degrees on both sides of the medial [17]. Thus, hypometria or hypermetria (deviation from the fixation point); a stopwatch counter measured the velocity of saccades as slow or fast, more than 1 s or less than 1 s, respectively.

The data obtained were processed using STATISTICA 8 software package. The mean values of visual functions were assessed; a chi-squared test was used to compare eye movements in Study and Control groups.

### Results

Visual function data in Study and Control groups are given in Table 1.

Data analysis showed that ATO area residents had decreased visual acuity and reserve of accommodation and weakened convergence compared to those residing in Odessa and Odessa region while refraction did not differ in both groups ( $p=0.29$ ). Frequency analysis revealed disorders in Study group patients: vergence eye movement disorders (45%), accommodation disorders (39.8%), and visual acuity loss (75.6%).

Also, there were significant alterations in conjugate eye movements in 52 persons of Study group, comprising 44.8% of cases vs. 22.4% of cases in Control group (Table 2). Among saccade disorders, they were more frequently noted in hypermetric saccades, in 25% of Study group patients compared to 6.2% in control ( $p=0.0035$ ) (Table 1, 2).

### Discussion

Eye movement tests have been found to be a good tool for understanding to what extent motor function is under central control both in health and disease. Brain structures, responsible for visual system function, eye movements, and mental and emotional state of an individual, are anatomically connected [9]. In the literature, there are works on studying eye movements, saccades, in particular, in patients with mental disorders (schizophrenia, depression, bipolar disorders) [6, 10, 11, 12]. The authors have recorded serious changes in eye movements. Disorders in accommodation, version, and vergence occurred in 50% of patients after a head injury; strabismus was noted in 25% of cases [7, 8, 13].

44% of the patients in Study group are believed to have PTSD if compared to the non-residents of the ATO area who had the mentioned disorders less frequently (22.8%). The data obtained give evidence of a need for further studies on this particular patient cohort in order to reveal the major mechanisms of the PTSD development. Nowadays, there are no such papers in the literature.

To conclude, firstly, the individuals, residing in the ATO area had impaired visual function (visual acuity, convergence, and accommodation) comparing to those residing in Odessa and Odessa region.

Secondly, significant disorders were revealed in vergence and conjugate eye movements (45% and 44.8%, respectively), accommodation (39.8%), and saccades (33.3%) in Study group, which can be used as objective signs of PTSD.

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**Table 1.** Visual function in Study and Control Groups (M ± SD)

Parameter	Study group n=120 (240 eyes)	Control group n=80 (160 eyes)	P
Visual acuity	0.7±0.3	0.85±0.25	0.0001
Refraction, D	1.5±2.5	1.25±2.0	0.29
Near point of convergence, cm	8.5±2.0	6.0±0.5	0.0001
RA, D	1.2± 0.6	1.6±0.3	0.0001

**Table 2.** The incidence of conjugate eye movement disorders in Study and Control Groups (%)

Parameter	Study group n=120	Control group n=80	P
<i>Eye position -</i>	52 (44,8%)	18 (22.4%)	
primary	12 (11,6%)	4 (5%)	0.035
secondary	20 (16,6%)	2 (2.5%)	0.004
tertiary	20 (16,6%)	2 (2.5%)	0.004
<i>saccades</i>	40 (33,%)	5 (6.2%)	0.0002
hypometric saccades	10 (8,3%)	-	0.008
hypermetric saccades	30 (25%)	5 (6.2%)	0.0035
slow saccades	15 (12,5%)	-	0.001
fast saccades	25 (20,8 %)	-	0.0001