

# Malingering or simulation in ophthalmology – visual acuity

*Ali Ihsan Incesu<sup>1</sup>, Güngör Sobacı<sup>2</sup>*

<sup>1</sup>S.B Konya Eğitim-Araştırma Hastanesi Göz Kliniği, Konya, Turkey

<sup>2</sup>GATA Göz Kliniği, Ankara, Turkey

**Correspondence to:** Ali Ihsan Incesu. S.B Konya Eğitim-Araştırma Hastanesi Göz Kliniği, Konya, Turkey. aiincesu@yahoo.com

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## Abstract

• Simulation can be defined as malingering, or sometimes functional visual loss (FVL). It manifests as either simulating an ophthalmic disease (positive simulation), or denial of ophthalmic disease (negative simulation). Conscious behavior and compensation or indemnity claims are prominent features of simulation. Since some authors suggest that this is a manifestation of underlying psychopathology, even conversion is included in this context. In today's world, every ophthalmologist can face with simulation of ophthalmic disease or disorder. In case of simulation suspect, the physician's responsibility is to prove the simulation considering the disease/disorder first, and simulation as an exclusion. In simulation examinations, the physician should be firm and smart to select appropriate test (s) to convince not only the subject, but also the judge in case of indemnity or compensation trials. Almost all ophthalmic sensory and motor functions including visual acuity, visual field, color vision and night vision can be the subject of simulation. Examiner must be skillful in selecting the most appropriate test. Apart from those in the literature, we included all kinds of simulation in ophthalmology. In addition, simulation examination techniques, such as, use of OCT (optical coherence tomography), frequency doubling perimetry (FDP), and modified polarization tests were also included. In this review, we made a thorough literature search, and added our experiences to give the readers up-to-date information on malingering or simulation in ophthalmology.

• **KEYWORDS:** malingering; simulation; conversion; hysteria

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## INTRODUCTION

Simulation can be defined as intentionally counterfeiting a disease with benefit instinct like in case of malingering, or misattributing his/her symptoms to another irrelevant clinical entity like in case of exaggerating. If the subject believes that he/she is really ill, then it is called 'conversion reaction' or 'hysteria'. In case of conversion, subject really lives his/her symptoms and can't control or even know that they are psychogenic in origin [1-5]. In all cases of real simulation or negative simulation there is only one instinct: Benefit may be monetary or nonmonetary. It may be sometimes escape of military service or work, get reduction of court penalty, get compensation from social security agencies or insurance companies, get unnecessary free medicines or medical equipments. The aim is rarely attraction of sympathy, help of family or social environment. Determining real incidence or prevalence of simulation is difficult, because majority of cases is are not reported. Villegas and Ilsen reported that 10% -30% of outpatient population of neurology clinics has no organic pathology and 1/3 to half of population applying to primary and secondary care settings have no pathological lesions [1]. In a study of 17 cases of idiopathic intracranial hypertension Ney *et al* [2] reported that all patients imitated functional visual acuity and field loss and 88 % also presents with significant psychiatric, psychosocial or other medical coexistent pathologies. In some research papers, 1-7% of all eye clinics outpatient population is reported as simulation [3,5]. Some of these percentages are reported from a tertiary university or military reference clinics; therefore, real incidence or prevalence has not yet been determined. Most strikingly, 13% of all psychiatry outpatient cases, 45% of social security compensations or legal claims are reported as simulation [1,4]. An article Gandhi and Amula reported that 59 billion USD dollars were paid to simulation cases by insurance companies in 1995 in USA [5]. Villegas and Ilsen reported that 5-12% of patients present with visual loss to a neuroophthalmologist are diagnosed as functional visual loss (FVL) [1]. In clinical examination, if the subject expects a monetary benefit or if complaints and examination findings do not fit into a diagnosis or not coinciding to each other,

then clinician must suspect that it would be a simulation case [3,4,6-8].

Sobaci [3] and Thompson *et al* [9] classified those problematic cases into three classes. The first one is intentional simulation case, the second, hysterics that are innocent but open to autosuggestions, and the third is the subjects exaggerating symptoms. Understanding the psychological nature of visual loss and subjective findings may be relatively easy. But looking for counter evidences like visual acuity tests, visual field analyses, electrophysiological tests etc. proving simulation is a difficult task. In these cases all subjective and objective tests should be applied. During subjective tests like visual acuity, contrast sensitivity and visual field tests sincere cooperation of subject is needed. But if the subject is uncooperative and says that he/she does not sees at all or even he/she tries to fake ophthalmologist overtly, it is hard to interpret the examinations. In these cases the examinations and tests are widely expanded.

In this situation, techniques that examine light sensation (visually evoked potentials (VEP), electronystagmography (ENG), electroretinography (ERG) etc), visual acuity (optokinetic nystagmus, pattern VEP etc) and probes retinal pathology and its burden on vision (optical coherence tomography (OCT), ERG, fluorescein angiography (FA) or indocyanin angiography ICG etc) are needed. Complex and diversified tests and equipments make simulation more difficult and risky for the subject. It is an necessity for clinicians to categorise the case as a positive simulation or negative simulation. Simulation cases are guilty and psychopathic but brave characters and they are guided only by benefit instinct [3,7,10]. To undercover the simulation requires a precautions, fast, kind, skilled and discreet ophthalmologist and a thorough examination.

Another aim of this paper is to remind ophthalmologists FVL cases are not always guided by events such as early retirement, immunity to military service, salary of disabled, escape from court penalty like benefits; sometimes it would be a simple neurosis or conversion case. In these cases without complex tests and examinations, it's possible to make a definite diagnosis with relatively simple and easy simulation examination techniques. Simulation, in general, is met in military recruitment or early retirement or disabled salary, work or traffic accidents or criminal fights examinations. In these cases, subject sometimes comes with simple changes or very little pathology in palpebrae, conjunctiva, cornea or pupils and attempts to intentional exaggeration or simulation. It is advisable that ophthalmologist should be experienced in simulation examinations and has sufficient equipment. If no alternative exists subject should be hospitalized inventing an irrelevant

and innocent diagnosis and followed closely without the subject's awareness.

## CONVERSION

Conversion term comprises definitions of psychogenic disease or 'hysteria. Sometimes real simulation or misdiagnosed conversion cases would be attributed to hysteria. On the other hand simultaneously functional visual loss and organic visual loss occur in the same case rarely and those cases are called "functional overlay" [11]. Functional overlay incidence is reported as 16.7% or even 25-53% [6,12,13]. An conversion or hysteria, subject doesn't imitate a visual pathology intentionally. He/she does believe sincerely that he/she is ill and doesn't want to cheat ophthalmologist. After a psychic shock he/she as admitted to emergency clinic, in general, with the diagnosis of sudden visual loss, sometimes with visual field loss, diplopia, eye-pain, asthenia, dyschromatopsia, blepharospasm or ptosis [1]. Then he/she is transferred to ophthalmology clinic from emergency. Subject is generally a young person and sincerely cooperates in examination. He/she is very calm, even surprisingly indifferent against his/her grave complaints [1]. After examination, when he/she is told he/she is healthy and has no problem in his/her eyes, he/she admits diagnosis easily and calmly thanks the ophthalmologist. He/she and his/her relatives never oppose ophthalmologist [1]. Ophthalmologist ought to talk to subject softly, saying he/she is 'healthy, his/her eyes are normal, and symptoms would disappear in few days. If the subject is accompanied with a clever and cooperative 'adult, he is also informed alone about the situation that the symptoms are psychological in origin and subject perhaps will need support of his/her family and friends; the subject may need professional psychiatric help if the symptoms do not subside. In conversion, almost all sensorial (afferent) symptoms are seen. Motor symptoms are very rare [14]. In some conversion patients thalamic hypoactivity is reported in PET scan [1]. This is in accord with functional overlay cases. Primarily visual acuity, then sometimes visual field loss complaints are reported in conversion cases [1,11,16]. Kathol *et al* [11] investigated 54 conversion cases collected-over a period of 24 years and reported that the most frequent complaint was visual acuity loss. Then, isolated visual field loss and combined visual acuity and field loss are reported respectively. Examination performed years later reported that visual acuity improved in 51 to 78% of cases. Only 22% of cases reported disabling visual acuity loss years later. Again, visual prognosis is good, especially in young people [1,11,16]. Visual acuity improves in a uncertain time span total or partially [1]. Visual acuity is generally between 1/10 to 5/10 range. When visual field loss is reported, it's gross concentric narrowing (tubular

vision) <sup>[11,17]</sup>. In these cases, generally psychiatric help is not necessary at the time of diagnosis. Suggestion, patience and reassurance help ophthalmologist to relieve conversion case at first hand. Sometimes organic brain syndromes mimic conversion syndrome. Eliminating organic brain syndrome requires looking for lateralization of findings, motor neurologic deficits and sometimes neurology consultation <sup>[15]</sup>.

### **SIMULATION OR MALINGERING**

Malingerer does everything to cheat ophthalmologist. In general he/she is transferred from court, local military draft office, health insurance or other governmental organizations. He/she is very attentive to doctor's attitudes to understand the nature of examinations and hides his/her simulation instinct. Those transfer and attitude differences are even sufficient to distinguish simulation from conversion. They seriously challenge if told he/she is simulating, become furious and may even assault the physician <sup>[14]</sup>. They get angry especially tests take long time <sup>[4]</sup>. Although at first, it's logical for ophthalmologist to think cautiously that subject would be really ill.

Some of the important points to be remembered in doubtful cases are:

- (1) Never give impression that you suspect simulation. This leads the subject to be much more attentive and cautious. Perform examination calm, fast and as if a daily, routine work.
- (2) Do write all complaints and manifestations including contradictory ones with subject's own words with all symptoms, beginning time, mood when entering the room, type of sitting, psychological profile and reactions. Those records would be necessary in case of future judicial investigations.
- (3) Do a serious, detailed and fast examination; write the tests and results with details. Always first obtain bilateral best corrected visual acuity with objective and subjective tests <sup>[3,18]</sup>. Routine refraction examination may not be sufficient and perform several techniques of refraction examination.
- (4) Do not let any friend or relative of subject stay in examination room. It's crucial.
- (5) Do perform tests and examinations you know well in a fast and perfect way without letting subject observe, think and adapt to the test <sup>[19]</sup>. Do remember that subject would be a clever, foxy, attentive and probably a simulating case.
- (6) Do have at least one attentive professional person, a doctor if possible, as an eye witness with you during examination as a precaution against future judicial investigations against you or your institutions <sup>[13]</sup>.
- (7) Management of simulation or malingering cases needs understanding and positive approach. Confrontation never

helps to examiner <sup>[19]</sup>. In contrast, it may cause future administrative or even legal problems.

Schutz and Mavrakanas in their study of 172 cases of malingering, exaggeration or misattributing reported that the most frequent exaggerated or misinterpreted complaints are 74% visual acuity loss, 28% discomfort feeling, 19% visual field loss, 17% headache and 13% photophobia. Visual acuity and field loss, discomfort, headache and epiphora are mostly simulated symptoms. Medical records of cases about past medical history gave useful information in 163 of 172 cases in diagnosis of functional loss <sup>[20]</sup>. Beside of conversion and malingering, some cases who inflicted temporary or longstanding injuries on their eyes are reported. Those cases are called Munchausen Syndrome and out of the scope of this paper. It's a kind of self injury (passive aggression) and met generally in young people experiencing psychological problems with their family, school and work <sup>[21]</sup>.

### **SIMULATION OF VISUAL ACUITY LOSS**

**Simulation of Bilateral Amaurosis** Fifty to eighty percent of functional loss complaints are bilateral <sup>[5]</sup>. But simulation of bilateral amaurosis without getting caught is difficult. Therefore, it is met in generally in conversion cases rather than malingerer <sup>[22]</sup>. As in all functional loss examinations, the first thing to do is visual acuity examination. If the subject enters and walks around the examination room easily without any hesitation it's an indication for overt simulation. Below are the most useful clinical tests for bilateral amaurosis simulation examination.

#### **Subjective Tests for Bilateral Amaurosis**

**Eye contact** Eye contact may be an important indicator discriminating simulation from organic disease. If a subject claims that he/she is totally bilateral blind and gets caught with eye contact with examiners, it is definitely a case of simulation <sup>[1]</sup>.

**Room with obstacles test** Room with obstacles test could be performed as a first choice <sup>[3,4,23]</sup>. Wastebasket, chairs etc are placed in the middle of examination room before subject's entry. In this environment, it is noticeable that simulating subject plays a interesting, artificial and constrained role of amaurosis. A real blind walks head up, but a simulating person head down and upset with fear of getting caught, simulating person sometimes wears dark glasses and holds a white blind walk cane. Wearing dark sunglasses all the time is a sign of simulation <sup>[24]</sup>. Simulators hit obstacles in the room intentionally and hurt themselves, walk inattentively, even refuses walk in the room without the help of others <sup>[25,26]</sup>. Real blind people are calm, walk in the room calmly and attentively examining their front, sensing the obstacles and walk peripheral. Conversion cases can easily walk around of obstacles without hitting <sup>[3,4,22,23]</sup>.

**Look at hand** (Schmidt-Rimpler) test<sup>[3,4]</sup>. Subject is told to look at his/her hand. Real blind extends his/her hand, looks at it and says "I know where my hand is but can not see it". Simulating subject extends his/her hand to and fro but does not look at it and says shortcut "I can not see it"<sup>[4]</sup>. Very rare cases of corporeal agnosia can not perform this test too.

**Signature test**<sup>[4]</sup> When the subject is given a pen and paper and asked to sign, simulating case scribbles. Real blind easily and regularly signs multiple times<sup>[3,4]</sup>.

**Menace test** When subject sitting in his/her chair comfortably, examiner passes his/her hand close in front of subject's eye suddenly. If the subject closes his eyes, it means that he/she sees. Even if simulator do exercises before to hold himself during the test he/she can't stop tachycardia occurring during the test<sup>[3,4,17]</sup>. Again examiner can suddenly make a hand movement with shameful and sexual meanings towards the subject, if the subject laughs or smiles it means that he/she could see it<sup>[3]</sup>.

**Mirror test** It's a rarely applied, but useful test in cases of bilateral amaurosis or deep amblyopia<sup>[3-5]</sup>. A mobile full size mirror is placed in front of the subject, and he/she is told to look at it both eyes open. When moving the mirror slightly to and fro examiner looks at the subject's eyes secretly. If the subject looks at himself in the mirror, it means he/she can see. In unilateral amblyopia, sound eye is closed and subject is observed secretly while he/she looks into the mirror.

**Finger to nose test** Finger to nose test has the same physiological mechanism and diagnostic value of finger to finger test below<sup>[1]</sup>. Subject is asked to touch his/her index finger to nose when eyes are closed. Simulator, again plays a role that he/she tries but can't do it.

**Index finger or proprioception test**<sup>[4,5,14]</sup> Subject is told to hold his/her arms up in shoulders and hands open to sides when his/her eyes shut. He/she is told to put his/her index fingers end-to-end in the front. Real blind can do that due to deep lemniscal sensitivity. Malingerer plays role he/she tries but can't do it. Only corporeal agnosia cases can't perform this test<sup>[5]</sup>.

#### **Objective Tests for Bilateral Amaurosis**

**Optokinetic nystagmus test** While the subject is looking at Barany's cylinder, if nystagmus appears, it means he/she sees it<sup>[3-5]</sup>. It means at least 1/20 or 1/10 Snellen line vision<sup>[5,27]</sup>. This test needs strict lighting conditions and standard Barany's cylinder. It's useful to diagnose in conversion and malingering<sup>[5]</sup>.

**Psychogalvanic test** Subject sits in front of a slit lamp and suddenly a bright light reflected on his so called weak eye. If he/she blinks or watering occurs, it means that he/she sees the light<sup>[3,4]</sup>. Light sweating and vasomotor stimulation also could be observed and is interpreted again as simulation.

**Pupillary examination** Pupillary examination is another useful discrimination test. Presence of bilateral direct and indirect light reflexes shows that inferior visual pathways are intact, and at least light perception and projection is present. But, even in the presence of light reflexes, cortical or subcortical blindness can't be ruled out<sup>[3]</sup>. On the other hand in cases of functional loss, secondary myosis or mydriasis might be observed. Simulator could exploit myotic or mydriatic drops<sup>[5]</sup>. If subject is really bilaterally amaurotic, they should have also bilateral fixed dilated pupils and no response to light. Only exception is bilateral oculomotor paralysis. In this case ptosis and esotropia are noted.

**Head rotation test** Head of subject can be rotated fast about 30 degrees in opposite directions and if nystagmus occurs it means that the case couldn't see at all. If no nystagmus is present, at least one fixation mechanism and indirectly some degree of vision is present<sup>[4]</sup>.

**Electroencephalography** If changes in basal occipital rhythm recordings are observed when light is projected to eyes, it indicates there is at least slight visual activity<sup>[4]</sup>.

**Pattern visually evoked potentials** Pattern visually evoked potentials is well-known method for evaluation of afferent visual pathway dysfunctions including the macula and the optic nerve. In case of unilateral amblyopia or blindness, asymmetrical recordings of two eyes are expected. PVEP can easily discriminate existence of unilateral blindness but may not help to quantification of visual acuity between 2/10 and full vision, 10/10. Normal PVEP and ERG is not compatible with visual acuity less than 6/10<sup>[14]</sup>. On the other hand, pattern VEP recordings using 5 different pattern sizes has been shown to quantify the visual acuity level and pattern VEP is well correlated with visual acuity levels with sensitivity 97% and specificity 62%<sup>[3,38]</sup>.

#### **HOSPITALISATION**

After all these tests, if the diagnosis of malingering can not be confirmed, he/she is hospitalized with an irrelevant and a fake diagnosis and followed closely without letting him/her notice. Nurses and clinic staff are informed and asked to follow secretly day and night. When the subject forgets playing his/her blind role or feels that he/she is safe, he/she might do free moves that indicates he/she is seeing<sup>[3,14]</sup>.

Another trick is that, if an appointment time is set before and a photo of subject is at hand, preferably one physician would watch secretly while the subject comes to the clinic from the parking lot. If this precaution could be performed, examiner and clinic can save lots of money and time. Again another solution is to follow up the subject upon his/her leave from clinic to the street.

In some suspicious cases, examiner might have to perform

objective tests to eliminate a retinal blinding etiology. If a pathology secondary to optic neuropathy is considered, fundus examination, swinging flash test, direct and indirect light reflexes, VEP and sometimes computed tomography or magnetic resonance imaging (MRI) of optic nerve tract with contrast dye are performed. Again, all tests and examinations performed must be included in medical files and the computer in detail as a precaution for future legal investigations. Results of laboratory tests are advised to be glued or stapled to file. All files must be recorded at the computer with extra protective measures against file smuggling.

To rule out cortical blindness, coincident symptoms and signs like disorientation, confusion, epileptic attacks and other neurological deficits have to be searched in medical history and examination. In real cortical blindness, pupillary reflexes, fundus examination and oculomotor tests should be normal. Subject as in Anton Syndrome might be unaware of his/her blindness. He/she has no palpebral menace reflexes. Bilaterally, he sees nothing or maximum like viewing from a pipe. VEP abnormality is evident. In suspicious cases, neurology consultation is asked after informing the neurologist about the case. Cortical blindness is encountered in general with infarcts or very rarely tumors placed in bilateral occipital lobes. Hemorrhages are not expected. Sometimes coup-counter coup head trauma, deep uremia, postpartum amnion embolism, postcoronary angiography spasm, incontinentia pigmenti, or similar toxic reasons may be responsible [1,28]. If cortical blindness is due to trauma no MRI signs could be seen at first. Visual field defects lean to vertical meridian and it's useful in differentiation from simulation in case of pipe vision [24,28].

**Simulation of Bilateral Amblyopia** It's frequently met and easily mimicked type of simulation. Sixty-five percent of visual functional loss cases have bilateral amblyopia [29]. Both subjective and objective examination techniques can be used for this purpose.

### **Subjective Examination Techniques for Simulation of Bilateral Amblyopia**

**Special optotypes** Special optotypes is one of classical examinations of simulation and probably the easiest. Optotypes are printed on the same size cartoons and have identical sizes and presented to the subject under standardized lighting conditions. There are lots of cartoons that have the same or different visual equivalents. Optotypes' number and leg lengths and total surface fields are different. The distances of spaces between optotypes and their lengths are same but visual equivalents are different. Simulating person can not know that big size optotypes may have the same visual equivalent with small ones. To correct

discordance between answers it is necessary to repeat this examination [14].

**Snellen test in mirror** Snellen test in mirror may be performed. Six-meter of regular visual acuity assessment distance could be easily doubled via mirror and subject is made think his/her visual acuity irregularly reduced. In reality, if distance is decreased to its half then visual acuity must be doubled. Different results mean malingering. Visual acuity test could be performed first from 6 meters then 3 meters and results compared [4].

**Reassurance test** Reassurance test is always among the most useful options. Ophthalmologist begins examination first show of 20/10 optotypes and when the case can't see, then embarrassed examiner shows 20/15 optotypes. And if the subject says he/she also does not see, examiner expresses extreme wonder and says he can not believe that the subject could not see 20/15 optotypes and insists that the subject must see at least 10/10 optotypes [3]. Even says "the letters now are double size of former" [27]. Examination could be repeated with reading charts of different optotypes.

**Lytton test** Lytton test may be performed. Before of weak eye +1.0D in 90 degrees and -1.0D in 45 degrees glasses placed and sound eye closed. Subject is told to find the brightest view. An honest subject neutralizes two glasses in 90 or 45 degrees and reads honestly. Simulator doesn't neutralize the lenses properly and reads maximum half of his/her real vision [4].

**Baudry test** Examiner wants the subject to read near chart. He/she will say that he/she can't read. Then examiner places +6.0D in trial set and asks the subject to read near chart in tip of nose and then says that the power of glasses will be doubled. In contrast, examiner places -6.0D glasses and at the same time draws near chart to read distance. If the subject simulates, he/she can easily read the chart, then his/her real vision is measured [4].

**Statistical calculations** Statistical calculations is a new test developed for visual acuity or field evaluation. For visual acuity evaluation, at least 16 optotypes designed for every Snellen line in mixed style is showed to the subject at random. Correct answers to preset n number optotypes with correct answers of the subject compared and calculated according to dispersion function of binomial formula of every Snellen line. P values of  $\leq 0.01$  indicates that answers are intentionally wrong. Landolt C optotypes on 32 white plates are projected for 2 seconds and answers are recorded. Correct answers rate is compared to dispersion of binomial formula which could provide this rate by pure chance. According to a report, 74% of 20 voluntary pseudosimulators and 80% of 15 real simulators could be determined [30]. These test are very useful in deliberate uncooperative

malingers. This method could also be used in visual field simulations. In visual field examination, saccadic responses of the eye to stimuli that are completely at random projected to four quadrants of eye are observed and results are calculated. Preferences of saccades to opposite directions of projected stimuli again indicates simulation [31].

**Stereoscopy** Stereoscopy can be used for evaluation of simulation. There seems to be direct relation between visual acuity and stereoscopy [27]. Subject is told that it's a short, fast, routine and simple test. Then Titmus test is performed. All fly, animal and circle optotypes seeing requires a definite full binocular vision level. That is to say, seeing of nine circles mean 40 second arc or full binocular vision [5]. A person that claims hand move and performs 52 seconds arc stereoscopy should have in reality 7/10 Snellen vision of both eyes [27] or identification of four of nine circles needs at least 2.5/10 Snellen line vision [25]. It is a good measure of visual acuity [4,12,17]. Unfortunately attentive malingerers rapidly realizes that test needs both eyes and close rapidly one eye, so examiner must be vigilant and catch this maneuver of subject.

#### **Objective Examination Techniques for Simulation of Bilateral Amblyopia**

**Optokinetic nystagmus** It is ideal for determination of gross visual acuity without cooperation of case. This test requires fixed lightning conditions and Barany cylinder but results are not always definitive. From distance which subject claims that can not see optotypes Barany cylinder is rotated and if nystagmus turns out, it means simulator can see at least from that distance and he/she is lying. Positive result means at least 1/20 or /10 Snellen line vision [4,27].

PVEP test is described above.

**Simulation of Unilateral Amblyopia or Blindness** It seems relatively easy to mimic unilateral blindness or amblyopia. Before diagnosing as simulation, it's necessary to rule out real functional or organic problems from amblyopia, strabismus, or cornea, lens, vitreous, retina and macula and retrobulbar pathways problems. There are lots of examination techniques to investigate claims but examiner must perform the ones that he/she knows in detail and is accustomed to. During the performance of the tests examiner must pay attention to subject not to understand the details (tricks) of the tests. Preparations of tests and equipments have to be performed in absence of subject and examiner must not discuss tests even the simplest detail. Bilateral complete refraction of subject before tests must be examined. During examination, examiner must observe eyes of subject because any single blink may interfere results of test.

If some organic diseases in early phase could not be realized in time, misdiagnosis of simulation can be inevitable and it

may cause loss of subject's rights. For example, early Stargardt's Disease, early onset macular dystrophy, amblyopia, cone dystrophy, atypical retinitis pigmentosa (sine pigmento), keratoconus, central serous retinopathy, retrobulbar neuritis, optic nerve compression, chiasmal tumors, hereditary optic neuropathies and cortical blindness could be considered in this context. [4,5,22,29]. In order not to miss out at least some of these cases, it's important to pay attention to pupillary reactions during swinging flash test. In case of suspicion, some advanced tests like fluorescein angiography, indocyanine green angiography, ERG, VEP, dark adaptation, corneal topography could be performed. Even in detailed examination, as reported 2.2% of the cases which diagnosed as malingering have proved to have an underlying or associated organic pathology [29]. There is no doubt that some specific procedures may enable timely diagnosis of pathologies mentioned above. Most frequently encountered of these pathologies accounting for visual acuity decrease in seemingly healthy eye.

**Amblyopia** In otherwise healthy eyes with no remarkable ocular sign explaining visual acuity decrease amblyopia is thought. Amblyopia generally can be diagnosed in presence of more than +1.0D asymmetrical refraction difference. Vision on weak eye is no below of 1/10 in general. A good history, open-close test, streak retinoscopy wet if necessary and crowding phenomenon on funduscopy are performed and anisometropia is looked for [22,32].

**Cone dystrophy** Bilateral but asymmetrical and slow pace visual acuity and color vision decrease is noted in children and young people before third decade. Day vision is worse than night and dim light. Family history, hemeralopia, photophobia, dyschromatopsia and nystagmus can be noted but they don't exist altogether necessarily [33,34]. Cone functions are decreased in ERG as well as VEP. Fundus findings are noted lately. Bull's eye maculopathy and temporal optic atrophy may help to diagnose [14,23]. Visual field examination may expose normal or sometimes present ring or central defects and even hemianopia. Diagnosis depends on high index of suspicion and color vision test, tangent screen examination and especially diffuse narrowing of retinal arterioles [33,34].

**Retrobulbar neuritis** Unilateral loss of vision and afferent pupillary defect (RAPD) are noted. History is important. Viral infection in recent days, similar attacks in the history and pain with globe movements are asked. Unilateral dyschromatopsia, central or centrocheal altitudinal field loss, dim vision of environment can be observed. Vision ameliorates in one month in most of the cases. Periventricular plaque lesions are reported in MRI with contrast matter [22].

**Chiasmal tumours** Vision loss is observed before optic atrophy and asymmetrical bitemporal hemianopia manifests. Afferent pupillary defect (RAPD) and mass effect in MRI or CT scan with contrast dye is observed.

**Cortical blindness** Besides of normal anterior and posterior segment examinations and pupillary reactions, bilateral total or near total (tubular vision) loss of vision exist. Frequently occipital infarct, very rarely mass lesion is observed in MR imaging with contrast dye. Hemorrhage is not expected. Rarely amnion fluid embolism, serious uremia, postcoronary angiography vascular spasm can cause cortical blindness. Neurological defects like confusion, disorientation, epileptic attack and lateralizing findings are looked for. If perimetry could be performed in cases of tubular vision, leaning of defect to vertical meridian could be observed and it's useful in differentiation from simulation [22,28].

**Cancer related retinopathy** Some rare cases of cancer related retinopathy would express with nonspecific symptoms like decreased visual acuity and visual phenomena like floaters. In fundus examination perhaps only arteriolar narrowing would be observed. Those cases would be diagnosed with high suspicion rate and paraneoplastic antibody tests. Visual field narrowing, abnormal dark adaptation and ERG would be useful in documentation [27].

### **Subjective Tests for Simulation of Unilateral Amblyopia or Blindness**

**Optokinetic test** Optokinetic test (mentioned above) also could be performed. First, Barany cylinder rotated when two eyes opened and nystagmus is observed. Then, while cylinder keeps rotating examiner closes rapidly sound eye of subject, if nystagmus persists it indicates that subject sees with so-called bad eye [3-5].

**Special optotypes** Special optotypes could also be used. If subject who can not know real visual equivalent of optotypes cooperates and reads honestly, his/her visual acuity could be determined.

**Ruler test** While subject reads near chart from 50-60cm, a ruler or tongue plate is placed in front of nose horizontally from 15-20 centimeters (cm) and is again asked to read. Because of visual fields superpose binocular persons read easily. A real monocular subject hesitates and can not read [4,5].

**Pencil test** Similar to ruler test, while subject reads a near chart, examiner slowly place a pencil before the sound eye without subject's awareness. If subject really has a problem in bad claimed eye, he/she can't keep reading easily [3,17].

**Mirror test** This test is defined before. It could be performed with the help of a long mirror and simulators can not suspect the mechanism and can not stop to follow their reflection in mirror [3-5,22,35].

On the other hand, in the second version of test with Snellen Chart visual acuity doubles when distance an half

diminishes. Again malingers do not know the mechanism of the test [4].

**Vertical bar test** Similar to another version of this test, while subject reads newspaper from 50 cm a tongue plate is placed in front of his/her face to 20cm. If vision is good bilaterally, subject can keep reading. But if one eye is weak and tongue plate is placed before sound eye, subject gets distracted and changes his/her head position [4,5].

**Encourage test** This test is defined before.

In some situations, such as compensation trials, reminding the simulator the LEGAL IMPLICATIONS that he/she would suffer in case he/she is proved to be a simulator, would be enough to get the result.

**Near vision reading test** Subject is asked to read near chart with the bad eye. If he/she can read smaller letter paragraphs, it's thought that he/she simulates, because near reading well requires reading far also [3]. In this test, subject must wear his/her near glasses if necessary. If distant vision is good but near vision is abnormal examiner must check media opacities like polar or posterior subcapsular cataracts [27].

**Low vision AID** instruments sometimes may help differentiation. An handheld 2.2 aphocal telescopic lens over distant correction is expected to enhance vision two times [27]. This test may reveal malingering if patients insist on his claim at bad near vision only.

**Pupillary reaction test** Pupillary reaction test may be helpful. In case of optic nerve pathology, monocular visual loss a relative afferent pupillary defect (RAPD) must be observed on that eye [3,4,27]. But some small macular lesions may cause poor vision without relative afferent pupillary defect. Again binocular visual loss is observed without relative afferent pupillary defect [27].

**Pinhole test** A pinhole is placed before of sound eye, bad eye is left open and subject is asked to read optotypes at far. While subject reads letters, examiner slowly plays buttons of trial frame and draws pinhole out of sound pupil without subject's awareness. If subject keeps reading, examiner lets him go reading till the bottom [5,17].

**Convex lens fogging test** It is used in cases which subject complaints asymmetrical visual loss. It is the most performed visual acuity assessment test [3-5]. In front of the sound eye, the convex lenses are placed with gradually increasing power upto +8.0 diopter to prevent seeing optotypes from 5 meters. Every time of increase subject is reassured and visual acuities reexamined to confuse him/her. Another +3.0 diopter lens is placed in front of so called weak eye. Then binocularity tests (Worth four dot) performed especially paying attention not to blink eyes. After that, removing +3.0 d lens, +1.0 and -1.0 diopter lenses are placed one after another repeatedly on weak eye and at last left eye is neutralized while both eyes are open. It

is a classical fogging test. Subject then believes that he/she sees bilaterally and he/she reads all optotypes with his/her so called bad eye, but he/she doesn't know the reality. If subject doesn't respond sincerely and replies in a contradictory manner, then examiner places +8.0 diopter lens in front of sound and bad eyes one after another and confounds the subject until he/she responds the truth.

**Cycloplegia test** Sight of subject is blurred with cyclopentolate drops 2 or 3 times on the sound eye, and on the so called bad eye but with another dropper filled with serum physiological and labeled the same with the cyclopentolate. After 45 minutes subject is asked to read from 5 meters eyes separately closed, eye with cyclopentolate reads from 5 meters easily, but subject refuses sincerely to read with so called bad eye. Then near reading bar J3 or J4 is asked to read with both eyes open that means subject can read with only bad eye without cyclopentolate. Subject reads bar's smallest paragraph easily thinking that he/she reads binocular<sup>[5,17]</sup>.

**Colored lens test** Subject is refracted and corrected and told that he/she will have no problem in reading with colored lenses. When viewing with colored lens of letters with different colors on white ground, same color letters can't be read with the lens colored same. Red lens to sound eye and green lens to so called bad eye are placed and white ground plate with some letters red, green and black on is showed to subject and asked to read. If subject is really amblyopic or blind in one eye, he/she reads only black letters, because eye with red lens sees and reads only black letters, can't see the others. If subject can see binocular, then reads all three colored letters as if black. Because green is complementary of red and makes read green ones as if black<sup>[12]</sup>. In another version of this test, subject wears color glasses with red and green lenses, like Worth test. He/she read letters on the chart, one half red, the other one green, reflected from chart projector when both eyes open with glasses. Subject can read all letters filtered with red and green lenses if binocularly have good vision. With this principle, confused subject could read all letters which his/her maximum capacity of vision permits<sup>[5]</sup>.

This test may be performed with Ishihara's color plates. If a subject can read Ishihara plates it means he/she can see at least 5/10 Snellen line<sup>[25]</sup>.

**Prism test**<sup>[5,17]</sup> This test is well-known for this purpose. This test can be performed in two forms. In the first form, while subject look at optotypes at far with so called weak eye, 4 prism lens is placed base out in that eye and this eye is carefully observed while looking at far letters. If bad eye moves, it means that the eye is fixed to the letters projected and can see them<sup>[5]</sup>.

In the second form of the test, examiner closes so called bad

eye, and places 4 prism lens base up on sound eye and apex of lens divides pupil into two parts. If prism is placed in correct place, monocular vertical diplopia occurs. Examiner asks if subject sees two lines on far really in the same clarity, the possible answer will be yes. Then examiner opens the bad eye, and just at that time he/she turns base of the prismatic lens down. Now, binocular diplopia turns out, but subject thinks he/she has monocular diplopia yet. At that point optotypes at far are asked to read one by one, subject thinks that he/she reads with sound eye and reads all the letters he/she could. But in reality he/she reads with bad eye. With this test, it's possible to get perfect visual acuity examination results from even the worst cooperated cases<sup>[17,36]</sup>. It's a good test for simulation evaluation.

**Duane test** Similar to prism test, while subject is reading near chart bilateral eyes open, examiner puts 10 prism diopter base up lens on bad eye, and if subject hesitates even one second, it's simulation<sup>[5]</sup>.

**Synoptofor test** When two fusion pictures (rabbit and cage) are shown and subject can see simultaneously both of them, it means good binocular vision is present<sup>[5]</sup>.

**Polarisation test** Subject wears lenses that refracts light 180 degrees in right, 90 degrees in left and looks to polarizing optotypes from 6 meters. One optotype in upper is seen with one eye, the other optotype on below with the other eye. That is to say, polarizing lenses dissociate the eyes. If subject reads all optotypes with both eyes open, it means that subject easily sees with the so called bad eye to the smallest optotype<sup>[5]</sup>.

**Mojon test** This test composed of 10 rows of Snellen letter, which is of equal minimum angle of resolution. Malingering is proved if suspect states he/she can not read the letters below<sup>[37]</sup>.

**Diploscopy test** In this test, there is a screen diameter of 60 cm perforated by transvers holes and subject looks from screen to a cartoon written K,O,L,A with majiscules. Test principle is physiological diplopia and right eye sees K and L, left eye O and A. Simulator sitting front of diploscope can see all letters if only both eyes are sound. With this test, visual acuity discrimination could also be assessed with appropriate size letters<sup>[29]</sup>.

**Objective Tests for Simulation of Unilateral Amblyopia or Blindness**

**Optical coherence tomography (OCT)** OCT can be used both in unilateral and bilateral amaurosis examination<sup>[38]</sup>. This test is valuable especially for cases presenting with optic disc pallor resembling optic atrophy. In this technique, temporal nerve fiber layer measurement is important. Cut-off level, (which is around 67.5 $\mu$ , for particular population) can be used in cases with bilateral involvement. Normal test results may disclose malingering objectively<sup>[38]</sup>.



**Pattern electroretinography (PERG)** PERG is a useful electrodiagnostic test to compare both retinas of subject as well as for diagnosis, documentation, and quantification of present pathology. Normal PERG means both of the optic nerve and the macula are functionally sound. PERG is of use in two ways in unexplained visual loss cases. First, it easily identifies photoreceptor dysfunction syndromes that rarely manifest in clinical fundus examination. Second, normal ERG indicates that fixation is good and optic picture focuses good in retina [4]. Therefore combination pattern ERG and VEP recordings are necessary in the most of malingering or conversion cases [4].

**PVEP** PVEP is described above.

**Multifocal electroretinography (mfERG)** mfERG can be used to assess fixation losses, which is not rare in malingeringers. Also, increased diagnostic value of this test when used combined with PVEP has been demonstrated [39]. Another study reports that VEP and mfERG combination is of use for both localize the area of pathology and check if visual pathways are normal [39,40].

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