

Punching Boxer's Eye and Optic Nerve Damage

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Firstly, the importance of the article and its urgent need for it: This article is of great importance in defining the seriousness of the punches that boxers receive and their negative impact on the optic nerve, which does not receive attention from the coaches and doctors who are present around the ring during the matches, and this article raises the alarm for attention. Where by the nature of the sport, boxers receive repeated physical traumas with the possibility of acute, as well as chronic, injuries [4]. The optic nerve is vulnerable to indirect and direct trauma causing functional impairment of vision [33].

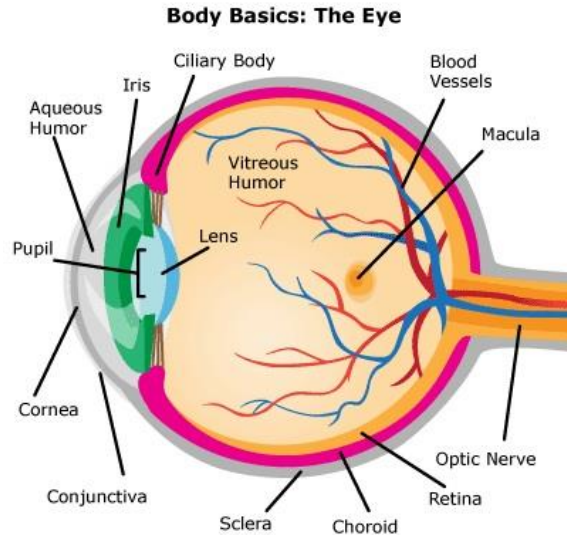
In boxing, along with a few other sports, trauma is inherent to the nature of the sport; therefore it is considered a high-risk sport for ocular injuries. The long-term morbidity of ocular injuries suffered by boxers is difficult to estimate due to the lack of structured long-term follow-up of these athletes. Complications of blunt ocular trauma may develop years after the athlete has retired from the ring and is no longer considered to be at risk for boxing-related injuries. This article describes the wide range of eye injuries a boxer can sustain; specifically the damage to optic nerve, considered a severe injury invariably leads to vision loss, often resulting in blindness, which ensures their immediate and long-term clinical management [15] [31].

Human optic nerve cells lack the ability to regenerate and to re-establish neuronal wiring from the eye to the brain. Additionally, there are no FDA-approved drugs or surgeries that prevent death of the cells that make the optic nerve, block nerve degeneration or stimulate nerve regeneration [31] [36].

The Eyes of boxers are important mirrors of the intracranial status of the Optic nerve. Vision is the process by which images captured by the eye are interpreted by the brain, and the visible part of the eye is where the process of sight begins. On the front surface of the eye is the see-through, circle-shaped cornea, the cornea is like a clear window that focuses light into the eye. Most ring injuries are the gory

but superficial facial cuts. They produce blood, but not in any quantity to cause problems and they hurt, but generally not enough to stop a fight. The problem is that if the cuts are in the area of the eyes, the blood can run into the eye and the fighter may be temporarily blinded. The eyes are an important mirror of the intracranial status. One of the important indications of brain damage is unequal pupil size. It is important to know before a fight if a boxer has unequal pupils in order to know after the fight if a change in size is meaningful [8] [11].

Our eyes work with our brains to tell us the size, shape, color, and texture of an object. They let the boxer know how close of blow it is, whether it's standing still or coming toward him, and how quickly it's moving toward his head [12], the eyes are responsible for four-fifths of all the information our brain receives [38] [39].



As shown in Figure (1), the optic nerve is the second cranial nerve (CN II) responsible for transmitting visual information. The optic nerve contains only afferent (sensory) fibers, and like all cranial nerves is paired. During embryogenesis, the optic nerve is formed in the retina, exits the orbit via the optic canal, and is relayed throughout the central nervous system (CNS). Synaptic targets of the optic nerve include, but are not limited to, the suprachiasmatic nucleus (SCN), lateral geniculate nucleus (LGN), pretectal nucleus, superior colliculus, and primary visual cortex. The stimulation of these different structures results in different functions. Furthermore, the optic nerve is the afferent limb for both the pupillary light reflex and the accommodation reflex [2] [28]. Indirect TON is caused by the transmission of forces to the optic nerve from a distant site, without any overt damage to the surrounding tissue structures [2] [11] [12] [36].

A punch to the head which does not lead to unconsciousness may still induce a state characterized by reduced reaction speed and confusion [16]. This is colloquially referred to as being groggy, since it resembles a person that has had too much grog, an alcoholic beverage. The gait may also be affected, and the afflicted person is then said to have developed spaghetti legs. This is dangerous for a boxer, as it reduces the ability to defend against further punches [19] [34].

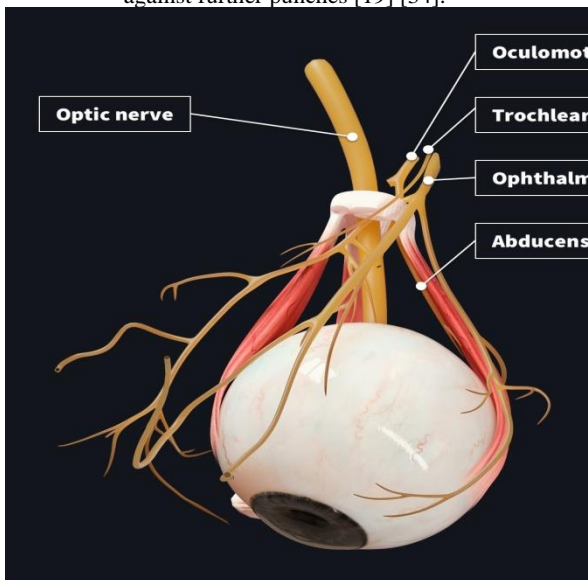


Figure (2) Innervations of the eye | Complete Anatomy
As illustrated in Figure (2), a direct blow to the eye can damage the eyeball, the supporting muscles and ligaments, the eyelid, or the bony eye socket (orbit). Symptoms that may mean there is a more serious injury includes: Vision changes, beside inability of moving the eye normally in all directions. While the most common vision problems related to head injuries include blurred vision, double vision and decreased peripheral vision. Boxers can also experience a complete loss of sight in one or both eyes depending on the severity of the injury [4] [9] [10] [13].

The force of impact in a head injury may be transmitted to the optic nerve. This complication of head injury was known to Hippocrates who noted that blows to the eyebrow may cause blindness. The frequency of optic nerve injury occurring in closed head injury varies from 0.5 to 5%. Direct optic nerve injuries are caused by penetrating orbital trauma resulting in contusion or transection of the optic nerve by a foreign body, such as a bullet or stab wound. Indirect optic nerve injuries are caused by contusive head trauma [20] [21] [37]. The torque of the blow force causes the rotation of the head around its longitudinal axis negatively affects the optic nerve [4] [10] [39].

The optic nerve is a bundle of more than one million nerve fibers that carry visual messages. Everyone has one connecting the back of each eye (retina) to his brain. Damage to an optic nerve can cause vision loss. The type of vision loss and how severe it is depends on where the damage occurs. Common symptoms of optic nerve damage include eye redness, and pain when moving the eye, vision distortion, loss of vision, and these symptoms may also be present with a variety of other eye conditions, so a proper diagnosis by a qualified medical professional is needed [26] [27].

*In this context the Author confirms what some boxers have reported that they see the opponent boxer as two persons in a blurry way during the actual fighting after receiving blows to the head.

The optic tract is a bundle of nerve fibers that serves to carry visual information from the optic chiasm to the left and right lateral geniculation bodies as a part of the visual pathway. The visual pathway refers to the series of cells and synapses that transmit visual signals from the environment to the brain for processing. This pathway begins with light striking the specialized nerve cells of the retina, which convert photons of light into electrochemical signals. Neural signals travel primarily through the retinal layers to the optic nerve (cranial nerve II, or CN II), optic chiasm, optic tract, lateral geniculation bodies, and visual cortex in the brain's occipital lobe [3] [35] [36].

Each optic tract carries one half of the visual field, consisting of afferent (sensory) information from temporal hemi-retinal fibers ipsilaterally and nasal hemi-retinal fibers contra laterally. The left optic tract is responsible for the right visual field, and the right optic tract corresponds to the left visual field [21].

The signs of optic nerve disorders may be temporary or permanent. They are: Color blindness., Eye pain., Headaches., Vomiting. Night Partial or complete Vision loss, Peripheral (side) vision loss, and ringing in ears (tinnitus) [9]. Also known as color vision deficiency (CVD) — is a condition where you don't see colors in the traditional way. This can happen if certain cells known as photoreceptors, or more specifically cones, in your eyes are missing or not working correctly. These cones

typically allow you to see each color on the rainbow. If you have color blindness, you might not see each of these colors [27].

The optic nerve is critical to the [vision](#). It's an extension of the central [nervous system](#), which includes brain and [spine](#). The optic nerve transmits electrical impulses from eyes to the brain. The brain processes this sensory information so that we can see. The optic nerve is the second of 12 [cranial nerves](#). Each eye has its own optic nerve. Creating upper and lower pathways called the optic radiations (ORs). The OR pathways carry nerve messages to a part of the brain called the visual cortex. The visual cortex processes sensory information for sight. The optic nerve transports signals from the eye to the brain, which then changes the signals into images. Optic neuropathy occurs when there is damage to the optic nerve resulting in partial or complete vision loss. Vision is not possible without a healthy optic nerve so if the nerve is damaged, for example, by compression, or if its blood supply is disrupted, then sight loss can quickly follow [8] [26] [27].

Each optic nerve has branches that travel to the brain or join with other fibers. When the two optic nerves cross at the optic chiasm: Half of the nerve fibers from the left eye continue to the left side of the brain. Half of the right eye's nerve fibers connect to the right side of the brain. The remaining nerve fibers join together. The brain receives signals from both eyes at the same time to create a cohesive visual image (binocular vision).

[20] The optic nerve is the second cranial nerve (CN II) responsible for transmitting visual information. The optic nerve contains only afferent (sensory) fibers, and like all cranial nerves is paired [17] [22] [24] [29] [36] [37].



Figure (3) the optic chiasm

As shown in Figure (3), [the optic chiasm, or optic chiasm, is the part of the brain where the optic nerves cross and is therefore of primary importance to the visual pathway. It is located at the base of the brain inferior to the hypothalamus, and approximately 10 mm superior to the pituitary gland within the suprasellar cistern](#) [1] [25].

The visual pathway refers to the series of anatomic structures responsible for transporting visual information from the eye to the brain. Most visual information follows the same course throughout the visual pathway: Retina -> optic nerve (cranial nerve II) -> optic chiasm -> optic tract -> lateral geniculate bodies (majority) + hypothalamus -> optic radiations -> visual cortex [36].

After exiting the orbit, the right and left optic nerves travel posteriorly and intersect at the ventral midline to form the optic chiasm [3]. It is located at the inferior aspect of the forebrain at the base of the hypothalamus, approximately 10 mm superior to the pituitary fossa, also known as the Sella Turcica [4]. It is adjacent to the junction of the anterior wall and floor of the third ventricle [5] [11] [14] [22].

Achiasmia : Although its name suggests the complete absence of the optic chiasm, chiasmic describes a congenital reduction in the number of decussating fibers within the optic chiasm. The complete absence of the optic chiasm is more appropriately termed *chiasmal aplasia*. The pathogenesis of achiasmia is thought to result from abnormalities in the biochemical molecules responsible for axonal guidance during development (*see Embryology section*). Clinical findings include reduced visual acuity, stereopsis, and seesaw nystagmus; visual fields and optic nerve appearance are normal [26] [31]. Chiasmal hypoplasia often (but not always) coexists with optic nerve hypoplasia. Reduced chiasmal size can be appreciated with neuroimaging studies. Monocular visually evoked potentials (VEPs) reveal a characteristic pattern of asymmetry in response to a flash of light [31]. The optic chiasm positioning is along the midline of the ventral subarachnoid space of the brain, inferior to the hypothalamus and anterior communicating artery, and superior to the pituitary gland situated within the sella turcica. After passing through the optic chiasm, the optic nerve becomes the optic tract that synapses to the lateral geniculate nucleus (LGN) of the thalamus and subsequently projects optic radiations to the primary visual cortex (V1) of the occipital lobe. The optic tract also projects to the superior colliculus, pretectal nuclei, and suprachiasmatic nuclei. This part of the optic pathway serves the important light reflex [41].

Optic nerve problems cause various symptoms depending on the underlying condition. The symptoms may be temporary or permanent. The Boxer may experience: Color blindness, Eye pain, Headaches, Nausea and vomiting, Night blindness, Partial or complete vision loss, Peripheral (side) vision loss, and Ringing in your ears (tinnitus). As for those, the punch- drun ken boxers experience tremors, slurred speech and a shuffling walk, among other things in boxing, the eyes tell something of the story [2] [20].

The optic nerve may be damaged either directly or indirectly. An indirect injury to the optic nerve typically occurs from the transmission of forces to the optic canal from blunt head trauma. In contrast to direct TON, which results from an anatomical disruption of the optic nerve fibers from penetrating orbital trauma, bone fragments

within the optic canal, or nerve sheath hematomas.

Patients usually present with a variable degree of vision loss (decreased visual acuity, visual field abnormalities, or loss of color vision). However, most cases (up to 60%) present with severe vision loss of light perception (LP) or worse. In the acute phase, the optic nerve usually appears normal on fundoscopic examination, but optic nerve atrophy is often seen 3-6 weeks after the injury [7] [40]. If it seems surprising that a soft boxing glove striking a smooth surface like the face causes such bloody cuts, it should be remembered that the glove is striking the face at about 25 times the normal force of gravity. Also, there are sharp, bony ridges under the skin, and the force of the punch on the skin over the ridge is what frequently causes the cut. The brain and the eyes are the two most vulnerable areas in a fight, despite the occasional ruptured spleen and stories of fighters urinating blood - that's a common occurrence in many contact sports, and usually clears itself up without permanent damage [8] [22].

Optic neuritis usually improves on its own. In some cases, steroid medications are used to reduce inflammation in the optic nerve. Possible side effects from steroid treatment include weight gain, mood changes, facial flushing, stomach upset and insomnia. Steroid treatment is usually given by vein (intravenously) [18].

To treat a punched eye, it should apply a cold compress soon after the injury. Using gentle pressure, place a cold pack, a cloth filled with ice — or even a bag of frozen vegetables — to the area around the eye. Beside taking care not to press on the eye itself. Apply cold as soon as possible after the injury to reduce swelling. Damage to the optic nerve is irreversible because the cable of nerve fibers doesn't have the capacity to regenerate, or heal itself, when damage occurs. This is why early detection is so important. Vision lost due to optic nerve damage cannot be recovered, it may be stopped, but it cannot recover [5].

MRI can show optic nerve compression by swollen extra ocular muscles, and it can demonstrate inflammation of extra ocular muscles and orbital fat tissue with high-intensity signal on STIR images [28]. There are no effective treatments to regenerate nerve cells or to restore connections between the eye and brain once the optic nerve is lost. Although, optic neuropathy is a reversible, treatable cause of vision loss and may be a harbinger for other manifestations of the disease. There are many neurological manifestations of vitamin B(12) deficiency. Optic neuropathy is a rare, but important, manifestation of vitamin B(12) deficiency that should be suspected in patients with risk factors for malnutrition [6].

Conclusion:

Considering the aforementioned studies conclusion & recommendations can be listed as follow:

- The eyes are an important part of the (prefight and post fight) exam.
- The eyes are an important mirror of the intracranial status.

- It must tell the other physicians to check these things. One of the important indications of brain damage is unequal pupil size.
- It is important to know before a fight if a boxer has unequal pupils in order to know after the fight if a change in size is meaningful.
- Most ring injuries are the gory but superficial facial cuts. They produce blood, but not in any quantity to cause problems and they hurt, but generally not enough to stop a fight. The problem is that if the cuts are in the area of the eyes, the blood can run into the eye and the fighter may be temporarily blinded.
- Prompt evaluation and treatment is critical to reduce risk of infection and to prevent further loss of vision. In the time between injury and evaluation the boxer should be given an eye shield to prevent additional pressure of the globe possibly furthering globe content expression through the break.

Recommendations:

To protect the boxer optic nerve, every boxer must get regular eye exams, to protect his optic nerve, beside maintain a healthy weight through exercise and a nutritious diet.

- If there was a blow to the eye, checking for other injuries is a must, Concern about the eye may cause to miss other more serious head or face injuries that need medical care
- Confirm the importance of several basic maneuvers, tactics, and defenses a boxer can use in order to evade or block punches as slipping where rotates the body slightly so that an incoming punch passes harmlessly next to the head.
- Every boxer must get self medical insurance till his practice and after Retire from boxing sport.
- Because foveal retinal detachment tends to be missed on routine examination. Periodic examination using OCT is recommended for highly myopic eyes with severe myopic degenerative changes and posterior staphyloma [1].

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