

# The Impact of Taekwondo Head Injuries on Visual Function

Daphne Chan

## Introduction

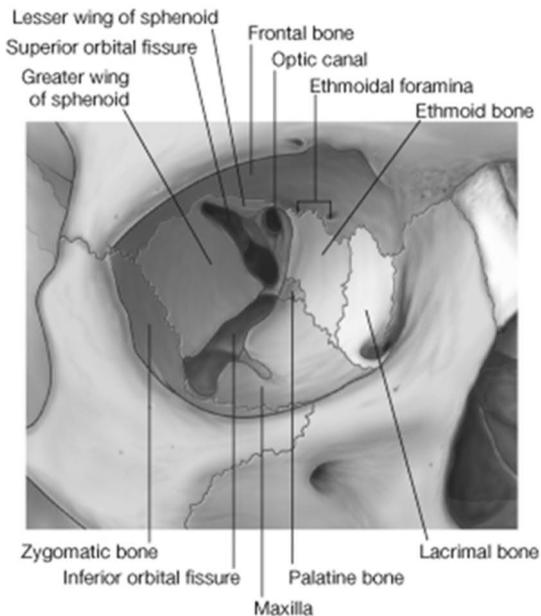
Although Taekwondo—the “way of the hand and foot”—enumerates discipline and control among its many benefits, injuries are inevitable, whether a result of competitive sparring, insufficient warmup, or lack of control. Studies in the literature have shown that the most common Taekwondo injuries occur in the lower extremities (particularly the foot’s instep) as well as the head and neck region.<sup>1</sup> Participants in Taekwondo competition wear mouthguards in addition to head gear, the soft helmet that protects the entire head except for the face. Indeed, since the face is exposed, I am interested in the degree to which the eyes are harmed because although face punches are illegal in competitive Taekwondo, head and face kicks are accepted and even rewarded with more points.<sup>2</sup> In this paper, I will utilize the literature and analyze an internal survey of eye injuries among UC Martial Arts Program members to address the issue of head injuries in martial arts and the effect they pose on visual function.

## Anatomy and Physiology of the Eye

Before we can discuss how injuries affect our eyes, it is important to understand basic visual anatomy and

function. The eye is an extension of the brain, relaying visual sensory information directly from the environment to the brain through the optic nerve.<sup>3</sup> The adult eyeball reaches an average length of 24 mm and an average width of 23.5 mm.<sup>4</sup> Housed and protected by a bony orbit (see Figure 1 below) comprised of the maxillary, frontal, zygomatic, sphenoid, palatine, ethmoid, and lacrimal bones, the eye is also protected in the front by the eyelid. By frequently coming down and up—in other words, blinking—the eyelids not only act as a barrier to foreign bodies such as dust, but also create a mechanical means of wiping away particles from the surface of the eyeball.<sup>5</sup>

***Figure 1: The bones of the right bony orbit.***



Source: *Tómate tu medicina!*

Tears play an important role in maintaining healthy eyes and vision. They aid in cleansing the eye by acting as a lubricant between the eye's surface and the eyelid during blinks, and also clear out foreign particles by washing them down to the inferior eyelid "pocket," where they will be less likely to irritate the eye or scratch the cornea; then they are either drained out of the tear ducts or coated with mucus to create a smoother, softer entity that is less likely to scratch the cornea. Furthermore, tears coat the surface of the eye, creating a smooth surface and therefore a clearer vision; indeed, it is possible for a person with perfect eyes but severe dry eye to have blurry vision.<sup>6</sup>

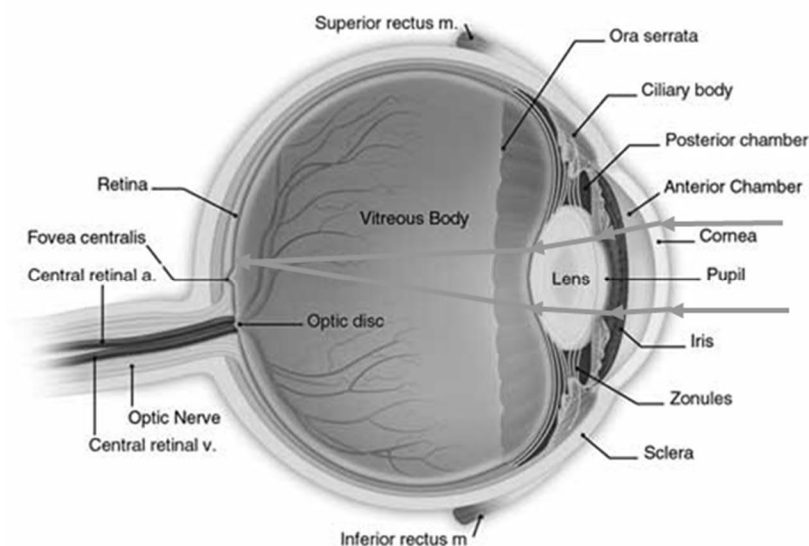
The movements of the eye are controlled by seven extraocular muscles. The lateral and medial recti muscles control side-to-side movement; the superior and inferior recti primarily control vertical movement; the superior and inferior obliques control vertical movement as well as torsional movements; and the levator palpebrae superioris, which is attached to the muscle sheath of the superior rectus, elevates the eye indirectly but primarily elevates the eyelid. These muscles are innervated by cranial nerves III, IV, and VI.<sup>7</sup> Damage to any of these nerves or muscles can cause overactive or underactive muscle action, resulting in eyes that do not point in the same direction and consequently see double images ("diplopia").

### **Visual Pathway: Transmitting Information From Object to Brain**

Normal vision is achieved by a system of several components. Light rays reflect from objects in the environment and enter our eyes through the cornea.

This is the clear tissue covering the front of the eye; its smooth, curved surface also bends or “refracts” light rays. This helps light rays begin to gather into a bundle as they are directed into the eye. Light rays then pass through the anterior chamber and into the pupil—the black hole formed by the iris, the colored part of the eye. The iris is a muscle that constricts or dilates to regulate the amount of light entering the eye: it allows more light to enter by dilating in the dark, and prevents too much light from entering by constricting in bright environments. The light then reaches the crystalline lens, which is a transparent and flexible M&M-shaped structure that plays an enormous role in focusing light properly. The lens is anchored in place by ciliary bodies

***Figure 2: Anatomy of the eye***



Source: Eyes and Eyesight blog, with light rays converging onto the retina added by the author

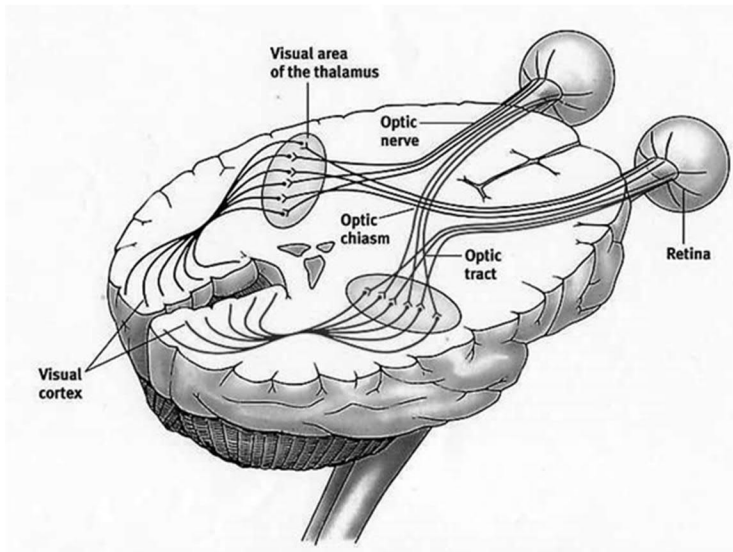
and fibers called zonules. As the ciliary bodies constrict or relax, the lens subsequently rounds up or flattens out, respectively. This dynamic movement bends incoming light just the right amount needed in order to focus light onto a sharp point onto the retina—the layer of tissue lining the inside of the eye that contains photoreceptor cells called rods and cones (see Figure 2 above). While cones are concentrated in the center of the retina in the fovea within the macula, rods are located outside that central area. This arrangement is most appropriate because in bright light, cones detect fine details, color, and provide clear, defined vision. Rods, on the other hand, detect motion and enable us to have heightened peripheral vision and to see in dim light conditions.<sup>8</sup>

The rod and cone photoreceptors sense photons of light and convert the light energy into neural signals,<sup>9</sup> which travel along the optic nerve, cranial nerve II. The nerve fibers from the nasal (toward the nose) half of each retina actually cross over to the other side of the head at the optic chiasm and join fibers coming from the temporal (toward the ear) side of the retina. The two bundles of “regrouped” nerve fibers travel through the optic tract to the lateral geniculate nucleus (LGN) in the brain, where the nerves synapse. From here, fibers called optic radiations leave the LGN and terminate in the visual cortex of the occipital lobe, where visual information is “passed out” and interpreted (see Figure 3 below).<sup>10</sup>

The visual pathway is an intricate process. With so many factors responsible for obtaining proper vision, it can be hypothesized that there are many possible sites of injury, and therefore many potential sources of

vision loss. For example, if the bony orbit protecting the eye is compromised, the eyeball will not sit properly in place and double vision will occur. Infection may even ensue.

***Figure 3: The optic nerve, chiasm, and tract***



Source: Yu, "Visual Pathway in the Brain"

## **Studies of Martial-Arts Related Head Injuries in the Literature**

Only a handful of studies have been performed on the relationship between martial arts and head injuries. In 1986, Siana et al, conducted a study on the injuries incurred during the 6th Taekwondo World Championship, discovering that over 4% of competitors obtained injuries serious enough to admit them to the hospital, and that the majority of the severe injuries

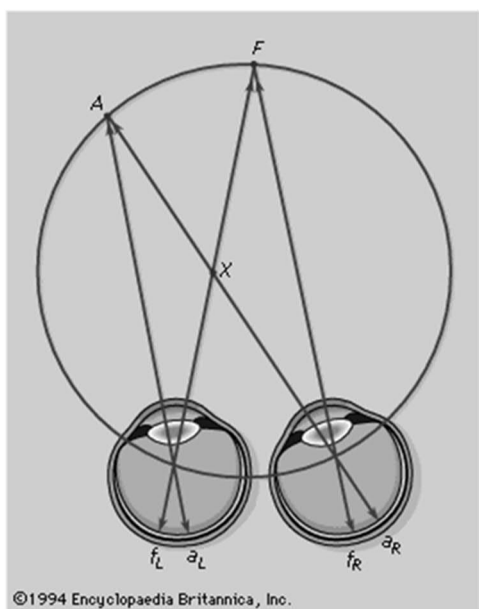
were to the head and neck. At this tournament, head gear was not a required piece of equipment; participants only wore "padding on the trunk and genitalia" and a "non-obligatory" mouthguard. The head and neck injuries included fractures of the zygomatic bone (cheek bone), mandibular rami (jaw bone), and mandibular angle; blows to the trachea; concussions; epistaxis (nosebleed); dental fractures; and facial contusions (bruises) and lacerations (cuts).<sup>11</sup>

The patient with the fractured zygomatic bone was reported to have sustained a "protusion of the eyeball," resulting in double vision but no harm to the optic nerve. As "protusion" is not a word, the authors probably meant "protrusion." A protrusion of the eye, also known as exophthalmos, describes an eye that is abnormally pushed out of the eyeball socket whether by pressure building behind the eye, bleeding, a tumor, or an aneurism. The zygomatic bone is one of the strongest bones of the orbit that protect the eye,<sup>12</sup> so massive force must be exerted to break it. In this case, it is likely that the attacker scored with a very powerful kick to the side of the patient's face, fracturing the cheekbone and causing the collapse of the bony orbit surrounding the eyeball. This structural disruption of the bony orbit most likely forced the bones to push into the orbital space and thus forced the eyeball to bulge out of the socket.

The patient's reported double vision, or diplopia, probably occurred as a result of the sudden misalignment of his eyes. In a normal person, single vision is achieved through the phenomenon of corresponding retinal points: one object in space stimulates the same physical points on the two retinas of the eyes, thereby forming the

perception that the object is single and located in only one place in space.<sup>13</sup> For example, in Figure 4, points  $a_R$  and  $a_L$  are corresponding points; they are the same relative distance from the fovea (this is the area in the center of the retina containing the densest population of cones, which gives the clearest, sharpest vision). If the eyes have been suddenly rearranged in the head from injury, it follows that the eyes incur abnormal retinal correspondence. This results in diplopia.

***Figure 4: Corresponding Points on the retina***



Source: Encyclopedia Britannica

Even though only one of the reported injuries in Siana et al's study—where Taekwondo competitors did not wear protective head gear—directly resulted in eye trauma, head and neck injuries were nonetheless the premier serious cause of hospitalization. Thus, this study suggests



that the absence of head gear is associated with a high incidence of head injuries. As Taekwondo is a mainly a kicking martial art, it is crucial to wear head gear to help avoid severe head trauma and eye injuries.

Learning to block head kicks properly has also been recommended by studies as a means to reduce the incidence of head injuries and concussions. In 2004, Jae Koh, et al, researched the “incidence of head blows and concussions in competition taekwondo” based on 2,328 competitors in a 2001 tournament in South Korea. They found the incidence rate of head blows to be 226 out of 1,000 athletes; the incidence rate of concussions was 50 per 1,000 athletes. Koh found that “head blows and concussions were associated with young age and a lack of blocking skills.” They concluded that “the incidence of head blows and concussions is high in competition taekwondo. Promoting blocking skills to prevent head blows could decrease concussions in taekwondo.” This study shows that taekwondo can be dangerous and inflict serious injury if the head is not protected—in this case by the simple act of blocking an incoming high kick.

A study by Kazemi, et al,<sup>14</sup> supports the notion that Taekwondo practitioners endure a high risk of head injuries. This was a nine-year retrospective longitudinal study of Taekwondo competitors who reported a total of 904 injuries throughout 58 different tournaments. This study aimed to identify the associations between “competitor experience level, age and gender, and the type, location, and mechanism of injury sustained.” Head injuries were found to comprise 19% of all reported injuries, followed by foot injuries (16%) and thigh injuries (9%). However, if combining hip, thigh, knee, leg, ankle, foot and toe injuries into one “lower

limb" category, then lower limb injuries outnumber head injuries among black belt (first dan and above) competitors. Nonetheless, Kazemi showed that head injuries are among the top reasons for seeking medical help in Taekwondo. Therefore, although injury-related visual defects are not explicitly examined in this analysis, preventative measures for protecting the head, face, and eyes is still an important concept.

One of the most severe instances of martial-arts-related eye trauma and subsequent vision loss was documented and analyzed by Mars, et al, in 1995. In this case, a 34-year-old male karateka (one who practices karate) competing in a tournament had been punched in the left cheek, fell to the wooden floor, hit his head, and was unconscious for 30 minutes. After an overnight stay in the hospital, he was diagnosed with "left periorbital bruising [bruising around the eyeball], a headache, and retrograde amnesia for the event." However, three weeks later, the patient reported "increasing distortion of the central vision of his left eye." His visual acuity continually declined, and a small rupture was found near the fovea in the choroid, the layer rich with blood vessels just exterior to the retina in the back of the eye that provides nutrients to the outer retina.<sup>15</sup> Over the next two months, the patient's visual acuity continued to worsen, and he eventually developed a dense central scotoma: a blind spot in his central vision. Although this article concerns a karateka and not a Taekwondo practitioner, the conclusion may be drawn that head and neck injuries abound in martial arts, especially in those that emphasize kicking such as Karate and Taekwondo. In fact, the article states that "an American study of the Tae Kwon Do national

championships found that 52% of all injuries involved the head and neck region.” Head injuries and potential visual defects are such serious issues that the authors of this paper even go so far as to suggest changing competition rules, making the head an illegal target altogether. Thus, it is a reality that head injuries may result in vision loss—sometimes not until weeks after the actual incident, as was the case studied by Mars.

However serious the consequence of this particular karateka’s experience, his case seems to be rather unique. According to Trish Bare Grounds—a former member of the UC Martial Arts Program; the owner of Bare Essentials Sports Medicine; and Medical Director of USA Taekwondo, the Amateur Athletic Union (AAU) Taekwondo, and the National Collegiate Taekwondo Association (NCTA) at the time of writing this paper—fewer than a dozen eye injuries have been documented since she started collecting head injury data in 1993. Although the data have not been published yet at the time of the writing of this paper, she cites illegal punches as the main cause of the eye injuries. This mechanism supports the case of the male karateka who sustained a permanent blind spot in his retina; his vision loss resulted from a punch to the face—but whether legal or not it is unknown. Therefore, it can be assumed that the illegality of punches to the face in Taekwondo sparring rules is a good safety measure for protecting vision.

Recording fewer than twelve Taekwondo-induced eye injuries over the past 17 years is quite remarkable. Although this number should make us relieved that chances of eye injury are low, those twelve cases still serve as a warning that our eyesight—one of the most

valuable senses we possess—can be compromised in competitive Taekwondo. Thus, based on the literature and on authoritative sources, Taekwondo does not appear to cause a significant number of eye injuries or visual defects. Yet as it has been found that head injuries are common in competition, it is extremely important to learn effective methods for preventing eye injury and protecting our eyesight.

## **Trends of Head Injuries in Martial Arts: A Survey of UCMAP Members**

To examine the types of head and eye injuries seen among martial arts outside of Taekwondo and Karate, I conducted a brief survey of current UC Martial Arts Program (UCMAP) members. Founded in 1969, UCMAP consists of six clubs: Judo, Karate, Taekwondo, Taichi, Yongmudo, and Wushu. Each art emphasizes different techniques and I wanted to identify trends among them in terms of head and neck injuries.

### **Purpose:**

The purpose of this survey was to examine members of six different martial arts and identify which art sustains the most head, neck, and eye injuries. I also analyze and present three interesting cases of eye trauma that UCMAP members have sustained.

### **Methods:**

I created a brief survey through the online survey service, [www.surveymonkey.com](http://www.surveymonkey.com), consisting of five questions with these possible answer choices:

Question	Answer choices
1. Which UCMAP club have you/ do you participate in?	Judo Karate Taekwondo Taichi Yongmudo Wushu
2. How many years have you been practicing your Martial Art (total)?	1-5 years 6-10 years 11-15 years 15+ years
3. Have you ever received any head, face, or eye injuries while practicing or competing in your martial art?	Yes No
4. If you answered "YES" to #3: Please describe briefly (location, situation, severity, etc).	[free answer]
5. Would you mind if I contacted you for further information regarding your injury? Please write your email address.	[free answer]

UCMAP members were asked through email to complete the survey. The survey was open for 18 days and injury data was sorted into six categories based upon regions of the face: eyes and eyebrows; cheeks, ears, and side of head; jaw, mouth, chin and teeth; nose, forehead, and top of head; neck and spine; and knockouts or concussions. Each reported injury was treated as an individual case, even if one person reported multiple injuries. Injuries were not double-counted or placed in multiple categories even if it

affected multiple areas (for example, an axe kick to the eye that caused a black eye and a knockout was counted as an eye injury only and not also as a knockout).

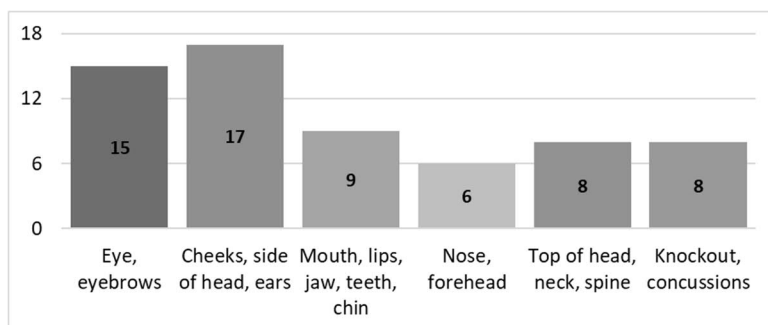
People with more serious eye injuries were then emailed follow-up questions to better understand the situation in which the accident occurred and to explore possible lasting vision effects that may not have been explained in the original survey response.

## **Results:**

74 people responded to this survey ( $n = 74$ ). The three most-practiced martial arts among respondents were Yongmudo, Taekwondo, and Judo: Fifty of the 74 respondents (67.6%) currently or used to practice Yongmudo; 44 participate or had participated in Taekwondo; and 14 had experience in Judo. It was possible for one subject to answer that they had belonged to multiple arts, and indeed many people were part of multiple clubs.

Out of the 74 respondents, 39 people answered positively to having received any type of eye, head, or neck injury. Among those 39 people, a total of 63 injuries were reported (see Figure 5).

***Figure 5: Self-reported head & neck injuries by type***



The most common site of trauma among all UCMAP respondents was in the region of the side of the head, including the ear and cheeks, which claimed 17 injuries out of the total 63 reported head and neck injuries (27.0%). For Taekwondo martial artists, the main cause was, naturally, kicks—such as axe kicks—to the face. For Yongmudo, the main contributors were kicks to the head as well as elbows to the ears or cheeks during groundwork. In fact, injuries to the side of the face was the most common type of injury experienced among Yongmudo practitioners. At ten out of 39 injuries incurred while engaging in Yongmudo, side-of-head injuries comprised 25.6% of total head and neck injuries in this club. Three Yongmudo practitioners sustained “cauliflower ear”—also known as auricular hematoma, where fluid or blood builds up between two layers of the outer ear and separates the cartilage from the perichondrium, which normally nourishes the cartilage. If the layers separate, the cartilage loses its source of nutrients and dies, causing the outer ear to permanently swell and deform.<sup>16</sup>

UCMAP members reported a total of 15 eye-related injuries ( $15/63 = 23.8\%$ ). These ranged from black eyes, orbital fractures, eyebrow burns caused by uniform abrasions, and foreign bodies embedded in the eyeball. There were no reported permanent eye injuries such as blindness or detached retinas. Among Taekwondo practitioners, face kicks of different varieties accounted for the most eye injuries; the most common mechanism was the axe kick, followed by back kick and jump spin hook kick. Only one Taekwondo member’s eye injury resulted from a splinter entering the eyeball while holding for a board break. Eye injuries caused by hands

and elbows most often occurred among Yongmudo and Judo members engaging in ground work or group drills.

Eye injuries occurred most frequently in the Taekwondo club out of the six different clubs. Conversely, the most common head or neck injury among Taekwondo members was injuries to the eye.

A total of eight knockouts or concussions (both mild and serious) were reported (12.7%). Yongmudo practitioners sustained most of these; the three that occurred in Taekwondo resulted from kicks to the head during competition or “blunt force trauma” throughout years of training.

Having between one to five years of martial arts experience—whether Taekwondo, Judo, or Yongmudo—was the most common trait among survey respondents (35 out of 74 respondents). Among this sub-group, 16 reported having a head or neck injury of some form (45.7%).

## **Discussion**

Based on survey results, representing Yongmudo and Taekwondo most heavily, trauma to the side of the face, the cheeks, and the ears was the most common head or neck injury, especially in the Yongmudo club, where head gear is not normal protective equipment. Injuries directly affecting the eye and eye-related structures followed as the second-most common site of injury.

As UCMAP is located on a four-year college campus, it is natural for most members to have between one to five years of martial arts experience, for many of us discovered martial arts through physical education classes or joined the clubs only after beginning studies at the University of California, Berkeley. Additionally, it



is understandable for this sub-group (that has between 1–5 years of experience) to have a roughly even divide among those with head injuries and those without: those who have experienced head or neck injuries have probably been participating in martial arts long enough to engage in full contact with others; the other half are probably newer to martial arts and have not yet begun full-contact and therefore have not received any head or neck injuries as of the time of this survey. To better understand the relationship between years of experience in martial arts and incidence of head injury, the categories of years of experience should have been broken down into smaller ranges, such as 1 year, 2 years, 3–4 years, 5–6 years, 6–10 years, 10–15 years, and 15+ years. Typically, full-contact martial arts are not fully practiced until after about one year of club experience. Thus, a better sense of the relationship between experience and injury would have been gained with narrower ranges of years.

In Taekwondo alone, kicks to the head—as opposed to illegal punches, stray boards or other accidents—were the primary source of face and eye injury. The fact that trauma resulted from purposeful kicks to the head supports Mars’ suggestion to exclude the head as a legal target in martial arts in order to prevent permanent damage. Fortunately, for several Taekwondo members, black eyes that healed within a week or two were the most obvious signs of damage; no Taekwondo member reported permanent vision defects or eye trauma.

With eight eye injuries out of 21 total head and neck injuries incurred during Taekwondo practice or competition, eye trauma comprises a large percent (38.1%) of all reported Taekwondo head and neck

injuries. On the other hand, Trish Bare Grounds, the USA Taekwondo Association, and other national Taekwondo associations have found fewer than one dozen eye injuries among thousands of head and body injuries incurred during national, regional, and local competitions since 1993. Although a direct comparison cannot be made between this study and her extensive research—because the data in this paper include non-sparring injuries and because I did not collect data on any injuries below the neck—it can still be seen by absolute values alone that UCMAP has seen 2/3 the number of eye-related injuries as the entire nation has recorded. This discrepancy may have arisen from a difference in the definition of an eye injury. It is possible that Ms. Bare Grounds only included permanent eye defects whereas I included healable trauma such as black eyes and torn eyelids.

If I narrow the definition of “eye injury” to only those with permanent damages, then UCMAP has reported zero such cases. This 0% rate much more closely reflects the value that Ms. Bare Grounds has found, whose 12 cases out of thousands of head, neck, and body injuries in Taekwondo is practically zero as well. Thus, my survey could have been strengthened if I had enforced more stringent parameters, and also if I had asked for the bodily injuries of UCMAP members so that I may have been able to examine the ratio of eye injuries among all injuries, as Ms. Bare Grounds had done. If I had done so, I predict that many hand, foot, leg, and hip injuries would have been reported. Thus, the rate of eye injuries, compared to entire-body injuries, would have appeared much lower and much more similar to that of Ms. Bare Grounds’ findings.

Another possible source of error in my study that may have artificially inflated the rate of eye injuries at UCMAP Taekwondo is the relatively low response rate. Only 44 Taekwondo members responded to the survey when club membership is about 170, and several respondents were primarily Yongmudo practitioners who had dabbled a semester or two in Taekwondo. Despite the instructions in my original email soliciting survey responses from everyone regardless of positive or negative eye injury history, it is possible that some people who have never sustained any head or neck injury misunderstood and thought it unnecessary to respond because they thought it did not apply to them. Having a smaller sample size makes the number of eye injuries that were reported comprise a larger percentage of all reported data.

One last potential source of error is that not all UCMAP members may have received word of the email, whether because they are not on the email listserv, or declined the solicitation of survey responses. Thus, this data only applies to Yongmudo, Taekwondo, and Judo clubs of UCMAP; and injury data on Taichi, Karate, and Wushu cannot accurately be assessed because of the lack of responses from these last three clubs.

## **Conclusion**

From this brief survey of UCMAP members, it can be concluded that eye-related injuries occur most frequently to the Taekwondo club, where members receive powerful kicks to the face and eye area during competitive sparring. However, if only permanent eye defects are taken into account, then members of UCMAP enjoy a 0% rate of enduring these lasting and

devastating damages. Yongmudo club experiences more side-of-face injuries than any other type of head or neck injury, especially cauliflower ear. Taekwondo club experiences more eye-related injuries than any other type of head injury.

Thus, based on my survey of 74 UCMAP members, it can be concluded that martial arts are a relatively safe sport and practice thereof does not pose significant threat of permanent damages to our vision.

## **Discussion of Three Unique Eye Injury Cases**

Although none of the responses reported permanent eye injury, three cases are especially unique and deserve elaboration. They illustrate the variety of dangers that martial arts may pose to practitioners, and cover three different martial arts.

### **Case 1: Foreign Body Entering the Eye and the Risks of Corneal Abrasions in Taekwondo**

One Taekwondo member who had practiced martial arts for over 15 years and had Yongmudo and Judo experience reported having received a splinter in one of his eyes.<sup>17</sup> This occurred while he was holding a wooden board for a break; although he had averted his face, a small piece of wood still flew toward him and became embedded in the clear tissue overlying the white part of his eye—the conjunctiva—about one millimeter inferior to the cornea (see Figure 2). The subject reported that the splinter irritated him more than it hurt so he had rubbed it frequently, which most likely caused the bits of wood to move around, scratching his cornea and the inner lining of his

eyelids. He sought treatment at the student health center the next day, where they attempted to remove the splinter with a special tweezer. However, the splinter shattered into more pieces at the touch of the tweezer, so the optometrist finally had to remove the pieces with what the subject remembers as an evisceration spoon.

Rubbing a foreign body such as a splinter in one's eye multiplies the magnitude of the problem even though the scratching might create temporary relief from the irritation. The foreign body can drive further into the eye or disintegrate into multiple pieces as it did for this patient. Then, actions such as blinking or rubbing can drag the foreign bodies around the surface of the eye, creating a mechanical force that scratches the cornea with each blink or touch. The cornea—which is smooth and clear to allow light to enter the eye and create the sensation of vision—is protected from the environment by a layer of epithelium comprised of five to seven layers of cells. The epithelium normally undergoes fast cell turnover and renews itself every seven days, so abrasions damaging layers within the epithelium can heal after several hours or overnight, but a wound penetrating past the epithelium and into the layer of the cornea beneath it, the stroma, may take months to completely heal.<sup>18</sup> Furthermore, the layers of the stroma in the cornea achieve transparency by maintaining regular layers of fibers. This special, uniform structure minimizes light scatter and enables uninhibited vision. However, once this unique layering is disrupted, as with a wound, opacities may occur and light entering the eye may scatter, thus disrupting normal vision.<sup>19</sup>

This subject was fortunate in the sense that the splinter did not penetrate his cornea, but rather had become embedded in the conjunctiva overlying the sclera. The sclera is composed of thick layers of dense connective tissue interweaving in random patterns, which explains its opacity, strength, and flexibility.<sup>20</sup> If the splinter had entered his cornea, it most likely would have posed much more serious healing and visual problems as described above. Thus, because foreign bodies in the eye present the risk of corneal scratches and may even interrupt normal corneal transparency, martial artists—especially Taekwondo practitioners who break boards or Yongmudo martial artists who break cinder blocks to demonstrate power—should take caution to avoid getting splinters or other foreign bodies embedded in their eyes.

## **Case 2: Orbital Blowout Fracture Resulting from Grappling in Jiu Jitsu**

The second case I will present happened to a non-UCMAP member practicing Jiu Jitsu but was reported by a Taekwondo member.<sup>21</sup> I include it in this paper because it involves grappling and can be applied to other martial arts that practice groundwork, such as Judo and Yongmudo.

The Taekwondo member reported that her brother had been grappling in Jiu Jitsu practice and had been trying to get his leg free from under his opponent. He miscalculated and when he relaxed his leg, his opponent's force caused his knee to ram into the subject's orbit: a blowout fracture. This resulted in diplopia (double vision) in upward and downward gaze and enophthalmos—the sinking of the eyeball into the socket. Two weeks after the incident he underwent surgery to treat the enophthalmos, which now

"looks better, but worsened diplopia." He currently wears special glasses containing prisms, which eliminate the perception of double vision by bending light and shifting images so that they appear to come from the direction in which the eye is pointing.

Enophthalmos usually occurs when an object such as a fist, tennis ball, or, in this case, the knee, collides past the frontal bone of one's orbit (see Figure 1) and connects with the eye. The force of the incoming object pushes the eye down, breaking the maxillary bone and causing the eyeball to sink down and inwardly.<sup>22</sup> Typically, double vision results because the eyes are now vertically off-set just as it was for the subject with exophthalmos in the paper by Siana, et al; fusing two radically different vertical images is an extremely difficult task for the brain. More serious consequences of a blowout fracture include orbital infections and retinal detachments at the fovea.

Although no one in UCMAP has reported having received a blowout fracture during groundwork, it is still important to be aware of such devastating reverberations. Perhaps protective goggles could be worn to prevent permanent visual consequences. Further research would need to be conducted analyzing the frequency of blowout fractures in groundwork-intensive martial arts and the benefits and drawbacks of wearing protective eyewear.

### **Case 3: A Retinal Detachment Scare Resulting from Weapons Practice in Wushu**

The individual from the UCMAP Wushu club who responded to my survey reported having injured her left eye and her nose while practicing with a weapon.<sup>23</sup>

Although her response was the sole representation of Wushu club, she stated that she knows of “stories of people who’ve gotten injured in a similar manner”.

While practicing with the straight sword, this patient reported not paying attention for a moment and accidentally striking herself on her left eye and nose. She reported that there was bleeding in the back of her left eye, blocking her vision from that eye for about four to five hours. After the bleeding went away, her vision returned to normal. No stitches were required, but she says that extensive tests had been performed because the optometrists were concerned about a possible detached retina. Fortunately, this subject had not actually suffered a detached retina.

A retinal detachment is usually when the rod and cone photoreceptor cells separate from the retinal pigment epithelium (RPE), the outermost layer of the retina that supplies nutrients to the photoreceptors and lies interior to the choroid (see Figure 2). This is the most likely place of detachment because there are no intercellular junctions joining the RPE with the photoreceptors; they only remain close together due to passive factors such as intraocular pressure (IOP, the pressure within the eye) and the presence of the vitreous (the collagenous jelly-like substance filling the inside of the eye which pushes up against the retina and subsequently “holds up” the retinal layers) (see Figure 2). When a retinal detachment occurs, the photoreceptors lose their blood supply and will die unless they are quickly reattached. Often, an argon laser is used to “glue down” the borders of the detachment, preventing the separation from enlarging and also assisting with the reattachment of the photoreceptors to the RPE.<sup>24</sup>



Fortunately, this particular case did not result in a retinal detachment. If it had, the subject may have had to laser or freeze her retina back on to preserve her vision and prevent blindness. Although more research must be performed before being able to draw conclusions about the rate of injuries caused by weapons such as straight swords in Wushu, this case may still serve as a reminder of the care martial artists need to take in order to avoid potentially losing their vision.

## **The New Taekwondo Competition Rules and its Impact on the Rate of Head Kicks**

A recent change in Taekwondo competition scoring rules might encourage more head kicks and lead to an increase in the number of head or eye injuries. As of March 2, 2010, the World Taekwondo Federation (WTF) changed the way kicks are scored. Instead of the traditional two points per head shot and one point per body shot, the official rules now award one point for a body kick, two points for a turning kick to the body, and three points for face or head kicks. According to the 2009–2010 UCMAP women's Taekwondo Competition Team Captain, Olivia Ngai, more competitors at the 2010 Collegiates in Denver, Colorado, attempted head shots than in the previous year. Ms. Ngai suspects that competitors wanted to gain more points more quickly since head kicks are now more greatly rewarded.<sup>25</sup>

Electronic hogus, or body protectors, have also recently been introduced to the Taekwondo competition scene. Ms. Ngai believes that these hogus might also play a role in the increased number of attempted head shots: Because they are reportedly less

effective at detecting body kicks, competitors try instead to target the head, where attempts are more obvious and therefore more likely to be scored.

Since the new scoring system and the implementation of the electronic hogus are still relatively recent, it will be difficult to say definitely whether or not these will affect the rate of head kicks and resulting head injuries. However, the study by Kazemi, et al, may serve as a predictor. This study researched the incidence of head injuries before and after the change in scoring in 2003, when head kicks were given more points than a body kick. Kazemi found that "recent rule changes have no significant effect on head injuries." Thus, this study might indicate that the 2010 point system changes may not generate more head or eye injuries.

## **Conclusion**

Our vision is one of the most precious gifts we have in this life. Fortunately, based upon the literature and my survey of head, neck, and eye injuries among UC Martial Arts Program club members, it may be observed that permanent eye injuries are not a frequent occurrence. According to the people who collect national data on all injuries incurred during Taekwondo competition, the rate of eye injuries is very low: only less than one dozen over the last 17 years. The survey I performed among UCMAP Judo, Karate, Taekwondo, Taichi, Yongmudo and Wushu members echoes this finding: based on the responses submitted, UCMAP has a 0% rate of permanent eye injuries.

However, as demonstrated in the literature and reported among UCMAP members, eye injuries still definitely do occur among various martial arts. In fact, the most common head or neck injury among UCMAP Taekwondo members were eye injuries from head kicks. As observed from the karateka in Mars' study who suffered a choroidal rupture and eventually a blind spot, to the Jiu Jitsu practitioner who sustained a blowout fracture and consequently permanent diplopia, to the splinter embedded in the eye of the Taekwondo martial artist, to the near-retinal detachment a girl incurred during Wushu practice, accidents do happen and sometimes endanger our visual health. Martial arts bestow so many benefits such as mental discipline, humility, focus, physical fitness, and camaraderie—but it is of vital importance to remember to protect our eyes whenever possible.

## References

- American Optometric Association. "How Your Eyes Work."  
Available at <https://www.aoa.org/patients-and-public/resources-for-teachers/how-your-eyes-work>  
Accessed July 8, 2010.
- Banks, Martin. Vision Science 219: Binocular Vision Reader  
Spring 2010. University of California, Berkeley, School of  
Optometry, p. 45
- Bare Grounds, Trish. Interview by author via email  
correspondence. July 2010.
- Doe, Jane. Interview by author via email correspondence.  
July 5, 2010.
- Doe, Joan. Interview by author via email correspondence.  
June 30, 2010
- Doe, John. Interview by author via email correspondence.  
July 15, 2010.
- Encyclopedia Britannica, Inc. "Vieth-Muller horopter circle:  
fixation plane." 1994. Available at  
<http://media-2.web.britannica.com/eb-media/83/4083-004-A08588CF.gif>  
Accessed July 15, 2010.
- Eyes and Eyesight blog, "Anatomy of the Eye". Available at  
<http://www.eyesandeyesight.com/wp-content/anatomy-of-the-eye.jpg>  
Accessed July 12, 2010.
- Fleiszig, Suzanne. "The Ocular Surface." Vision Science 206A:  
Anatomy and Physiology of the Eye. University of  
California, Berkeley, School of Optometry. September 17,  
2009.

Gong, Xiaohua. Vision Science 206A: Anatomy and Physiology of the Eye. University of California, Berkeley, School of Optometry. September 9, 2009.

Harvey, Patsy. "History of Optometry" Optometry C10: Introduction to Optometry. University of California, Berkeley, School of Optometry. January 18, 2007.

Kazemi, Mohsen, with Artur Chudolinski, et al., "Nine Year Longitudinal Retrospective Study of Taekwondo Injuries." *Journal of the Canadian Chiropractic Association*, v. 53, no. 4, December 2009, pp. 272–281. Available at <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2796946/> Accessed July 13, 2010.

Kazemi, Mohsen, and Willy Pieter, "Injuries at a Canadian National Taekwondo Championships: A Prospective Study." *BMC Musculoskeletal Disorders*, July 27, 2004; v. 5, no. 22, 7 pages. Available at <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC506779/> Accessed July 13, 2010.

Koh Jae O, and J. David Cassidy, "Incidence study of head blows and concussions in competition taekwondo." *Clinical Journal of Sport Medicine*. March, 2004, v. 14, no. 2, pp. 72–79. Available at <http://www.ncbi.nlm.nih.gov/pubmed/15014340> Accessed July 13, 2010.

Mars, J S and D. Pimenides, "Blinding choroidal rupture in a karateka." *British Journal of Sports Medicine*. December 1995, v. 29, no. 4, pp. 273–278. Available at <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1332241/> Accessed July 13, 2010.

Ngai, Olivia. Phone interview by author. Berkeley, CA. June 25, 2010.

Remington, Lee Ann. *Clinical Anatomy of the Visual System*, 2nd Ed. St. Louis: Elsevier, 2005, ISBN# 0750674903.

- Siana J.E., with P. Borum, and H. Kryger, "Injuries in Taekwondo." *British Journal of Sports Medicine*. December, 1986, v. 20, no. 4, pp. 165-166
- Tómate tu medicina! "Bones of the Orbit." Available at <http://tomatetumedicina.files.wordpress.com/2008/04/bony-orbit.jpg>  
Accessed July 10, 2010.
- Van Sluyters, Richard, "Appendages of the Orbit." *Vision Science 206B: Anatomy of the Eye*. University of California, Berkeley, School of Optometry. January 26, 2010.
- Van Sluyters, Richard, "Myology." *Vision Science 206B: Anatomy of the Eye*. University of California, Berkeley, School of Optometry. February 2 and 4, 2010.
- Van Sluyters, Richard, "Position of the Globe in the Orbit." *Vision Science 206B: Anatomy of the Eye*. University of California, Berkeley, School of Optometry. January 21, 2010.
- Wikipedia. "Cauliflower ear." Available at [http://en.wikipedia.org/wiki/Cauliflower\\_ear](http://en.wikipedia.org/wiki/Cauliflower_ear)  
Accessed July 12, 2010.
- World Taekwondo Federation. "Competition Rules and Interpretation." Available at <http://www.worldtaekwondo.org/world-taekwondos-new-competition-rules/>  
Accessed July 12, 2010.
- Yu, Yunguo. "Visual Pathway in the Brain", Mount Sinai School of Medicine, Department of Neuroscience. Available at [http://www.rhsmpsychology.com/Handouts/Visual\\_pathway.jpg](http://www.rhsmpsychology.com/Handouts/Visual_pathway.jpg)  
Accessed July 12, 2010.

## Endnotes

- <sup>1</sup> Kazemi and Pieter
- <sup>2</sup> World Taekwondo Federation Competition Rules
- <sup>3</sup> Harvey
- <sup>4</sup> Gong
- <sup>5</sup> Van Sluyters, "Appendages of the Orbit."
- <sup>6</sup> Fleiszig
- <sup>7</sup> Van Sluyters, "Myology."
- <sup>8</sup> American Optometric Association. "How Your Eyes Work."
- <sup>9</sup> Remington, p. 55
- <sup>10</sup> Remington, p. 232
- <sup>11</sup> Siana
- <sup>12</sup> Van Sluyters, "Position of the Globe in the Orbit."
- <sup>13</sup> Banks, p. 45
- <sup>14</sup> Kazemi, Chudolinski, et al.
- <sup>15</sup> Remington, p. 51
- <sup>16</sup> Wikipedia. "Cauliflower ear."
- <sup>17</sup> Doe, John
- <sup>18</sup> Remington, p. 12
- <sup>19</sup> Remington, p. 18
- <sup>20</sup> Remington, p. 24
- <sup>21</sup> Doe, Jane
- <sup>22</sup> Van Sluyters, "Position of the Globe in the Orbit."
- <sup>23</sup> Doe, Joan
- <sup>24</sup> Remington, p. 58
- <sup>25</sup> Ngai