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# Listen to the Patient

**Shakila Abdul**

I did not know that by feeding copious amounts of formula to my newborn daughter, Sara, I was pushing her closer to death. When Sara was born in the hospital, like many other mothers, I started breastfeeding her. Unexpectedly, breastfeeding made Sara fussy. Thinking that Sara was hungry, I started feeding her baby formula rather than breast milk. She started vomiting soon after each feeding, and sometimes her color changed from red to bluish red. Worried and panicked, I described Sara's symptoms to the two resident doctors who frequently checked her. They assured me that vomiting and change of color after birth were normal for most babies. But Sara's vomiting and crying seemed almost non-stop. Sara's constant vomiting and seeming hunger forced me to keep feeding her both formula and breast milk during my after-birth hospitalization.

Whenever the two resident doctors visited her, I repeatedly expressed that Sara's vomiting and other symptoms did not seem normal based on my experiences with my two previous babies, but I received the same response from them. The day I was discharged from the hospital, Sara finally went to sleep in the morning. In the afternoon, after she was thoroughly checked by the two resident doctors, I took her home thinking that she was still asleep. At home, I could not wake up Sara, and in a few hours I was back in the hospital's emergency room with my little girl in a coma.

Perfectly normal looking and highly responsive when born, Sara suffered from a genetically rare and deadly disease called Argininosuccinic aciduria. In 1958, J.D. Allan, a British doctor, and his colleagues first described argininosuccinic

aciduria or argininosuccinic acidemia.<sup>4</sup> Human genes, like most organisms' genes, come in two copies and contain instructions for the production of many molecules (proteins) in the body. Life sustaining processes such as the urea cycle, involved in the production of urine, use these molecules.<sup>2</sup> In some individuals, such as my husband and I, one copy of the gene is impaired, but the gene product of the other copy is enough to compensate for the deficiency. Receiving both impaired copies of the gene, as Sara did, gives rise to genetic disorders like argininosuccinic aciduria.

Protein, a life sustaining substance, becomes a deadly poison in argininosuccinic aciduria patients. Unlike carbohydrates and fats, the body cannot store proteins.<sup>1</sup> Catabolized excess proteins liberate nitrogen in the form of ammonia (NH<sub>3</sub>). Ammonia is further metabolized in the liver by the urea cycle and eliminated as urea by urination. In babies with argininosuccinic aciduria, like Sara, ammonia cannot be metabolized and accumulates in the blood, mostly in the form of argininosuccinic acid. When present in higher levels than normal, ammonia is very toxic to the body, especially to the central nervous system. As a result, Sara's vomiting and fussiness intensified after frequent feeding with high protein formula along with breast milk.

Clinical manifestations of argininosuccinic aciduria are evident in the first few days of life. The symptoms include lack of energy (lethargy), poor sucking, vomiting, irritability, poorly regulated body temperature or breathing rate, and ultimately coma and seizures.<sup>1</sup> Argininosuccinic aciduria is also characterized by high levels of argininosuccinic acid, an intermediate in the urea cycle, in the urine and blood.<sup>1</sup> Sara was in a coma in her third day of life. She also had several episodes of seizure when the doctors were trying to wake her up in the emergency room before she was hospitalized in the intensive care section at the UC Davis Children's Hospital.

Although many patients with argininosuccinic aciduria suffer from mental retardation, the syndrome is treatable.<sup>5</sup> Mental retardation is preventable if patients are diagnosed and treated before plasma

ammonia reaches toxic levels. If a neonate is diagnosed with argininosuccinic aciduria, physicians can stabilize ammonia levels in the blood by temporarily ceasing protein intake, increasing non-protein caloric sources, administering several medications intravenously such as benzoate, arginine, and phenylacetate along with hemodialysis. Long-term therapy includes a low protein diet and arginine supplementation. In some other studies, sodium benzoate and sodium phenylacetate intake are also recommended.<sup>1</sup> These two substances bind with glycine and glutamine, respectively, and promote glycine and glutamine excretion by bypassing the urea cycle.<sup>1</sup>

The normal level of ammonia in the blood is less than 100 $\mu$ mol/L of the blood, but Sara's plasma level of ammonia was 2016  $\mu$ mol/L on her fourth day of life. Sara was put on dialysis and received a blood transfusion. As I write these sentences, I see her buried under the plastic tubes for life support and dialysis. The doctors were finally able to bring down her plasma ammonia levels close to normal. On the ninth day of Sara's life, after analysis of several PET scans from multiple parts of her brain, doctors formally pronounced Sara dead. To me, Sara died the night I took her to the emergency room.

Argininosuccinic aciduria is one of several inborn errors of metabolism (IEM).<sup>3</sup> IEMs are individually rare, but collectively they constitute a significant proportion of childhood illnesses. The rarity of IEMs does not mean they can be ignored and assumed to be nonexistent. In the case of Sara, the resident doctors ignored this fact. I am still shocked by their negligence regarding my concerns about Sara's vomiting and abnormal reactions. The two resident doctors did not even bother to share my concerns with the pediatrician in-charge. The resident student doctors just relied on what they knew from the literature and medical books, in which symptoms of a particular human disease are nothing more than thorough descriptions by afflicted patients. A good doctor, by contrast, diagnoses a condition in a patient based heavily on the patient's illustration of the symptoms. I hope Sara's story has changed current and future physicians' perspectives

about the treatment of their patients. It is very important in medicine to take any deviation from normal seriously, regardless of who describes the symptoms.

# What Did You Say?

Anugeet Aujla

"Grandpa, do you know what we are having for dinner?" I ask him while walking toward the park. "Yes, yes, it is indeed a lovely evening," replies Grandpa. I look at him suspiciously and realize that he has forgotten his hearing aid at home. "Grandpa...?" I repeat my question, this time a little louder so that he can hear me clearly. "Uhh... What?" He looks at me with his narrowed eyebrows and his eyes focus on my lips as I repeat my question for the third time. "Oh, I think we have some chicken gravy," he replies with a smile. Hearing loss in elderly adults is a fairly common disorder and is medically referred to as presbycusis.

It is estimated that more than half of people seventy-five and older have some hearing loss.<sup>1</sup> Although presbycusis is usually detected in people over 50 years of age, the deterioration of hearing associated with it has been noticed in people as young as 20 years old. People with presbycusis usually complain of not being able to hear high-pitched sounds. For example, it may be strenuous for someone to hear a high pitched opera singer, but the same person may be able to hear a low pitched rapper. One problem with detection of presbycusis is that people who have it may not even realize that their hearing is diminishing as the process is very gradual. Presbycusis is usually considered a snowballing, negative effect of the various noises, like loud music or a noisy workplace, which surround us. As a person

ages, the cochlear hair cells responsible for acoustic sensitivity in the inner ear may become damaged due to excessive noise, resulting in hearing loss. These receptive hair cells cannot re-grow in humans; however, a recent study done at Harvard shows that cochlear hair cells can re-grow in mice.<sup>2</sup> This research provides a new approach to replace the lost hair cells in humans, which is a leading cause of hearing loss in adults. Loss of cochlear hair cells is not only permanent, but it may also be accompanied by thickening and stiffening of the basilar membrane of the cochlea. The basilar membrane plays a crucial role in transfer of sound waves to the brain; therefore, its distortion can lead to poor sound conduction. Presbycusis may also result from atrophy, or breakdown and reabsorption, of the stria vascularis, which maintains the chemical and bioelectric balance of the cochlea in the inner ear.<sup>3</sup>

In order to explain presbycusis, another major theory which includes a hereditary component has been put forward. According to this theory, reduced perfusion, or the delivery of arterial blood, to the cochlea (associated with age) may form reactive oxygen metabolites. These metabolites include a wide variety of free radicals such as superoxide, nitric oxide, and hydroxyl radical. These free radicals damage the mitochondrial DNA of the inner ear, which can cause problems with the neural functioning of the inner ear.<sup>3</sup> It has been found that in addition to the loss of cochlear hair cells, there is also a loss of neurons (spiral ganglion cells) in the Organ of Corti, which is also found in the inner ear, in people suffering from the disorder. The neural loss begins early in life and is pre-determined genetically; however, the effects are noticeable only in late age, as hearing tones are not affected until 90% of the neurons are dead.<sup>3</sup> Damage to the mitochondrial DNA of the inner ear has also been associated with anatomical changes in the inner ear. For example, severe narrowing of the vaso nervorum (network of small arteries that provide blood supply to peripheral nerves) in the middle ear, is associated with a mitochondrial DNA deletion.<sup>3</sup> Two specific mitochon-

drial DNA deletions, mtDNA4834 and mtDNA4977, have been linked to age-related hearing loss in rodents, although the latter is more closely related with humans.<sup>3</sup> A presbycusis patient may have problems with conduction of sound either due to reduced functioning of the tympanic membrane (the eardrum) or due to reduced function of tiny bones (malleus, incus, and stapes) in the middle ear.<sup>1</sup> Some medicines, such as aspirin and certain antibiotics, which are usually taken regularly by adults later on in life, result in side effects leading to presbycusis.<sup>1</sup> However, the mechanisms of action by which medicines affect the ears are not well understood.

Although presbycusis does not have a non-invasive cure, it can be prevented from worsening. Devices such as the built-in telephone amplifier can help patients with hearing, along with a regular hearing aid. A simple device like a hearing aid can avert a person from disconnecting from the beautiful voices of the world. Current wireless hearing aids use FM systems (similar to radio) to eliminate background sounds and clarify conversations for the user.<sup>1</sup> In addition, training in reading visual cues can help those with presbycusis to better understand what is being said in conversations.<sup>1</sup>

Presbycusis results from the wear and tear inside an ear during one's lifetime. The changes can be caused by environmental conditions as well as by genetic factors. Although it is not entirely possible to prevent presbycusis, measures can be taken to prevent its negative impact on a person's life. Even though presbycusis is usually caused during old age, it is never too early to start taking precautions. By limiting our exposure to the loud sounds that surrounds us, we can at least reduce the probability of having hearing loss due to environmental conditions. Presbycusis is not a disease, but a disorder, that can be prevented to a certain extent if we take proper precautions throughout life.

# Performance at a Price

**Sukhpal Dhanjal**

While I was talking to a friend about his high school football season, he brought up the subject of performance enhancing supplements. “All of the guys on my team are juicing it up,” he said. I knew that my friend was a devoted athlete and practiced daily. I had seen him spend countless hours in the gym and also hold back on eating out in order to maintain his diet. I could tell that he was not happy about being outperformed on the field because of the advantages his teammates may have had by using performance enhancing supplements. In order to keep up with the team and not let anyone down, my friend felt compelled to do the same. When he was considering taking them as well, I asked him, “What about the side effects, and would it be worth it in the long run?”

In 2003, a Blue Cross Blue Shield Association survey found that 1.1 million teenagers in the U.S., ages 12 to 17, had used performance enhancing supplements and drugs. This number is said to be on the rise as performance enhancing supplements have become more readily available on store shelves and online.<sup>1</sup> Creatine, anabolic-androgenic steroids, and diuretics are the most commonly used supplements. Very little is known about the long term effects of these supplements, but many short term studies suggest serious side effects.

Creatine is considered the most popularly used supplement by athletes. It is a naturally occurring compound that is produced by the body in order to aid in the release of energy by muscles. Scientific studies show that creatine may have some athletic benefits because it helps in the production and circulation of more adenosine triphosphate (also known

as ATP, a substance produced in the body that stores and transports energy in cells) in muscles, and it also delays muscle fatigue.<sup>5,6</sup> These benefits are very useful for activities that require short bursts of energy, such as sprinting and weightlifting. But the studies also show that creatine use results in side effects such as stomach and muscle cramps, nausea, diarrhea, and weight gain from water retention. Long term usage of creatine may even lead to kidney and liver damage. These side effects occur because creatine has a plateau effect in the body, meaning that creatine cannot be stored, so any excess creatine must be secreted, causing stress on the kidneys and liver.<sup>6</sup>

Anabolic-androgenic steroids are commonly used by athletes to increase muscle mass and strength. The main anabolic-androgenic steroid produced in the human body is testosterone, and the majority of steroid supplements are synthetic forms of testosterone. Testosterone is called an anabolic-androgenic steroid because it has both anabolic and androgenic effects. Anabolic effects help with muscle building, and androgenic effects stimulate growth of facial hair and other masculine traits. There are serious side effects from taking steroids since the human body has a natural balance of hormones which the body still tries to maintain even when someone takes a steroid like testosterone. Males usually begin displaying more feminine traits because of this hormone imbalance. These side effects include development of prominent breasts, shrunken testicles, and infertility. Females usually begin displaying more masculine traits due to the increased amount of testosterone. These side effects include increased body hair, a deeper voice, and an enlarged clitoris. There are also many side effects that both males and females experience including baldness, liver abnormalities, severe acne, aggressive behavior, cholesterol lipoprotein proportion imbalance, and inhibited growth and development.<sup>4,6</sup>

Diuretics are used by athletes who wish to decrease their weight. Many athletes use diuretics in order to compete in a lighter weight class, which gives them an advantage. Athletes also use diuretics

to speed up the elimination of other performance enhancing supplements from their system in order to pass testing procedures. Some common diuretics include Diamox, Aldactone, and Lasix. These supplements change the natural balance of fluids and electrolytes (salts) in the body, causing increased urination. The most common side effect of diuretics is dehydration. Exhaustion, muscle cramps, drop in blood pressure, dizziness, potassium deficiency, heart arrhythmias, and even death are other side effects associated with using diuretics.<sup>2,6</sup>

The side effects of using performance enhancing supplements are serious. David Marshall, M.D., a clinical instructor in the University of Michigan, Department of Pediatrics, and a physician at the University of Michigan Brighton Health Center, told College Sports Scholarships, "The consequences may turn out to be dire. But more and more younger athletes than ever before are imitating their professional sports heroes by using outlawed drugs and unproven supplements to pump up their bodies and their game."<sup>3</sup> Most of the studies on performance enhancing supplements were done on adults, so the effects on teenagers are even more concerning as they are still growing and developing. My friend's future most likely does not lie in professional football, and he now realizes that, for him, taking performance enhancing supplements is not worth the price. Even if he was to improve his performance by using supplements, drug tests are required in both college and professional football. In his case, the side effects of performance enhancing supplements are far too great to justify the use. Teenagers may have the misconception that certain over-the-counter supplements are safe, because they are attracted by the fancy advertisements and the ease of their availability. The increased teenage use of performance enhancing supplements is attributed to this misconception. In addition, teenagers tend to ignore side effects after only seeing potential results on the field, while ignoring the side effects suffered by users. Proper information regarding the dangers of performance enhancing supplements should be provided to teenage athletes. Then they can answer the

question for themselves: Are potential short term gains from using performance enhancing supplements truly worth the significant and harmful side effects?

# Treatment for Osteoarthritis

Ehsan Ejaz

Arthritis, an orthopedic condition, causes swelling and stiffness around the joints. The disorder can manifest as a result of breakdown of the joint's cartilage and ligaments. But some forms of arthritis, such as rheumatoid and juvenile rheumatoid arthritis, are autoimmune disorders. According to the Center for Disease Control and Prevention (CDC), about 46 million adults in the United States had some form of arthritis in 2006. The bureau estimated that by 2030, approximately 67 million Americans of ages 18 or older will have some form of arthritis.<sup>2</sup> While medical research on arthritis is still in its early stages, there is no complete treatment for most patients.

Most orthopedics patients suffer from Osteoarthritis (OA), also known as degenerative arthritis. OA typically affects the hips, hands, knees and lower back. Although the disorder can be hereditary, it can also result from joint injury, lack of physical activity, nerve injury, or repeated overuse of certain joints. For instance, Dr. John Krebs believes that basketball players, with years of pounding up and down the court, eventually wear out their knees and may cause them to develop knee arthritis.<sup>4</sup> Even with so many casualties of the disorder, the exact mechanisms of the disease's actions are still unknown. But among scientists, there is a consensus that OA causes inflammation of the joints by releasing inter-



stitial fluid, tearing the ligaments and cartilage. For most cases, these symptoms begin after the age of 40 and progress slowly thereafter. According to the bureau, about 50% people 65 years and older reported an arthritis diagnosis.

Most people have the ability to affect their own health when it comes to their OA. Health enhancing factors such as regular exercise and restricted diet are always helpful for most illness. Yet for OA patients, regular exercise and a restricted diet is not always enough. Many times weight reduction serves as a crucial treatment. As a matter of fact, approximately 66% of people diagnosed with arthritis are overweight or obese.<sup>2</sup> This strongly indicates that obesity, which is one of leading causes of death, negatively impacts OA. As shown in Figure 1, additional weight requires more work from the joints, causing them to eventually wear out. Thus, controlling weight can drastically reduce the risk of arthritis.

Even with normal weight, OA patients still need to take medications to reduce the pain. Naproxen, Ibuprofen, Nalfon, and Relafen are a few medicines most commonly used by OA patients. These anti-inflammatory drugs help to reduce the swelling in joints. While these medications benefit the patient in many ways, they also have side effects, including anxiety, diarrhea, vomiting, weakness, and indigestion. More importantly, long-term use of these drugs can lead to liver failure, renal failure, and other serious health problems. This evidence suggests that while arthritis may not always be life threatening, other diseases associated with arthritis can indirectly lead to fatal health conditions.



Figure 1

In the past several years, knee replacement surgeries have played an important role in changing the lifestyle of OA patients. Currently, a new advancement in surgical implantation procedures is significantly benefiting OA patients. This new advancement in surgical implantation involves a procedure which places a cushion between the femur and tibia. Three to four inch long incisions are made to place the cushion by computer robotic arms. The new use of this technology has significant potential benefits. An orthopedic surgeon, Dr. Richard Levitt said, "The cushion acts like new cartilage. It works very well. It alleviates the pain, the swelling, the deformity and really can cure the symptoms of arthritis."<sup>3</sup> Since the treatment is relatively new, it is only available in advanced research hospitals.

In an article on "Robotic Knee Surgery," Dr. Jay Aldersberg tells the story of Judy Turner.<sup>1</sup> Judy Turner had been camping, hiking, and biking with the Girl Scouts for several years. When she was diagnosed with OA she said, "It got really hard, I mean I couldn't, certainly couldn't run. And walking, I was always afraid I was going to trip." When she received the cushion implant surgery, however, she was even back on her legs a day after the surgery. She said, "I was surprised, I didn't think I would be walking that quickly, though he [the surgeon] told me I would."<sup>1</sup> The cushion implant, which lasts about ten to fifteen years, could significantly improve the quality of life for the patient.

This robotic arm is just the beginning of new surgical procedures that may benefit individuals suffering from OA. Researchers are working to increase

the durability of the knee by using the robotic arm to replace the knee. This procedure is being tested in labs and is in its final stages. With the new robotic arm, surgeons will find it possible to replace the whole knee with an artificial knee, something that

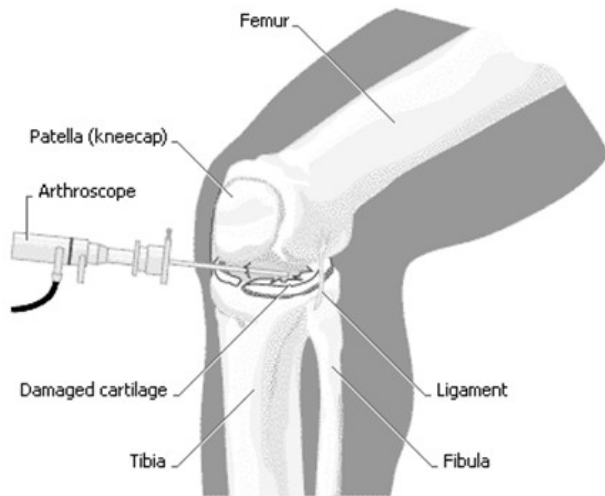


Figure 2

has yet to be done. The artificial knee would be attached to the femur and tibia, and would not affect the blood or nerve circulation of the leg. With the robotic arm, the tissue damage would be minimal and the rehabilitation would be faster. In spite of the evidence predicting that 67 million people will have to suffer from arthritis by 2030, new advanced treatments are proving to change the role of medicine and disease as we know it.

# Traumatic Brain Injury and Memory

Jennifer Gahan

Imagine going to Starbucks on your way to work. After driving 30 minutes, when it should only take you five, you start to realize that you do not remember where the Starbucks is. After you pull off to the side of the road, you call your roommate and get simple directions. You start to head toward the Starbucks, but after the first turn you cannot remember the rest of the directions, or even the drinks your roommate told you to buy. Then, you finally give up and go home. Though the drive has been an awful experience, you cannot remember any of it when you wake up in the morning. A person with traumatic brain injury (TBI) might experience this type of confusion every day.

Traumatic brain injury—an injury to the brain—can result from a direct blow to the head or a sudden stop, most often occurring during a car crash. Most people 18-24—college age—suffer TBI because of car accidents.<sup>1</sup> In a car crash, often a person may hit his or her head on the windshield, window, or dashboard, resulting in damage to the brain. However, it is not necessary for a person to directly hit his or her head. When a car suddenly stops, so does the person buckled in; however, the person's brain does not stop with the car. In this case, the victim's skull is the enemy, not the protector. The skull forcefully stops the brain. In either case, the brain can be badly damaged after a car accident, but the problems do not stop there.

Memory problems are one of the most common and severe results of traumatic brain injury. Memory impairments after traumatic

brain injury include loss of memory for locations, events, and spoken information. Although these problems can be severe, no reliably successful treatments currently exist to prevent or reverse such memory problems.

### ***What Happens During Traumatic Brain Injury?***

Traumatic brain injury (TBI) is an injury to the brain caused by an outside force which leads to brain damage.<sup>1</sup> After the initial impact, a number of issues arise that cause more destruction to the brain, including pressure buildup in the skull, blood clots, and cell death. Build up of blood in the skull results in high pressure, causing parts of the brain to die.<sup>2</sup> Blood clots prevent oxygen and nutrients from reaching the brain, resulting in tissue death.<sup>2</sup> In addition to cell death because of these external factors, cells of the brain can actually decide to commit “suicide.”<sup>2</sup> After TBI, cells receive signals that there are problems in the brain and will undergo what is called programmed cell death. All of the cell death that happens during TBI usually causes memory problems that last long after the victim returns home from the hospital.

### ***What causes memory problems after TBI?***

Cell death in the brain produces memory problems after TBI. Cells are essentially the work horses of the brain. The more cells you have, the better your work goes. The brain needs cells to store and retrieve memories. After TBI, there is extensive cell death in the brain. When cells die in memory centers of the brain, these centers cannot process memories anymore.

### ***What types of memory problems do people have?***

The brain contains many memory centers at various locations within the brain, and TBI often affects at least one of these centers. TBI usually disrupts areas of the brain associated with memory for events, speech, and location.<sup>4,3,5</sup>

### ***Episodic Memory***

College students rely on memory for events, called episodic memory, every day, and the inability to use it could be devastating. In college, students constantly meet new people and gain information. It would be difficult for students to make progress in their relationships or in classes if they could not remember that these events happened.

### ***Verbal Memory***

Loss of verbal memory due to TBI can also affect a student’s success in school. Verbal memory is the type of memory a student uses when she remembers that her psychology professor said, “There will be a pop-quiz tomorrow.” Though writing notes may serve as a viable method to remember what people say, it would be very tedious to have to write down absolutely everything.

### ***Spatial Memory***

TBI often affects the area of the brain specific to one’s memory of locations. A person uses memory of locations, called spatial memory, when navigating to a destination; this can include biking to the library, driving to In-N-Out, or walking to class.<sup>5</sup> Someone suffering from TBI with impaired spatial memory cannot get to places like lecture halls on their own. Again this is frustrating, but not insurmountable. People *can* use maps, written directions, or GPS systems, but what happens when options like these are not available? When a student with TBI randomly tosses her keys to her bike lock in the corner of her room at the end of the day, she will not be able to find the keys in the morning. She won’t remember that she put the keys directly across from the night stand and five feet from the bedroom door.

### ***Implicit Memory***

As frustrating as loss of spatial memory (and loss of verbal and episodic memory) is, TBI does not damage all memory. One category of memory, unconscious memory, generally still functions after TBI.<sup>6</sup> This type of memory, also called implicit memory, is used when a person does an activity without thinking.<sup>7</sup> A person suffering from TBI will remember how to ride a bike without consciously

thinking about it, or remember where the bowls are in the kitchen because they have reached for them a hundred times. Though the person may do these things without thinking, he would not remember the specifics, such as the bike ride to the grocery store or the act of putting away the clean dishes. Though a person's habits may still be apparent, the person suffering from TBI would not remember that he did them. A person with TBI can make use of implicit memory to do simple things, such as putting away groceries, by doing them enough times to make it an unconscious habit.

### ***Treatments for TBI:***

Sadly, no reliable drugs exist to prevent the progression of cell death in TBI.<sup>8</sup> Many scientists, however, are currently working to change this. Current research examines ways of preventing cell death after injury, which would, in turn, reduce memory loss.<sup>8</sup> Another area of research attempts to increase the birth of new brain cells after TBI.<sup>8</sup> However, research scientists often run into problems trying to direct cell growth and ensure that new brain cells take over the function of old brain cells.

### ***Prevention of TBI***

Prevention of TBI for students begins at the source: driving. Young adults can greatly reduce their probability of getting in a car accident, and thus avoid TBI, by driving defensively, observing the speed limit and other rules of the road, and avoiding distracted driving. Most importantly this includes not texting or talking on the phone while driving.<sup>11</sup> A decrease in the number of car accidents that students have would decrease the number of students who suffer from TBI and likely memory impairment. You cannot avoid the effects TBI has on your memory, but you can reduce the likelihood that TBI will happen to you.

# White Grand or White Coat?

## Katerina Kalaitzidis

He has the ability to heal other living things and can cure even the worst diseases and plagues. In art, he is depicted as a young, beardless man with a guitar-like instrument in his hand and a snake wrapped around his arm. His name is Apollo, and he is the Greek God of music and medicine. This ancient Greek God is like many others who pursue an interest in both medicine and music.

In an article titled "Tuning up Musicians," Phyllis L. Fagell talks about Harvard doctors who treat the injuries of musicians.<sup>1</sup> After describing different injuries ranging from a hemorrhaged blood vessel on a vocal chord, to a pianist unable to lift his fourth finger, the article ends by noting similarities between musicians and physicians. Musicians and surgeons have analogous skills, because "both require a great deal of discipline, much dedication, and long hours of study...and they both require artistry."<sup>1</sup> One of the physicians in the article, Michael Charness, is the director of the performing arts clinic at Brigham and Women's Hospital, and also finds time to play music with his wife and three children. He began treating musicians because of his own injury that arose from frequent piano playing, one that required surgery before he could play piano again. Charness adds that there are "hordes of physicians who are also musicians," and that "there is a historical connection between music and medicine."<sup>1</sup> He recalls once participating in a duet with a pianist who, at age twelve, had performed with the Philadelphia Orchestra. After hearing from the pianist later, Charness found that he had decided to become a

physician instead of a musician. Having an interest and desire to pursue both music and science is not rare; there are many instances where people integrate both music and science into their lives.

In an article titled “The Double Life of a Doctor-Musician,” Suria Santanta discusses two physicians who have made time for music. Dr. Newberger, former chief of a clinic at Boston Children’s Hospital and current assistant professor of pediatrics at Harvard, is one of these doctor-musicians. Santanta explains how after work, Newberger performs with his band called the New Black Eagle Jazz Band. He has been recognized for his skills as a jazz musician and has played for audiences around the country and internationally.<sup>2</sup> Another doctor-musician, Keith Cheng, M.D., Ph.D. is a cancer-research geneticist at the Jake Gittlen Cancer Research Institute. Santanta describes how Dr. Cheng’s time commitment to medicine has not stopped him from seriously pursuing his interests in music. In the article, Cheng said he finds the time to play because “if you have the passion for music, thinking about or doing it is part of you. You almost don’t have a choice.”<sup>2</sup>

The idea of a doctor-musician is also discussed in an article from *The New Yorker* titled “Music and Science Meet on a Piano Bench” by Bruce Schechter. The article describes a panel of eight pianists who earn their livings as doctors, mathematicians, biologists, and computer scientists. Dr. Michael Hawley, one of the panelists and an assistant professor of media technology at the Massachusetts Institute of Technology Media Lab, views the piano in a mysteriously technical way. The piano, he said, is “a fantastic machine, a universe in a box that begs for exploration.”<sup>3</sup> He added that “expressing yourself through these tools...is inherently attractive to the technologist and scientist.”<sup>3</sup> The doctors on the panel of pianists took a less analytical and more practical approach to the music. Dr. Len Horovitz, a New York pulmonologist, believed that music was a healing art. He said that “music can offer a kind of comfort that medicine lacks.”<sup>3</sup> Perhaps doctors lean toward the music because it offers

them an outlet from the rigors of a medical career. Dr. Rebecca Martin, an associate professor in the Division of Infectious Diseases at the University of Arkansas, noted the connection between making a medical diagnosis and interpreting a musical score. She said that “both require intuition and the ability to listen. In medicine, you can know every symptom and have all the facts right in front of you. Similarly, when analyzing a score, all the notes are right in front of you.” With both, it takes a kind of intuition to put all the pieces together, and so to truly explore a patient’s illness is similar to “peeling away the layers of music.”<sup>3</sup> The physicians balanced the hours of piano practice with the demands of their professional careers in a different way. A couple of the physicians also admitted that they stopped playing the piano for about ten years while pursuing their medical careers. During this time, Dr. Hawley felt as though his life was unbalanced and that his creative side was lacking.

Even if you have two interests that seem worlds apart, pursuing both of them is possible. Whether you enjoy art, literature, philosophy, music, or fashion design – all of these studies can be pursued along with any type of science, math, or engineering. Just because you are a scientist, a doctor, or an engineer, does not mean that you cannot also be talented in the arts and humanities as well. Life is about doing what you enjoy. You may start of as a writer, and later on decide to become a doctor. Do not allow your major in school to define or limit you.

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# Naina: Eyes

Vaishali Mittal

Out of the corner of my eye, I noticed a seemingly young woman in tattered clothing sitting next to me, holding a baby girl covered in mud. As a fourteen year old, self-centered teenager, I somehow found myself standing in a walk-in, unsanitary, under-furnished pharmacy in India. I hated my aunt for dragging me there. I hated my parents for forcing me to go there. I hated that my so-called “homeland” seemed to be so repulsive. I almost felt ashamed to say that I was Indian. I just wanted to be back in my own bed in my own home, Folsom. Folsom was clean. The pharmacies were orderly. These were the only thoughts running around in my mind until I noticed the baby.

The baby, Naina, with scrawny arms, was continuously coughing. I could also tell she was crying by the motions of her face but the rest of her body was completely stiff. “Do you have the time?” the young woman, Shilpa, asked in a sincere and croaky voice. As soon as my eyes met hers, I felt compelled to talk to her. It was apparent that she was accustomed to negligence, and her face depicted exactly what I hated to see, pain. My simple question, “Are you okay?” led to a detailed story about her life and the shocking fact that Naina suffered from polio. As I listened to her story, my concern for Naina began to grow. I forgot about my complaints as I became engrossed in her story.

Like many other unfortunate children in India, Naina was not born in a hospital or a legitimate medical facility with licensed doctors. She did not receive appropriate medical attention necessary for newborn babies. As a result, her polio went undiagnosed. It was not until Shilpa noticed the stiffness in Naina’s body, the continuous fever, and coughing that she really grew concerned for Naina. Despite her concerns, there was nothing she could do. She had no money to go to a doctor, purchase the expen-

sive medications, or pay for a treatment. While this situation may seem alien to many of us, Shilpa’s situation is not uncommon in India. According to a report published by Price Waterhouse Coopers nearly “three million people in India live on less than a dollar a day, and more than fifty percent of all children are malnourished.”<sup>1</sup>

While Shilpa recited her story, her face displayed pain and sorrow, and her eyes glistened in a remorseful way. Thoughts about how self-centered and ignorant I had been kept playing in my head: “How can I be so selfish when this innocent baby is fighting for her life?” The tears in her eyes profoundly affected me because I felt the pain she held inside her. Shilpa and Naina changed me. I cannot stand to see tears roll down someone’s cheeks. I cannot stand to see someone helpless.

Social inequality has already cost many families their loved ones in India. It deprives individuals of a healthy start and end to life. It increases their burden of disease and suffering. It even sometimes brings early death. In a recent paper published in the *New York Times*, Somini Sengupta tells the story of a young man who travelled from America to receive medical attention in India because he was uninsured and did not want to liquidate his assets.<sup>2</sup> “He had a mitral valve repaired at a state-of-the-art private hospital here, called Wockhardt, and for 10 days, he was recuperating in a carpeted, wood-paneled room, with a view of a leafy green courtyard,” simply because he could afford it in India.<sup>2</sup> He ended up paying one tenth of how much he would have paid for this treatment in a private hospital in the United States. This demonstrates simply that India has magnificent resources and fully capable doctors; however, they are completely unaffordable to nearly seventy five percent of the population in India according to PWC.<sup>1</sup> Essentially, where you stand in the social ladder shapes what kind of health you are in and what kind of health care you receive. According to K. Sujatha Rao, I.A.S., secretary of India’s National Commission on Macroeconomics and Health,

“The payment system in our country is still on fee for service, at the point of service, which means if

you don't have money, you don't get care...Forty percent of people who get into a hospital have to sell their assets or borrow money at usurious interest rates...Intergenerational poverty sets in because once you sell your assets or are in deep debt, it means pulling the kids out of school, making them earn for the family."<sup>3</sup>

Nearly three quarters of India's population still lives in rural areas where they cannot acquire appropriate housing, clean, filtered water, and clothes. They are surrounded by dusty, polluted air.<sup>2</sup> Not only is there inadequate infrastructure for their homes, but the hospitals also lack proper facilities to increase the standards of health care, or to provide anything beyond basic care. In addition to this insufficient infrastructure, the existing facilities are lacking in staff, medical equipment, laboratories, and even licensed medical practitioners. In India, there is an immense health care divide. Essentially, one could say there are two Indias when it comes to health care. There is the country that provides high-quality medical care to upper and middle class Indians and medical tourists. And then there is the rest of the country, where the majority of the population has limited or no access to quality care, just like Naina and Shilpa.

In short, health care disparities are one of the many inequalities which people around the world endure when it comes to maintaining good health and living a healthy life due to economic and social reasons, lack of natural resources, geographic location and unavailability of basic amenities. The challenges India faces are substantial. The physical infrastructure needs to be improved so that it can provide the clean, organized health care that seventy-five percent of India's entire population still requires. As we consider graduate schools and other career plans, we should also consider what populations we can help improve. There are programs like *Médecins Sans Frontières* that specialize in helping that seventy-five percent and more in other third world countries. The future lies ahead of us, and we have the chance to help those who cannot help themselves.

# President Obama's Healthcare Reform Bill

**Peter Muraki**

On June 12, 2010 Tyler will graduate from UC Davis with a Bachelors degree in psychology, a 3.2 cumulative GPA, four years of college memories, and twenty thousand dollars of debt. Until March 21, 2010, Tyler would have also graduated with the burden of finding health insurance and joining 45.8 million other Americans with no health insurance.<sup>10</sup> Thanks to President Obama's healthcare reform bill, Tyler's future has become more promising.

On March 21, 2010 the U.S. Congress passed the healthcare reform bill known as the Patient Protection and Affordable Care Act by a vote of 219 to 212, and on March 23 President Obama signed the bill into law. The House Republicans unanimously opposed the bill, but the Democrats and President Obama saw the bill as a necessary step in the right direction.<sup>7</sup> Just before signing the bill, President Obama said, "We have now just enshrine the core principle that everybody should have some basic security when it comes to their health care."<sup>6</sup>

Health insurance premiums have doubled in the past ten years, leaving more and more people without access to medical services. Recently graduated college students like Tyler represent a disproportionately high percentage of this uninsured population.<sup>8</sup> The structure of the US healthcare system is responsible for the lack of healthcare coverage among college graduates. The current recession and recent increases in the national unemployment rate



have made it increasingly unlikely that college graduates will find jobs upon graduation, thus making it difficult for them to have healthcare. Statistics have shown that one-in-five recent college graduates lack insurance coverage for a period of time following graduation.

The healthcare reform bill addresses the lack of coverage among young adults, especially recent college graduates. The bill increases the age at which young adults are dropped from their parents' health insurance plans from 22 to 26 years of age. "And this year young adults will be able to stay on their parents policies until they are 26 years old," said President Obama right before he signed the healthcare bill on March 23, "That happens this year."<sup>6</sup> This gives college grads, like Tyler, an additional four years of insurance coverage while they search for future careers, and thus the new law extends coverage to a large portion of the uninsured population in America.

The new healthcare plan also helps college age individuals with pre-existing health conditions receive health insurance. Prior to the healthcare bill, some healthcare recipients were sometimes denied coverage by insurance companies due to pre-existing health conditions. Obama's healthcare reform prohibits insurance companies from restricting coverage to these individuals, but that part of the reform package will not take full effect until 2014. Subsidized coverage will also be offered to individuals with pre-existing health conditions through new, high-risk insurance plans.

After college graduates turn 26, they will no longer be covered by their parents' insurance, but the healthcare bill will continue to affect them. All citizens, including college graduates, will be required by federal law to obtain health insurance after 2014. This insurance can be provided by an employer or purchased privately. Individuals will be able to choose whether to keep their current insurance providers, or purchase different insurance plans in new, state-run insurance markets that will begin in 2014. However, the consequences of mandated insurance coverage are still uncertain.<sup>4</sup>

Opponents of the healthcare law present several arguments. Some opponents of healthcare reform believe that the plan is too expensive for the government to finance. They also suggest that the plan takes responsibility away from citizens and gives it to the state, reducing personal initiative and responsibility. In addition, many opponents believe that the government intervention will reduce the efficiency of the healthcare market.

The healthcare plan may reduce the future costs of health insurance and increase the efficiency of the entire healthcare system. Right before President Obama signed the bill he stated, "This legislation will also lower costs for families and for businesses and for the federal government, reducing our deficit by over \$1 trillion in the next two decades."<sup>6</sup> An estimated 32 million more people will have access to primary and preventative care as a result of expanded coverage. Preventative care is much more cost effective than treating patients who have already been diagnosed with illnesses, so expanded preventative care could reduce the total cost of healthcare.<sup>8</sup> Additionally, expanded insurance coverage will allow newly insured individuals to visit primary care physicians instead of going to the ER for treatment. Expanded coverage may also increase hospital efficiency and allow ERs to treat patients with real emergencies. Preventative care also helps to prevent the spread of transmissible diseases, so the healthcare plan could reduce the cost of treating epidemics.

The financial burden on college graduates and taxpayers in the long term as a result of healthcare reform is uncertain. If the opponents of healthcare reform are correct, college graduates will see a large portion of their future earnings go toward financing a healthcare plan steeped in inefficiency. If President Obama is correct, recent college graduates could benefit from living in a more fair and just United States, where everyone has access to affordable healthcare. There is no way to be certain what the financial consequences of healthcare reform will be.

The short term effects that healthcare reform will have on young adults and recent college gradu-

ates is clear, however. Recent college graduates like Tyler will be assured four additional years of insurance coverage on their parents' insurance plans while they pay off their debts and search for jobs. And everyone, including college grads, with pre-existing medical conditions will no longer be denied health insurance coverage as of 2014.

# Malaria: Infectious Killer

Veronica Orr

When you imagine a tropical getaway, what do you envision? Do cool breezes, spectacular sunsets, and near fatal infection come to mind? Each year many tourists bring home more than just souvenirs. They are exposed to an ancient disease that has claimed the lives of millions and is still a daily threat to nearly forty-percent of the world's population.<sup>12</sup>

## *The Buzz on Malaria*

Malaria is a vector-borne disease located in tropical and sub-tropical areas. It infects about 500 million people yearly with upwards of three million cases resulting in death. The majority of these deaths occur in children under five who live in rural areas without adequate access to health care.<sup>1</sup> In Africa alone, malaria is estimated to claim the life of one child every thirty seconds<sup>8</sup>, and the actual rate of infection could be much higher.

Inadequate reporting stems from malaria's position as a "disease of poverty," with the poorest twenty percent of the world's population accounting for fifty-eight percent of malaria cases.<sup>1</sup> These individuals are trapped in a destructive cycle: their illness

prevents them from working, and their inability to work prevents their access to treatment. In West Africa, poor families spend over one-third of their annual income combating the disease.<sup>8</sup> Therefore, malaria represents the ultimate villain: it robs people's ability to buy food, start a business, and pursue an education.<sup>10</sup>

The vicious disease was first attributed to the polluted air around swamps, and the name "malaria" literally translates to "bad air." Today we know the true culprit is the *Plasmodium* parasite, which is transmitted by the female *Anopheles* mosquito.<sup>15</sup> Like a vampire from a horror film, she only hunts her victims at night. By biting an infected individual, she inadvertently becomes a host for the *Plasmodium* parasite. When she feeds again, the *Plasmodium* slip into the victim's bloodstream along with the anticoagulant the mosquito must inject to sip her dinner.<sup>15</sup>

Once passed into a human, the parasites target liver cells and clear the bloodstream within thirty minutes. At this stage of infection, the individual is completely oblivious to the parasites inside him. Within as little as a week, the few initial parasites can multiply into tens of thousands. Accumulating parasites cause the liver cells to rupture, releasing the *Plasmodium* into the bloodstream.<sup>15</sup>

Malarial parasites then target and destroy red blood cells (RBCs), and the primary symptoms reflect this RBCs loss: anemia (insufficient oxygen) and periodic fever.<sup>5</sup> Waves of fever are the result of synchronous rupture of RBCs. Bursting RBCs cause anemia, since they lose their ability to carry and deliver oxygen.

As the disease progresses, the amount of RBC debris can overwhelm the spleen, resulting in blood vessels blockage. This prevents blood from reaching organs, which can lead to kidney failure and brain damage. In addition, the growing parasites deplete the blood of nutrients, causing the low blood sugar termed hypoglycemia. The lack of sugar to supply tissues with energy results in acidosis, or blood acid accumulation. In severe cases, this can lead to coma or death.<sup>11</sup>

## ***What's Old is New Again: Treatment and Prevention***

The use of the first known anti-malarial treatment, quinine, dates back to sixteenth century. Amazingly, it was the only successful treatment until the middle of the 1900s.<sup>2</sup> After the Second World War, more efficient quinine-derivatives were developed, but growing parasite resistance has diminished their current effectiveness. Unfortunately, quinine-derivatives are still the drug of choice in most malaria-endemic regions, despite the reduced effectiveness, because they are cheap to obtain and administer to the impoverished victims of the disease.<sup>1, 13</sup>

The difficulty in discovering new malaria treatments stems from the biology of the parasite. Humans and *Plasmodium* are both organisms known as eukaryotes, which means we share the same cellular makeup. Any chemical researcher's device to kill the parasite can also harm the human host. Striking the right balance between eradicating the disease with minimal human harm has slowed the progress of new anti-malarial medications.<sup>2</sup>

The ultimate gold standard for treatment is a vaccine that prevents infection from occurring in the first place. Currently, 50 vaccines are in the process of development, with a few actually starting clinical trials.<sup>2,3</sup> However, their preliminary success has been marginal at best, and production of an effective anti-malarial vaccine is not anticipated in the near future.<sup>3</sup>

With so many Nobel-hopefuls tackling this disease, why is vaccine development a long shot? Once again, the biology of the parasite limits progress. During infection, the *Plasmodium* spends the majority of its time hidden inside the host's tissues, where the immune system cannot detect it.<sup>3,5,15</sup> This not only complicates the body's reaction to infection, but it also complicates vaccine development, since vaccines work to boost an immune-response.

However, the vector-borne nature of malaria makes it a completely preventable disease. The use of bed nets is an age-old method to prevent the mosquito's access to unsuspecting victims.<sup>14</sup> Additionally, the use of insecticides can help keep the mosquito

population down, reducing the chances of contracting malaria. Simply said: "stopping the bite stops infection."

## ***The Final "Buzz"***

Those of you jet-setters who plan a trip to the tropics have no reason to fear malaria as long as you are proactive and think ahead. Prevention is as simple as starting anti-malarial treatments<sup>†</sup>, wearing insect repellent, and limiting skin exposure at night. To minimize the dangers of going to bed with a malaria mosquito, remember to stay in a well-screened area or tucked-in under a bed net.<sup>6,9</sup>

Malaria is still deadly for the millions of impoverished individuals living with the disease. The steps we take today can shift the tide on this viscous killer. You can make a difference by contacting anti-malaria organizations, such as Davis' own "Freedom from Hunger." Spread the word! Proper awareness can prevent this age-old killer.

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<sup>†</sup> Anti-malaria treatments can prevent infection if taken before, during, and after your stay. Talk to your doctor about the right treatment for the region you plan on visiting. These drugs cannot be taken over long periods of time (they can damage your body) and not 100% effective; so other precautions are necessary.

# Osteopathic Medicine? Bah Humbug!

Sameer Thadani

As the 2011 medical application cycle starts, many of us have probably heard of some students starting to create a list of medical schools to apply to. As they select schools, many students often wonder: osteopathic or not? Just this past year, over 25,000 students chose to apply to osteopathic schools. This number often startles students, which is unsurprising since over half of Americans have no idea what a Diploma in Osteopathy, or D.O., is. When most Americans think about a health care provider, they only think of allopathic medicine, or an M.D. In reality, however, many patients also choose osteopathic doctors as their health care provider. To the untrained mind, the difference between an osteopathic doctor and an allopathic doctor may seem like night and day. But the truth of the matter is that these disciples of medicine have much in common. Whether you are choosing medical schools or your primary health care provider, you should consider the differences between osteopathic and allopathic medicine.

The first major difference between an osteopathic doctor and an allopathic doctor is the extra class a student takes during osteopathic medical school. Anatomy, microbiology, and toxicology are all part of every medical student's curriculum, but in addition to those classes, osteopathic students must also take a class on Osteopathic Manipulative Treatment (OMT). The idea behind OMT is to align the structure of the body in order to bring improve-

ments like increased lymphatic flow and circulation to the patient's body.

OMTs include soft tissue techniques, which include stretching and kneading in order to relax muscles. These are meant to increase circulation of lymph and blood. The direct osteopathic technique is also a form of OMT. This technique involves the patient flexing his muscles against the physician's resistance with the goal of increasing the range of motion and releasing muscle tension. The indirect osteopathic technique is a final category of OMTs. With this learned skill, physicians tell patients to adjust and hold the pain filled area in a position that is pain-free. By holding that position for a period of time, the number of muscle contractions around that specific point decreases, allowing those muscles to relax. This technique decreases the stress and strain on the affected area.

The first osteopathic school was started in Kirksville, Missouri in 1892 by Andrew Still, a Civil War doctor. In the last 119 years, 27 schools have opened throughout the U.S. At each of the twenty-seven schools currently in existence in the U.S., osteopathic students, just like allopathic students, are taught *primum non nocere*, which translated from Latin means "first, do no harm." But osteopathic students are also taught three extra philosophical ideas. First, the body is a unit, and all regions and areas of the body affect one another. Second, structure and function are interrelated. Third, the body has self-regulating, self-healing mechanisms. These ideas allow a D.O. to treat the entire patient rather than just the affected or tissue or organ.

A final major difference between M.D. and D.O. degrees is the type of licensing tests students must take. For an M.D. degree, one must take the United States Medical Licensing Exam (USMLE), while an osteopathic doctor must take the Comprehensive Osteopathic Medical Licensing Examination (COMLEX). Both of these tests are very complicated, but the COMLEX also tests the student on his ability to understand and perform OMTs. Though they may take different exams, students from both allopathic and osteopathic students are required to

demonstrate their knowledge and understanding of medicine in order to receive their medical license.

A story from the National Eosinophilia Myalgia Syndrome Network tells of a woman in New York had been suffering from Eosinophilia–myalgia syndrome, an incurable disease caused by the consumption of poorly manufactured L-tryptophan. Her husband’s family had connections to an osteopathic doctor in nearby New York City, and she was ready to try anything that could help. The woman knew nothing about what osteopaths do, but since, by this point, she was emotionally at the end of her rope, she agreed to go, just to try something.

She was in very bad shape, yet the doctor ended up saving her life. Even though there was still no diagnosis, he began working on the symptoms. He immediately felt how knotted up her body was and diagnosed that the “lymphatic return” in the upper body was blocked. The flow of lymphatic fluid up and down her spine was very low. He said that her head was “slowly drying.” Since she had been sick for so long and gone a year and a half with no treatment, parts of her insides that were supposed to be dynamic, moving, and flowing were instead frozen into place. She was in such poor condition that the doctor didn’t know if his treatment could even help her, but he tried anyway.

After the doctor started treating her, week after week with indirect osteopathic techniques, some of the extreme symptoms did go away. The burning pain on the top of her head left, never to return. The dizziness gradually decreased, the nightly numbness in her face stopped occurring, and she was able to swallow comfortably again. Only an osteopathic doctor would have been able to administer the OMTs this patient needed in order to alleviate her symptoms, so that she could live a normal life again.

If you are a student considering medical school or a patient looking for a health care provider, here are some important facts that might help ease your insecurities about osteopathic medicine. According to the American Osteopathic Association, over the last ten years, the percent of osteopathic

doctors has grown from 3% to 8%. Even though osteopaths comprise only 8% of the country's physicians, they still handle approximately 16% of all primary care visits. In fact, in Michigan and Oklahoma, almost 20% of the physician workforce is made up of osteopathic doctors. At a more local level, Kaiser Permanente has a 1:50 ratio of D.O.s to M.D.s, meaning that 190 out of the 9415 physicians working for Kaiser are osteopathic doctors.

As long as there have been DOs, there has been an ongoing M.D. vs. D.O. debate. Education in allopathic treatments combined with chiropractic techniques make up a D.O. degree. Although obtaining an M.D. degree is a trend of our times, students should consider an osteopathic degree. At a broader level, patients of all ages should consider the unique techniques a D.O. has to offer when choosing their next primary care physician. After examining the philosophy and methods behind osteopathic medicine, you may find osteopathy to be right for you.

# Computer Vision

**Bernice Wong**

Over the years, college students have more access to computers as our society learns to rely on technology in presenting instructional material. Students are given unlimited access to online materials such as lectures and podcasts to assist in the studying and learning process. As a result, students spend more time on the computer and this study habit can affect their eyes and vision.

## *Amount of time students spend on the computer*

Due to the significant decrease in the printing rate at UC Davis, the computer rooms are

offering only thirty pages of free printing (as compared to the ninety they used to offer a few years ago). This new policy is eco-friendly, but it results in an increase in the number of hours spent on the computer because students choose to study lecture materials displayed on computer screens instead of studying notes on paper. As a result of these changing study habits, in recent years, the amount of time a student uses a computer has steadily increased.

In July 2007, Burst Media conducted an online survey to see how many hours college students typically spend on the computer during a given week. Four hundred and thirty nine students participated in this survey, and statistics showed that 33 percent of college students spent more than ten hours a week and 19.6 percent spent more than twenty hours a week online.<sup>1</sup>

### ***Consequences of prolonged computer use:***

People who sit in front of a computer for long periods of time often develop eye and vision problems. Because students spend such significant amounts of time on the Internet, they tend to experience certain symptoms such as dry eye, eye strain, blurry or double vision, and most often, headaches.<sup>2</sup> Often, we do not blink as frequently as we should when working on the computer because we are focusing on the study material.<sup>3</sup>

Blinking frequently keeps the front surface of the eye moist. In an experiment conducted by Shirley Telles, a researcher studying visual discomfort, the average rate of blinking for subjects was twenty-two blinks per minute under relaxed conditions, ten blinks per minute while reading a book, and seven blinks per minute while working at a computer.<sup>4</sup>

Eye strain can also occur when our eye muscles are fatigued due to several hours of staring at a computer. This strain is caused by focusing our eyes on the computer, poor-lighting, and reflected glares for extended periods of time. The part of the eye primarily affected by focusing on a computer is the ciliary muscle, which is a ring of smooth muscle fi-

bers that are responsible for changing the shape of the lens so that the eye can focus on close or far away objects. When intently concentrating on a nearby object such as the computer screen, a person's ciliary muscles tighten, and the muscle will become fatigued after many hours of computer use.<sup>5</sup> In addition, computer screens have a reflected glare which results in a contrast between the image being viewed and its background which is reduced by reflected light, making it harder for the brain to interpret the image. Such eye and vision problems related to prolonged computer use may lead to Computer Vision Syndrome (CVS), a complex eye disorder which is used to describe a variety of vision related consequences such as dry eye, eye strain, or blurry vision that is aggravated by spending more than two hours a day on the computer on a regular basis.<sup>6</sup>

### ***What can we do to prevent CVS?***

Although there are many possible problems associated with prolonged computer usage, most of these issues can be addressed by following these basic prevention tips. These disciplines will help with any eye irritation and eye-focusing problems in the future.

**Use the 20/20 rule.** Try to look away from the computer every twenty minutes for about twenty seconds.<sup>7</sup> This routine will also help us to blink more to keep our eyes moist. We can also use a humidifier or use eye drops/artificial tears.

**Practice yoga for about ten minutes.** One of the many practices of yoga includes visual cleansing exercises known as *trataka*. This technique helps to rest the eyes because it allows the ciliary muscles to relax after contracting for several hours.

**Set up a proper work station.** Below are some standard guidelines that would help eliminate or minimize bodily discomfort that can come on top of various eye and vision problems. [Refer to Figure 1].

Feet should be flat on the floor with knees bent to ninety degrees.

The back should be against the seat to fit the

spinal contour.

Wrists and hands should extend straight from the elbow to the keyboard. The arm and elbow should be ninety degrees to each other.

Place the monitor twenty to twenty-six inches from the eyes.



Figure 1

## Check your vision on a regular basis.

Get an annual comprehensive eye exam to ensure your eyes are healthy, and keep the most current eyeglass or contact lens prescription. In addition, let your optometrist know how much time you spend using the computer, since there are glasses that are specifically designed for computer use.

With the technological advances we have today, we, of course, should take advantage of it. But there may also be some consequences. While UC Davis is saving large amounts of paper, students are spending even more time on computers to study for academic purposes. Although this approach is very eco-friendly, this may create eye and vision problems, such as Computer Vision Syndrome, for students. These vision problems are something we should all keep in mind when spending too much time on the computer. Let us do our best to protect our eyes' health!

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Fig. 2 is retrieve from: [http://knee-surgery-recovery.blogspot.com/2005\\_10\\_01\\_archive.html](http://knee-surgery-recovery.blogspot.com/2005_10_01_archive.html)

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