

Berkeley Optometry

Magazine



Berkeley Optometry
partners with Cal
Athletics to tackle
concussions. page 12

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It's all hands on deck, as students in Dr. Susanne Fleiszig's lab work to unlock the secrets of the eye's natural defense against infection.



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Return to Learn

After a Hit on the Head

A Partnership Between Berkeley Optometry and Cal Athletics Aims to Streamline Concussion Evaluation and Help Students Get Back to Their Studies

Dr. Jacqueline Theis and Cal Field Hockey player Keats Iwanaga. A collaboration between Cal Athletics and the School of Optometry will get baseline data on as many as 500 Division 1 athletes.

BY GORDY SLACK

Josephine Devanbu was a sophomore neuroscience major at Brown University when she hit her head at a dance party two years ago. “I knew I’d hit my head too hard, but I didn’t expect there to be serious consequences,” she says. When she described her symptoms to student health services over the phone a couple of days later, they wanted to rush her to the hospital in an ambulance. “From the beginning, there was a lot of tension between different assessments of what I could and couldn’t do, about what I was and wasn’t up to,” she says now. “I didn’t want to go to the hospital at all. I had a lot of studying to do. Little did I know that I wasn’t going to be doing much coursework for months,” she adds.

Hits to the head—on the athletic field, in the dorm, and on the street—are a common form of student injury. About 500 concussions are diagnosed by the UC Berkeley student health center each year (less than one-tenth of those are suffered by athletes). And yet the injury is notoriously tricky to diagnose and treat. Two UC Berkeley doctors, one a sports physician and the other an optometrist, are deploying the tools of optometry to help bring greater clarity to the field and to ease the way for all students, whether athletes or not, back into their academic saddles.

Concussion symptoms are due to a complex pathophysiologic change in the brain, and at times these symptoms may be subtle, says Dr. Casey Batten, MD, UC Berkeley Head Team Physician, and co-investigator of a new study examining the use of optometry measurements to evaluate mild head injury patients. “Concussions do not entail structural damage, but only functional disturbance,” Batten says. If you’re experiencing profound visual changes, or have other signs or symptoms suggestive of possible swelling or bleeding inside your skull, you may not be concussed but may have another, more serious traumatic brain injury. However, if none of those more salient signs of damage are present after a hit to the head, and yet you are experiencing amnesia, say, or dizziness, nausea, headaches, exhaustion, or confusion, then you may have a concussion, says Batten.

Currently, diagnosis is based largely on subjective patient reports and these range all over the map, often depending on both the extent and the context of the injury, says the project’s other co-investigator, Dr. Jacqueline Theis, OD, FAAO, a Clinical Instructor and previous resident in the UC Berkeley Binocular Vision and Neuro-Optometry clinic. An athlete chomping at the bit to return to play, for example, may minimize his symptoms, while a cyclist hit by a car may feel an equivalent injury more keenly. With this project, the researchers are hoping to employ optometric measurements, currently not a key part of concussion diagnosis, to create a standardized, quantifiable, and portable way to diagnose the shape-shifting disturbance. If the researchers are right, the work will be a major new contribution by optometry to the study and treatment of concussion, a territory pretty much uncharted for optometrists except those specifically treating vision-related concussion symptoms. A standardized vision-based evaluation protocol would be extremely valuable to any medic, sports doctor, military field doctor, or coach who regularly needs to diagnose, evaluate, treat, or advocate for those who have hit their heads, says Batten.



Dr. Jacqueline Theis takes the field while Cal club lacrosse players Emily Brown and Danielle Lecher practice their stick work.

The Need for Baseline Data

The first step is to get reliable baseline data on normal eye movement patterns, says Theis. Currently, there are a lot of promising studies noting post-concussive changes in vision, but without baseline data, it is hard to verify that these changes are directly from the concussion. At their new, well-scrubbed UC Berkeley Sports Vision Institute, housed in the Simpson Center for Student Athlete High Performance, adjacent to Memorial Stadium, Theis has already conducted baseline screenings on 100 of UC Berkeley's Division 1 athletes. In coming months she is hoping to screen 300 to 400 more.

The baseline screening, composed of ten simple tests, takes only 15-20 minutes. Theis first checks visual acuity to make sure each subject has 20/20 vision. Most student athletes do. Next, she performs a series of tests that check each eye's ability to focus—including the gross amount, accuracy, and ability to repeatedly engage and relax focus. After concussion, Theis expects "a fatigue component" to be introduced, which would explain why concussed students can get exhausted in class just looking back and forth from their notes to the blackboard.

Some studies suggest that the ability to bring your eyes together, known as convergence, is decreased after a concussion. Using a Bernell Convergence/Accommodation ruler, Theis moves a small target closer and closer to the subject's face, recording how much the eyes can converge, and then how quickly they can recover from their break in convergence.

Theis also tests oculomotor coordination by investigating how the two eyes work together when looking at both distant and near objects. Perceiving single vision with two eyes is a complex accomplishment requiring coordination of nuclei, nerves, and muscles. If this system fails, a patient will have double vision. "If you have injury or

swelling in the brain, it is likely this system could be affected," says Theis.

The researchers will also test visual tracking. "To look at something and keep your eyes fixated in one place, a lot of different neurons have to fire," says Theis. Just by asking a subject to track a visual target moving from side to side she can test multiple pathways in the brain. The neural pathway governing tracking from the midline to the right is different than the one going to the left, or up from the midline, or down, says Theis.

Finally, administering the Developmental Eye Movement Test, Theis first measures how quickly subjects can read numbers listed in vertical columns. Then she times them reading number sequences arranged horizontally, but irregularly interspaced as words would be in a book. "If the subject has trouble with their saccades [rapid eye movements,] or has trouble with their larger regression eye movements," she says, "it will take disproportionately longer for them to do this test than to read the vertical columns. That would indicate binocular vision related eye-tracking problems."

"We know that, unfortunately, some small percentage of our athletes are going to get concussions while engaged in sports," says Theis. "If an athlete's tracking ability changes post-concussion compared to their baseline measurements, it would support that eye-tracking movements are impaired by the concussion. If this is the case, one could argue that it would be unjust to mandate someone with a concussion to be expected to participate with the same scholastic rigor as they did pre-concussion."

"Currently, optometry doesn't play a role in concussion management," Batten says. "Yet the literature shows that a multidisciplinary approach in evaluation is the way to go. You can't put all your stock into symptom scores only, or balance tests only, or cognitive tests only. You need to assess multiple domains, and standardized visual tests could prove to be vital," he says.

In addition to developing techniques for better identifying and quantifying the severity of concussions, Theis and Batten also hope to develop techniques and practices for helping athletes, and other students, make the smoothest possible transition back to their studies.

"In the past, the majority of focus has been on clearing student athletes to play sports," says Batten. "But we're finding that concussion can also have a significant negative affect on their academic performance. A lot of people who've had concussions can often quickly return to training without symptoms. But when they sit down to study or to read a book they run into trouble."

"One thing brains do is filter out irrelevant information by dampening certain neuronal signals," says Theis. "After a concussion it seems that a lot less signal dampening is going on. After a head injury, people often complain that they are visually overwhelmed. Memory is affected, too. Without filtering, it's harder to distinguish what's important and what's not, as well as maintain focus, which is key to productive studying. People also tend to be very light sensitive, and have trouble keeping their place while reading, or reading for prolonged periods of time," says Theis. Combined, all of these symptoms can have a big impact on academic performance.

Impact on Studying

When Josephine Devanbu, the neuroscience student, tried to study in the days and weeks after her head injury, her persistent but low-grade headache intensified, she felt like

her body was in a fog, and like there was pressure building in her skull, she remembers. Whereas she had put in long hours of studying all through high school and college, after her concussion she couldn't focus for any length of time. She felt discouraged, guilty, and increasingly anxious about the workload she would face when she was finally better.

"There was this constant double take," Devanbu says. "Was I supposed to be worried about my health or was I supposed to be worried about my coursework?"

Some of her professors "totally got it," she says, and urged her to focus on recovery. Others were skeptical and required convincing by her doctor that she was not exaggerating her injury.

"Unfortunately, the scientific literature is equivocal on the effectiveness of rehab," says Theis. "Some studies show that if you rehabilitate the visual problems they get better faster. Other studies seem to show the opposite, that simple rest is the best," she says. "Nobody knows which it is. Or if maybe it's different in different cases. But if we can measure the effects of rehabilitation on visual signs and symptoms, that could go a long way."

Optometry may be especially well positioned to help detect concussions because the network of muscular and neuronal systems that govern the movement of eyes is so thoroughly distributed throughout the brain.

At academic institutions like Berkeley and Brown, the pressure to get students back into class can be as great as the pressure to get them back onto the field. Evidence suggests that returning too soon to either activity can delay the healing process, says Batten. If that's so, it would be important to know, he adds. Not least so that doctors can help advocate for academic accommodations with the professors of concussed students like Devanbu. Extensions on assignments and exams, for example, can help make time for students to recover without unnecessary stress. But before granting such accommodations, some professors ask for quantitative science to validate the request. Theis's and Batten's work, should produce that kind of evidence.

In recent years, concussion has demanded more and more attention, both from sport and military doctors. Helping to positively identify and measure the condition using objective optometric measurements will not only help doctors of students, soldiers, and others who have hit their heads know how best to proceed, but it will also contribute key information to the intensifying national discussion about concussion. Debates based on vague definitions and assumptions are notoriously difficult to resolve; this study could help to clarify the terms.

"We have a unique situation," says Batten. "At Berkeley not only do we have arguably the best optometry school in the country, and a great intercollegiate athletics program, but our offices are located right across the street from each other. The ball is rolling now. If we can keep it moving down the field, this will grow into something big."