Brains have a remarkable ability to rewire themselves following injury, concussion specialist explains

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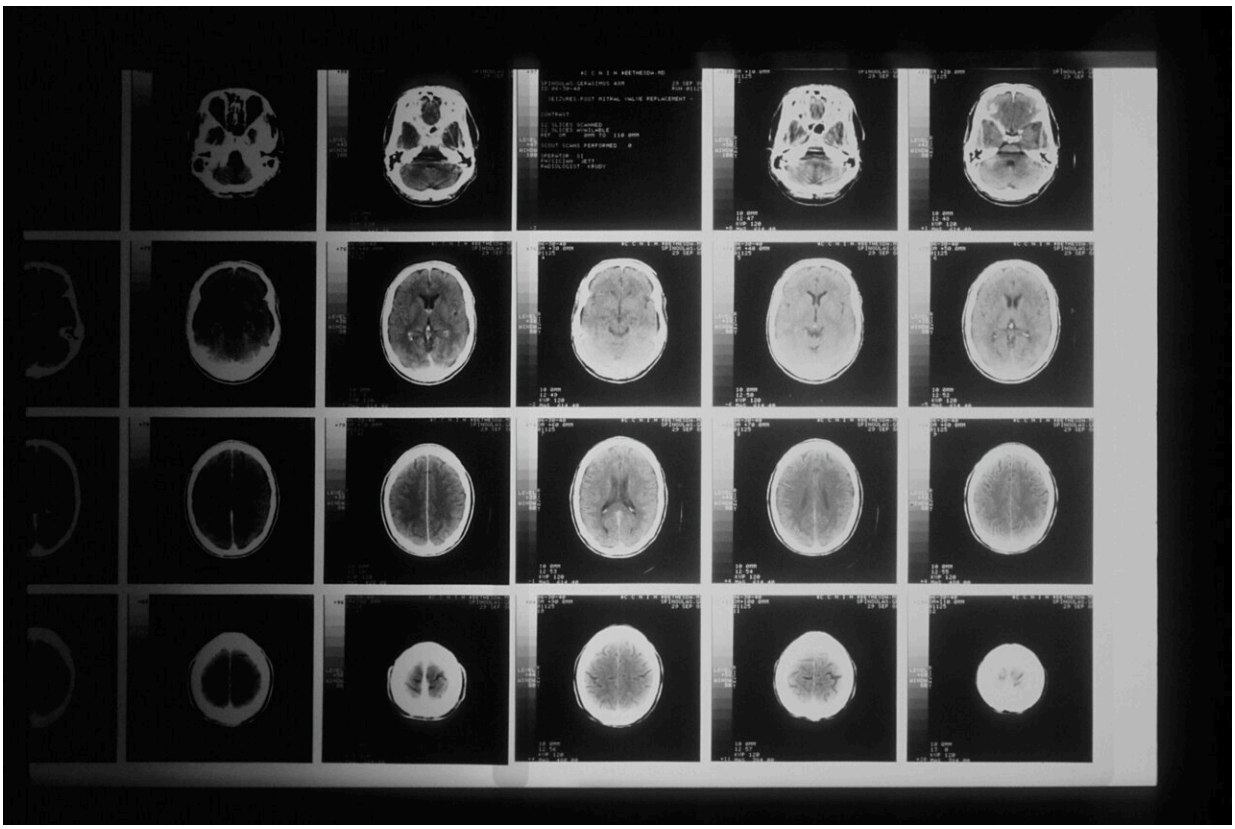

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High-profile sports like football and soccer have brought greater attention in recent years to concussions—the mildest form of traumatic

brain injury.

Yet people often do not realize how common concussions are in everyday life, and seldom does the public hear about what happens in the aftermath of concussions—how long the road to recovery can be and what supports healing. Concussions are important to understand, not only for recovery, but also for the insights that the science of recovery can bring to brain health.

I am a speech language pathologist and an instructor in physical medicine and rehabilitation. I specialize in brain injury rehabilitation, with experience ranging from coma recovery to concussion care.

Treating problems tied to head injuries is complex. This is, in part, because it is not possible to directly examine the brain of a living person and because every brain injury is unique. Many aspects of health, both pre- and post-injury, affect recovery. In treating brain injuries, I work to translate this specialized science for each patient and their unique situation.

Brain injury can take many forms

While people commonly think of athletes when it comes to concussions, sports-related concussions are just one type of mild brain injury seen in health care practice. Concussions can also result from abusive head trauma, blast exposure, car accidents and falls.

The severity of a brain injury is diagnosed based on symptoms, brain imaging and a neurologic exam. Concussions are characterized by a lack of clear tissue damage seen on brain images like an MRI and by the length of time that a person loses consciousness—defined as between zero to 30 minutes.

In addition, a significant portion of concussions may not be identified or formally diagnosed at all. Even if you do not lose consciousness at the time of an injury, you could still have a concussion. Confusion, sensitivity to noise and lights and even changes to sleep and mood are common symptoms. But often, these signs may be misunderstood as signs of stress or shock during traumatic events, such as a car accident. Some people mistakenly assume that if they don't lose consciousness, they haven't experienced a concussion.

People who don't feel that they have returned to normal after a concussion may need further treatment. Many report chronic symptoms that linger beyond the typical three-month recovery—a condition known as post-concussive syndrome. Around 10% of those who suffer a concussion experience post-concussive syndrome, although differences in how this problem is defined and recorded leads to highly variable estimates across studies.

So how does having a concussion affect the brain over time?

The links between concussion and dementias such as chronic traumatic encephalopathy, or, more generally, the relationship between a brain injury early in life and later brain diseases, are not yet clear.

This uncertainty should not stop people from finding a path forward and taking strides to support their own brain health.

The brain's mode of repair

After recovering from a brain injury, patients want to understand how to minimize further risk to their brain, which is all the more important since prior injury puts the brain at greater risk for further injuries.

Researchers and medical providers have learned that after injury the

brain can change and "rewire" itself at a cellular level over the life span —a process called neuroplasticity.

Brain cells, called neurons, join to form electrical pathways that power activity within the brain. In addition to other repair processes, neuroplasticity supports damaged brain areas to reconnect injured routes or find "detours" to restore brain function. This means that in recovery, the brain can literally find a new way—or make one—to regain critical abilities.

Neuroplasticity also offers insight into why each brain injury is unique.

Following a concussion, therapists focus on detailed evaluations and patient interviews to identify affected areas and to design an intervention. While the general map of brain regions and their associated functions is standard, individual variability is common. Brain injuries from the same cause of injury, via similar force and intensity of impact and affecting the same location of the brain, can lead to very different symptoms in different people.

While the brain is fully developed by the time people reach their early 20s, neuroplasticity continues well beyond this point. Researchers have seen neuroplastic change during the life span in both the white and gray matter that form brain tissue. The remapping of brain pathways that occurs in late-life injuries, such as a stroke, is one strong piece of evidence to suggest there may be no specific "end date" to the brain's capacity to restore its internal connections.

Importantly, fuller density of brain cells is thought to create a buffer that is protective against damage due to injury and aging. This extra "bandwidth" is referred to as cognitive reserve. Broadly speaking, higher levels of baseline cognitive reserve have been linked to genetics, educational attainment and health factors.

Neuroplasticity is one process that research shows is critical to maintaining these reserves throughout life.

Building and maintaining your cognitive reserves

Cognitive reserve is crucial to brain health both before and after a concussion.

Studies show that higher levels of cognitive reserve may lessen your risk for prolonged problems after a concussion. In addition, injuries that occur during childhood and late life may present different challenges in recovery linked to the brain's cognitive reserves and overall health.

For this reason, screening tools for concussion often probe a person's medical history prior to the event.

Keeping up cognitive reserves likely maintains healthy brain connections that can help us age better. Bilingualism, maintaining an active social life and even going to museums are linked with lower rates of dementia. These studies support that brain activity is good for brain health and it is triggered by many things, including thinking, learning and engaging with the world around us.

How daily activity rewires the brain

Just as there is no one-size-fits-all brain injury, there is also no single path toward brain health.

Advanced brain imaging to detect concussions is not available in standard clinical settings, so clinicians rarely have clear road maps for rehabilitation. But getting optimal sleep, avoiding excessive drinking or other toxic substances and leading a physically and mentally active life

are core tenets of brain health.

Finally, the brain does not exist in isolation. Its health is connected to other parts of the body in many ways. Therefore, doctors recommend treating medical conditions that directly affect our brain health and that reduce brain aging, such as high blood pressure,sleep apnea,migraines and even hearing loss.

Brain health is unique to each person, and brain injury treatment depends on your individual lifestyle and health risks. Strategies to treat specific symptoms vary and should be designed with the help of medical specialists. But brain health and cognitive reserve provide a common direction for everyone. Living an active lifestyle—physically, mentally and socially—can drive neuroplasticity and maintain the brain.

Studies of healthy people offer insights into how individual brains are shaped through everyday activities. For instance, research finds that expert musicians have denser sound-processing regions in their brains. The brains of cab drivers have greater development of spatial memory areas. Even military fighter pilots have been shown to have denser tissue in regions connected to strategic thinking.

These startling discoveries teach us that what we do every day truly matters to brain health. For all of these reasons, brain researchers commonly use the phrase "neurons that fire together, wire together" to describe how the brain's connections change shape associated with repeated patterns of the electrical firing of brain activity.

While many questions remain to be answered, it is well established that the brain can be shaped throughout life. With this knowledge in mind, we can tend to it with greater care.

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