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Brainstorm: Head Injuries and the NFL, Part 6: Memory Loss

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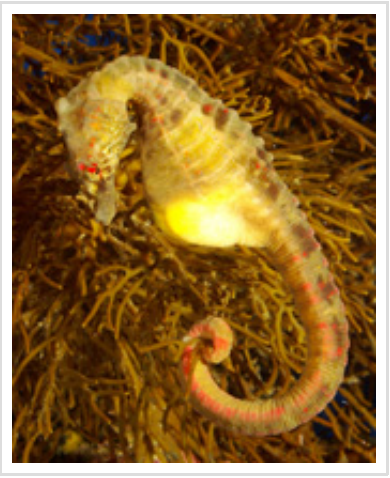

We are in the process of examining the relationship between neurological damage associated with repeated closed-head injuries and the behaviors of CTE. We've been using the example of spearing, illustrating the effects of this banned football behavior on the biological integrity of the human brain. We discussed how damage to one such neurological circuit, the Papez Circuit, can lead to chronic changes in mood. Here we discuss changes in three cognitive gadgets: executive function, memory processing, and motor control.

1) Loss of executive function

Many people with CTE have damaged areas of the brain known as the prefrontal cortex (logically termed the PFC) and regions just beyond it (logically termed the subcortical cortex). The PFC is, from an evolutionary perspective, the newest part of the brain. No other creature has one just like ours; it is responsible for many of our amazing — uniquely human — intellectual talents. If you put your hand on your forehead, you are just fractions of inches away from these regions.

Why is that important to know? It is because of what behaviors these cortical regions control, and what sports can do to athletes as a result.

These neural areas are involved in a suite of seemingly disparate behaviors we call *executive function*. Executive function behaviors include impulse control, the ability to plan for the future, and the ability to understand the consequences of one's actions. People who suffer damage in these regions — and many sports stars do — may begin exhibiting a loss of these critical socializing behaviors. They may be given to impulsivity, or a lack of foresight and planning. They may even embark on doing really stupid, even dangerous things to themselves or other people — and end up having no idea that something was wrong.

2) Memory loss

If you are detail-oriented, or just have a really good memory, you may recall

that our discussion of the Papez circuit included a very important region called the *hippocampus*. Seated in the middle of your brain, this region looks something like a seahorse (hippocampus literally means “seahorse”) and is connected to a region that helps control it, called the *entorhinal cortex*.

Know what the jobs of these regions are? Memory-making. All kinds of memory-making.

One prominent part of their memorable job description is to convert short-term memory traces (you just learned the name of a new co-worker) to long-term memory traces (you then recall the name of the new co-worker hours, even days, later). If you damage these circuits, you can incur such memory loss. People with CTE often suffer damage to those circuits — and when they do, they incur memory loss too.

3) Motor functions (Parkinsonism)

You are probably familiar with Parkinson’s disease. There is progressive loss of control over the movement of one’s body (motor control), which includes amongst many other things, uncontrollable shaking. We collectively call these symptoms Parkinsonism.

The areas involved in Parkinson’s include a small structure in the lower middle parts of your brain called the *substantia nigra*. Many athletes with CTE suffer degeneration of the substantia nigra. Consequently, they may exhibit increasingly impaired balance, staggering through their world as though drunk, or present with a shuffling walk, with heartbreaking slowness of movement. I can’t think of anything more tragic for a finely-tuned professional athletic body than an increasing inability to control it.

You will notice that I have used the word “damaged” or “injured” (or even “degenerated” in the last paragraph) to describe the effect of trauma on neural tissues. But exactly what do I mean by the word “damaged”? Since neural*tissues* are made up of neural *cells*, the question is this: What exactly do I mean by “damaged cells”? What does something like spearing do to individual nerve cells in the brain?

Understanding this damage at the level of the microscope is exactly where we are headed (forgive the pun) in our next installment.

Comments