Predicting Recovery from Concussion: The Role of Post-traumatic Migraine Symptoms

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It is estimated that nearly 4 million sport-related concussions occur each year in the US (Langlois et al., 2006). Following a concussion, athletes may experience a number of physical symptoms (e.g., headache, dizziness, fogginess) as well as cognitive (e.g., memory, reaction time [RT], processing speed), vestibular (imbalance, gait), oculomotor, and other impairments. These injuries can result from direct (e.g., helmet to helmet contact) or indirect (e.g., whiplash) mechanisms. These mechanisms may involve linear (i.e., acceleration-deceleration; head moving back and forth along a straight line), and/or rotational (i.e., head moving sideways as well as back and forth) forces acting on the brain. As a result of these forces, neurons may be stretched or torn, which can interfere with the brain's ability to function. These forces create an energy crisis within the brain, wherein communication between neurons is disrupted. Consequently, the brain is in a depressed state of functioning that, in some cases, may result in persistent symptoms and impairment. Although the majority (~80%) of young athletes with a concussion recover within a few weeks of injury (Meehan, 2010) many (~20%) of these athletes may take a month or longer to recover. This group of athletes is often referred to as the "miserable minority" (Iverson, 2007).

One of the most common questions that athletes, parents, and others affected by concussion ask is "how long will it take to recover?" Consequently, much of our research has focused on determining which factors predict recovery. In particular, we have examined the role that different post-concussion signs and symptoms play in impairment and recovery time. Our findings indicate that timing is an important element in determining the role of specific signs and symptoms of concussion in predicting recovery time. The relevant time injury periods include: 1) acute- within the first 24-36 hours, and 2) sub-acute- within the first 2-7 days post-injury. Within the acute phase our studies show that athletes with on-field dizziness following a concussion - as reported by trained sports medicine professionals- are 6.4x more likely to have a prolonged (>21 days) recovery than those without (Lau et al., 2011). Similarly, the presence of cognitive impairments in reaction time and visual memory in the first week (Lau et al., 2009) are also predictive of longer recovery times. More recently, we have turned

our attention to the role of certain types of post-concussion headaches, in particular migraine headaches, following concussion.

Headaches are the most common symptom associated with concussion with up to 75-80% of young athletes reporting headache following this injury (Kontos et al., 2012). Their ubiquity would imply that they have little value in predicting recovery. However, our recent work suggests that athletes with post-traumatic migraine (PTM) headaches- which include headache, nausea, and light or noise sensitivity- in the first week following injury are 7.3x more likely to have a prolonged recovery than those without PTM. This finding was expected, however, what was surprising was that young athletes with PTM were 2.5x more likely to have a prolonged recovery than those who reported headache without the other PTM symptoms of light or noise sensitivity and nausea (Kontos et al., 2013). Moreover, the patients who presented with PTM also experienced greater cognitive impairment in visual memory and reaction time in the first few weeks following their injury (Figures 1, 2). In short, athletes who experience PTM following a concussion do not fair well.

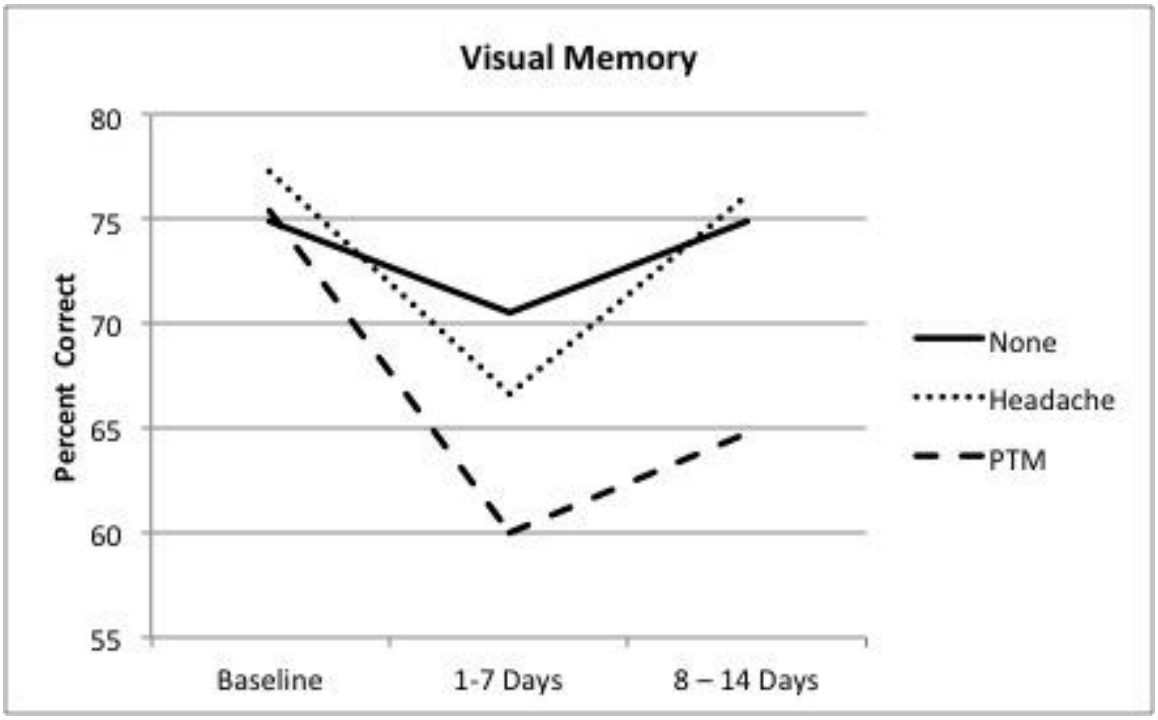

Figure 1. Visual memory scores for PTM, Headache, and No Headache (None) groups.

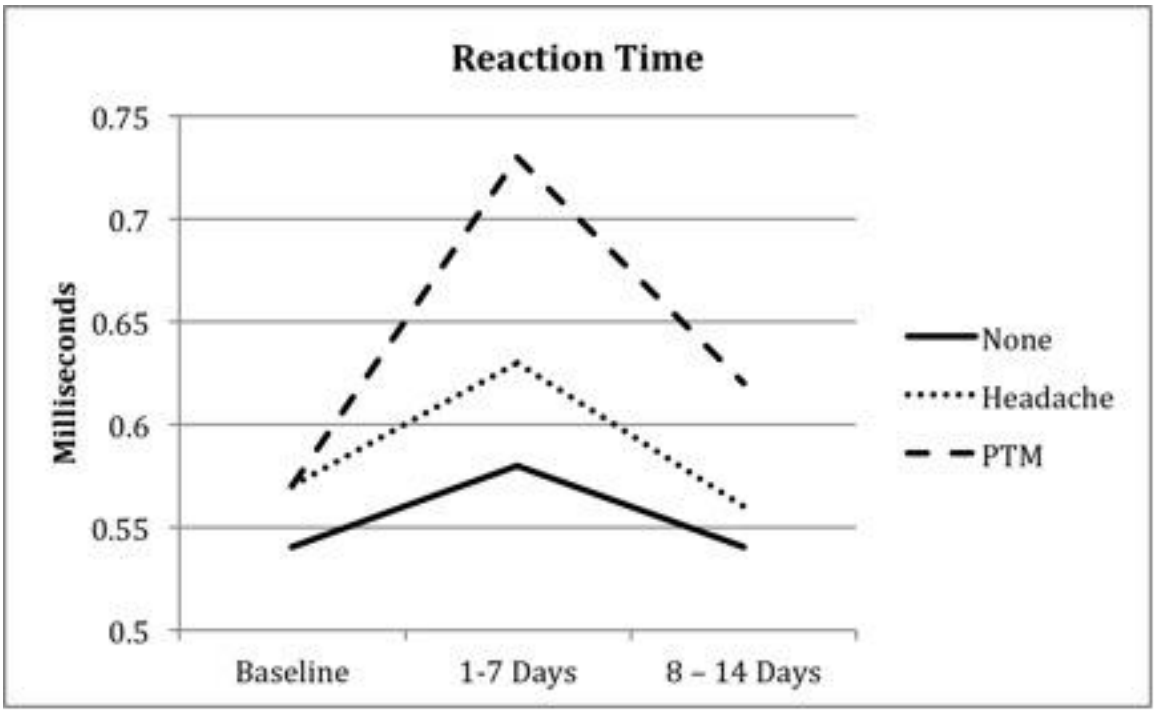

Figure 2. Reaction time scores for PTM, Headache, and No Headache (None) groups.

Although there is a substantial amount of work to be done regarding how best to treat and manage young athletes with PTM following concussion, lessons can be applied from the approach used to treat non-traumatic migraine headaches. Current expert consensus with respect to initial concussion management is to prescribe cognitive and physical rest. It is important that young concussed athletes have adequate rest and also avoid environments or activities where there is a high likelihood of re-injury early after a concussive injury has occurred. However, this strategy is often extended beyond the acute and sub-acute phases, such that concussed athletes are essentially sequestered- with no texting,m computer use, video games, school work… as well as exercise and sport activity- particularly if symptoms return or worsen. Such an approach, while useful early on, can be maladaptive over time. If we are to apply what we know from the approach to treating migraine headaches we should be careful to avoid under- as well as over-stimulation in youth with PTM following a concussion.

Avoidance of migraine triggers through inactivity is both unlikely and potentially problematic. Although in the short term a headache may be avoided by reducing physical and cognitive activity levels; in the longterm, complete avoidance results in a hyper- sensitization that can have adverse effects. Instead of avoidance of stimulation altogether in concussed youth with PTM, a more flexible, balanced approach where the headache and associated symptoms are approached in a calm and rational way is

warranted. For example, preparing children for the symptoms they are likely to experience, establishing a tolerable level of symptoms, and knowing when to take breaks/rest from exposure to environments and situations that provoke symptoms (i.e., school) is the best approach. Such an approach may also involve developing an academic plan where the concussed athlete can still be in class, but with accommodations to facilitate learning and socialization, while also allowing for rest at regular periods throughout the day. A similar strategy with respect to television, computer, video game, and cell phone/texting should be applied rather than taking a "shut down" approach that limits school, use of technology, and social interaction. After all, telling a 14 year athlete they cannot play their sport for a couple of weeks is one thing; but telling them they cannot go to school and be around their friends, play video games, watch TV, or use their cell phone is quite another. By adopting a middle ground approach, whereby young athletes with PTM following concussion are progressively returned to normal activities, we can facilitate a better recovery from this injury.

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