Dementia Pugilistica in HEMA: Brain Damage from Repeated Head Hits

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Introduction

Dementia Pugilistica, sometimes known as “punch drunk syndrome”, and also called Parkinsonism Pugilistica, is a neurodegenerative disease, similar to dementia, which can affect athletes and sportsmen who receive concussive blows to the head. This is a very high profile problem in boxing, with many top-level fighters retiring due to head injuries, and even dying from brain damage sustained during their fights. It is also a problem in other contact and supposedly non-contact sports such as rugby, football, ice hockey and American football.

In historical fencing, many techniques and sequences involve striking the head. As technical and athletic skill increases in the community, and a competitive scene develops, there is a greater opportunity for practitioners to receive stronger hits to the head on a more regular basis. Furthermore, a greater number of instructors are engaging in professional teaching activities, including private lessons; this exposes instructors to a greater risk of head injury from repeated strikes during private tuition.

It is time to look at this problem, to find out more about it, and to present the information to the historical fencing community. Hopefully this article will inspire instructors and competitors to consider the longevity of both their physical and mental health, and to take action to ensure that both combative behaviour and protective gear is appropriate for their activities.
Definition of the problem

In 1928, Harrison Martland wrote an article describing a syndrome that was associated with repeated head injuries, and in particular, that was found in former boxers.\(^1\) Over the course of the 20\(^{th}\) century, more research followed, and two names were used to refer to slightly different manifestations of this syndrome. Dementia Pugilistica was the term often used for cases where subjects showed symptoms relating to thinking or behaviour, such as memory problems, paranoia and hallucinations.\(^2\) Parkinsonism Pugilistica was often used for cases where subjects showed symptoms relating to movement or balance, such as stiffness or slowness, tremors, or problems with walking or balancing.\(^3\)

It is not a condition affecting only boxers; it is a condition that can manifest whenever there are repeated blows to the head\(^4\) or where the neck is susceptible to injuries\(^5\) resulting from blows to the head.

Michael Flanagan describes what happens when boxers receive a knock out blow, taking a cross punch across the jaw:

> The cross punch violently snaps the upper cervical spine in a side bending and rotation movement. It’s the best way to knock an opponent out because it causes a mini stroke that temporarily cuts off blood flow to the brain. But the damage goes much further than a mini stroke. It can also damage the upper cervical spine soft tissue. Over time, damage to the upper cervical spine can lead to normal pressure hydrocephalus.\(^6\)

This describes the damage that is taken when a boxer receives this kind of punch. If a boxer receives several heavy blows over a longer period of time, he or she may suffer from chronic traumatic brain injury (CTBI) as a result of the repeated blows to the head. The physiological mechanisms are discussed by Barry Jordan:

> The pathophysiologic mechanisms of CTBI are unknown. It has been hypothesized by Martland that this syndrome is secondary to single or repeated head blows resulting in multiple petechial hemorrhages in the deeper portions of the cerebrum that are later replaced by gliosis or a progressive degenerative lesion. It can also be theorized that for clinical symptoms of CTBI to develop, a critical number or percentage of functional neurons must be damaged or experience cell death. Conceivably, a boxer

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3 Ibid.
4 Ibid.
6 Ibid.
who terminates a boxing career and has experienced some neuronal loss does not exhibit clinical symptoms consistent with CTBI because he has a critical number or percentage of functional neurons. However, as he experiences normal or accelerated neuronal dropout associated with aging, he may develop clinical signs of CTBI because he has less than the critical threshold level of functioning neurons. This theory would explain why CTBI appears to progress after the termination of a boxing career and the cessation of cerebral trauma.\(^7\)

This theory is important, because it describes why people may appear relatively unaffected by repeated blows to the head while still young, yet why the same people may develop brain damage later in life, after normal deterioration due to aging drops their number of functioning neurons below the critical threshold. HEMA practitioners should consider this delayed reaction. Even if head strikes are not obviously concussive, if a practitioner receives too many heavy hits to the head, it may add up over time and cause problems in later life.

The chance of developing dementia pugilistica appears to increase with various factors. Continuing to fight professionally after the age of 27 is one factor, along with boxing for more than 10 years.\(^8\) Participating in more than 150 fights is another factor,\(^9\) as is a greater exposure to sparring activities.\(^10\) Fighting as a “slugger” rather than fighting as a “scientific boxer” also carries risk,\(^11\) and of course a history of being knocked out or losing by technical knock out increases the chance of it happening again.\(^12\)

The mean number of fights in which professional boxers engage has dropped from 336 fights across a 19 year career in 1931 to just 13 fights across a 5 year career in 2002.\(^13\) Professional boxers have been reducing their exposure to head injuries, but even so, between 1918 and 1998, 659 boxers died from a boxing-related brain injury.\(^14\)

However, amateur boxers tend not to suffer from chronic traumatic brain injury “unless they have excessive exposure to the sport.”\(^15\) This finding was

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supported by a separate British study by Loosemore, Knowles and Whyte in 2007, who conclude that:

In this systematic review we found no evidence for a strong association between amateur boxing and chronic traumatic brain injury.¹⁶

They also note that:

Amateur boxing is a different sport from professional boxing, including in its motivation to participate, rules, and equipment, but, most importantly, there is considerably greater exposure to injury in professionals (increased frequency and force of punches over a greater duration of career).¹⁷

Generally speaking, participants in amateur sports run fewer risks than participants in professional sports. Amateur athletes tend to perform in an environment with a lower intensity of competition, and with lower forces of impact in contact sports. Amateur athletes may also wear more protective gear than professional athletes, making amateur sports safer. At the moment, in the HEMA community, there are few athletes or instructors who could be described as professionals; so most practitioners are probably relatively safe. However, those individuals who do invest more time and effort in their practice, who work at higher levels of intensity, are more at risk than the rest of the community.

While concussions are often the most obvious and noticeable type of injury in high impact sports such as boxing or taekwondo (although in HEMA we tend to see more broken hands than concussions), less is known about the aftereffects of heavy blows to the head; namely, second-impact syndrome and post-concussion syndrome.

Second-impact syndrome (SIS) occurs when the brain swells rapidly after a person suffers a second concussion before symptoms of the first concussion have subsided. It can be catastrophic, and can lead to death. In an article published in 1999, Kimberly Harmon defines the problem:

Several serious risks are associated with premature return to play. The most serious is second-impact syndrome. This syndrome was first described in 1973. Second-impact syndrome occurs in players who return to competition before the symptoms of a first concussion have completely resolved. A second blow to the head, even a minor one, can result in a loss of autoregulation of the brain’s blood supply; this leads to a vascular engorgement and subsequent herniation of the brain that is usually fatal. Since 1992, 17 cases of second-impact syndrome have been reported. This translates to one or two cases per year resulting from injuries sustained in football alone.¹⁸

¹⁷ Ibid.
Post-concussion syndrome (PCS) is a condition where the symptoms of concussion continue for some period of time (days, weeks, months) after an individual receives a concussion. Harmon also characterises this syndrome in the following fashion:

Returning to competition prematurely may also increase the likelihood that the athlete will develop postconcussion syndrome. This syndrome is characterized by fatigue, headaches, equilibrium disturbances or difficulty in concentrating that may persist for weeks to months after the initial injury.\(^\text{19}\)

If a concussed athlete is not allowed to return to play, then this decision will remove the chance that the athlete will suffer from second-impact syndrome (although this is still an issue in sports such as boxing if the boxer receives a concussion and the referee does not manage to stop the fight before another concussing hit lands). Post-concussion syndrome is something that any athlete risks after receiving a concussive injury.

\(^{19}\) Ibid.
Red herrings

The subject of dementia pugilistica is often discussed ardently in “popular science” articles online. Unfortunately, their authors do not always have the scientific evidence to back up their claims, or misunderstand the studies that they do cite. Consequently, there is much misinformation in circulation.

One such example is an article written by Jose Espinoza, which is hosted on various popular websites. I would like to single out this article because it introduces certain claims about boxing and dementia pugilistica that are unsubstantiated and incorrect, yet the article has been quoted on various boxing forums as an authoritative source. It is also one of the first search results to appear when looking for information about dementia pugilistica online. I believe it is important to address this article, so that HEMA practitioners seeking further information about the subject recognise the article and know why it is wrong.

In his article, Espinoza references two studies: one conducted by the British Board of Sports Medicine, one conducted by the Nevada Athletic Commission. He does not provide a link to either study, nor does he make a proper citation; it is almost impossible for a reader to find the studies that he references. In fact, there is no British Board of Sports Medicine; researchers Ngai, Levy and Hsu conducted the study, and it was published through the British Journal of Sports Medicine in 2008. Espinoza claimed that the study found that the “standing eight count” rule was the primary cause of the most serious injuries in boxing, but the study made little mention of boxing, and at no point mentioned this rule.

The other study was conducted by the Nevada State Athletic Commission, who did publish a report in June 2006 at the end of a study into boxing injuries, with recommendations to reduce injuries. The study admitted outright that there was no scientific basis for a decision and that they recommended that such data be collected by a scientific study. Furthermore, they suggested that increasing the glove size might be safer, which is the opposite of what Espinoza claimed that they wrote.

Finally, he referred to the condition as “pugilistic dementia”. Every scientific source and dictionary definition I have found uses the name “dementia pugilistica”. It is difficult to regard his article as an authoritative source if the condition is named incorrectly.

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http://uk.askmen.com/sports/fanatic_300/316_which-is-more-dangerous-boxing-or-mma.html


http://boxing.nv.gov/uploadedFiles/boxingnv.gov/content/HotTopics/CommitteeReport.pdf
To summarise, Espinoza’s article is hosted on several popular websites, appears near the top of a Google search for dementia pugilistica, and has been quoted on many boxing forums as an authoritative source of information. However, he misrepresented the findings of the two studies that he referenced, he did not cite his sources, and he gave the wrong name for one of the publishers. This casts significant doubt on the validity of the information in the article and the integrity of Espinoza’s research. If HEMA practitioners find Espinoza’s writing on the subject of dementia pugilistica, then I hope my article shows why it should be ignored in favour of more scientific sources or articles with greater journalistic integrity.

When reading about the issue, any material that does not cite specific scientific sources (using footnotes, end notes or other form of notation that specifies the name of the researcher, the title of publication and the title and date of the volume in which it was published, preferably with page references) is probably not as meticulously researched as it should be, and may therefore spread misinformation. The misinformation may not be malicious, but everything is written with an agenda; if the agenda is not to convey scientific knowledge in a well-referenced fashion, then the material is probably a poor source of information for study.
Similar problems in other sports

It is not exclusively boxers who suffer from dementia pugilistica. In late 2009, “following a rash of concussions during that season,” the National Football League Players Association (NFLPA) in the United States asked the National Football League (NFL) “to develop immediately and then implement concussion guidelines to protect the players.” The NFL obliged, and now places posters about concussion where players and team personnel will see and read them.

A study published in 2013 by Giza et al. suggested that for males, playing American football or Australian rugby poses a greater risk of concussion than other sports, although female athletes have the greatest risk playing soccer:

It is highly likely that there is a greater concussion risk with American football and Australian rugby than with other sports. It is highly likely that the risk is lowest for baseball, softball, volleyball, and gymnastics. For female athletes, it is highly likely that soccer is the sport with the greatest concussion risk (multiple Class I studies).

However, the study did not find that age or level of competition was a particular factor for risk:

Based on Class I studies, there is insufficient evidence to determine whether age or level of competition affects concussion risk overall, as findings are not consistent across all studies or in all sports examined.

The study found that in some sports, males might be more at risk; yet in other sports, such as “soccer and basketball”, females may be more at risk.

Unfortunately, the study provided no information or suggestions about elements of different sports that might influence which gender would be more at risk.

Michael Flanagan suggests why females may be more at risk of concussion than males in certain sports:

What is worse, and truly irresponsible, is knowing what we know about head injuries and neurodegenerative diseases in male athletes, we have encouraged females to play the same risky male sports [boxing, wrestling and American football]. Females have smaller, thinner bones in the skull and spine compared to males with smaller openings and dimensions for blood vessels and nerves. This makes them more susceptible to compression of neurovascular tunnels from bone, cartilage and connective tissue breakdown.

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26 Ibid. Page 2251.
27 Ibid.
Moreover, even the most hardened highly accomplished and fit female athletes have much smaller neck muscles making them far less capable of resisting whiplash type forces, such as from cross punches to the face.\(^{28}\)

An NBC news report looked at the issue of concussion in young female athletes, specifically in soccer, in the US. The authors interviewed Bob Cantu, chairman of the surgery division and the director of sports medicine at Emerson Hospital:

Dr. Cantu has made the bold proposal that heading be eliminated from youth soccer under the age of 14. He said girls, because of their anatomy, may be especially vulnerable to concussions.

“Girls as a group have far weaker necks,” Cantu said. “The same force delivered to a girl’s head spins the head much more because of the weak neck than it does the guys.”

New research suggests some body types may be more at risk than others.

“We believe that individuals with very long, thin necks may be at greater risk,” Cantu said.

With this evidence, Cantu said, “I would hope it would not only make parents look at their daughters, but make every one of those parents insist their daughters are on a neck strengthening program if they’re playing a collision sport.”\(^{29}\)

Neck strengthening exercises may be a good idea for HEMA practitioners who do not possess well-developed neck muscles, although professional advice should be sought from a physiotherapist before beginning a programme of such exercises. Female HEMA practitioners in particular should monitor how their head is influenced by strikes, to become aware of whether or not this is a problem for them in different historical fencing disciplines.

Although boxing is probably the best-known example of this problem of brain damage occurring through participation in sport, the risk of concussion is present in other sports as well. In fact, the study by Loosemore, Knowles and Whyte states that:

In boxing the head might get hit repeatedly with resultant concussion, though less than in several more popular sports – such as rugby union and equestrian activities – which may harm cerebral function.\(^{30}\)

Therefore it is worth looking at how various different sports choose to mitigate the risk of concussion, and see if it the learning points can be in any way transferable to HEMA.

\(^{28}\) Flanagan. “Parkinson’s Disease, Dementia, Neck Injuries and Sports.”

\(^{29}\) Kate Snow et al. “Concussion crisis growing in girls' soccer.” \textit{NBC News}, 9\textsuperscript{th} May 2012, accessed 20\textsuperscript{th} May 2014. \url{http://rockcenter.nbcnews.com/_news/2012/05/09/11604307-concussion-crisis-growing-in-girls-soccer}

Mitigating the risk of concussion

The main suggestion in boxing for mitigating dementia pugilistica is to limit exposure to heavy hits to the head, and possibly even to wear protective gear. Barry Jordan writes:

In view of the limited and proven treatment protocols for CTBI, the prevention of CTBI remains of paramount importance. The mainstay of preventing CTBI in boxing is to limit excessive exposure. This would be best accomplished by detailed medical surveillance and supervision of active boxers by the regulatory agencies (i.e., state boxing commissions), as advocated by federal legislation. Boxers at high risk for CTBI (e.g., older boxers, boxers with long careers, poor performers, boxers with multiple concussions) can be identified and required to undergo more detailed neurological evaluation to determine whether they are experiencing the untoward effects of boxing. If a boxer is noted to be experiencing neurological deterioration, that boxer should be prohibited from continued participation in the sport.\(^{31}\)

Monitoring fighters who may be more susceptible is an important task to ensure that people with more risk do not push themselves too far. Furthermore, Bush and Myers suggested that professional boxers could wear protective equipment:

Due to the lack of empirical support in treating DP, prevention is of paramount importance. Prevention could be accomplished by closely monitoring those fighters who have risk factors for neurological signs and use of additional protective equipment such as is used by amateur boxers.\(^{32}\)

The Nevada State Athletic Commission suggested that a mouthguard is an important piece of protective equipment for any athlete:

With no guard or a guard that is not properly fitted there is usually no consistent space between the lower jaw and the base of the skull which can result in injuries to the athlete.

With a properly fitted custom fitted guard you will get 2-4 mm of space which will help to protect you against injuries, you will breathe better and have more confidence. You should always consider the option of getting a custom properly fitted guard! Without a properly made and fitted mouthguard, your lower jaw will still be in contact with the base of your skull, increasing the possibility of a secondary trauma and concussions.

It is extremely difficult to have a store bought mouthguard provide the proper protection to your jaw. Each person has a different size and shape jaw, by using a stock mouthguard will decrease the protective abilities of a mouthguard.

With a properly made and fitted mouthguard, your lower jaw is NOT in contact with the base of your skull, REDUCING the possibility of secondary trauma and concussions.\(^33\)

However, Giza et al. notes that there is "no compelling evidence that mouth guards protect athletes from concussion (3 Class I studies)".\(^34\) The Nevada State Athletic Commission mouthguard study did not cite any scientific sources for its assertions, so its value is dubious.

In the game of rugby, Giza et al. suggests that it is "highly probable that headgear use has a protective effect on concussion incidence in rugby (2 Class I studies)"\(^35\), basing this assertion on a published study of Australian rugby players\(^36\) and a published study of English rugby players.\(^37\) In the historical fencing community over the last decade, there have been suggestions that using rugby caps inside fencing masks would be a good idea for practitioners of historical European martial arts, to help reduce the risk of concussion.\(^38\)

In ice hockey, where body checking is common, players run the risk of suffering concussions from this action.\(^39\) If team personnel believe that a player may have concussion, then they "should immediately remove from play any athlete suspected of having sustained a concussion, in order to minimize the risk of further injury".\(^40\)

Several sports have instituted "baseline tests" of cognitive function, that professional players must pass in order to be allowed to participate in the sport. Furthermore, there is a growing awareness of the need for neurologists to watch over sporting events, and improvements in how swiftly and correctly players who receive concussions are treated at and after an event. There have been attempts to improve or mandate safety gear, but this does not appear to have been as successful or as helpful as improvements in the general sporting environment by having neurologists in attendance and removing concussed players from the game.\(^41\)


\(^{35}\) Ibid.


\(^{40}\) Ibid. Page 2254.

In 1983, an article in *Sports Illustrated* summarised the scientific studies that had been conducted to date about the problem of dementia pugilistica, and noted that "ruthless managers" posed a huge threat to concussed boxers, by pushing them back into the ring:

As Quarry says these words, he doesn't sound bitter, and he doesn't sound punchy. A thoughtful, animated man, he is mindful of the need for medical reform in boxing, yet personally philosophical, not bothered by the threat of brain damage. "You step into the ring," he says, "and you know there's a chance of getting knocked out, of getting hurt, but you figure your abilities are good enough that you can handle yourself appropriately." But he hopes that federal legislation will result in uniform medical standards and that these in turn will protect fighters from ruthless managers. "The manager is the one putting a fighter back into the ring one week after he's been knocked out," he says. "But if they have strict enforcement of physicals, then the manager won't have a damn thing to do with it." Quarry's scenario for himself, which apparently wasn't altered by learning the results of the tests, is to get in shape and, if all goes well, mount a challenge for the cruiser-weight title.

It does appear that the general attitude towards athletes who suffer concussions has changed since this 1983 article, in a positive direction. However, there is still some amount of disagreement over the best way to determine if a concussed athlete might be able to return to the game or not. Harmon writes that:

**THE FIRST CONCUSSION**
The type of concussion most frequently encountered by a clinician covering an athletic event is the mild form known in sports as the "ding" or "bellringer." As mentioned above, the major guidelines propose similar approaches to the management of these injuries. If concussion symptoms clear away within 15 minutes and if no associated loss of consciousness or post-traumatic amnesia has occurred, the athlete may return to play that day. Some guidelines would permit an immediate return to play once the player is asymptomatic; others recommend a 15- or 20-minute wait after symptoms have disappeared.

When an athlete experiences symptoms of concussion that last for more than 15 minutes or sustains a concussion associated with post-traumatic amnesia, the major guidelines agree that the athlete should be removed from the contest and should not return to play until asymptomatic for at least one week. In practice, this means that an athlete who suffers a concussion during a Friday night contest and is subsequently restricted for one week may be able to play the following Friday evening. The athlete should undergo exertional testing, such as running drills and noncontact activity in practice, one to several days before returning to regular play. The guidelines also agree that an athlete who suffers any loss of consciousness should be removed from the game and should not be allowed to return to play for a minimum of one week.

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SUBSEQUENT CONCUSSIONS
There is a lack of agreement about how to manage second or third concussions in the same athlete. In addition, no guidelines are offered for the management of serial concussions of different grades. For this reason, the clinician must understand the risks of returning an athlete to play and offer reasonable clinical judgment. 43

While the suggestion that athletes might be able to return to the game flies in the face of the advice quoted previously, Harmon does acknowledge the need for neurologically trained specialists to be present at events:

Physician coverage of athletic events is a service to the community and is required at many such events. It is important, especially in sports with a high risk of head injury, that the physician have an understanding of the assessment and management of concussion. The sideline physician should also be fully aware of the possible catastrophic sequelae of improperly managed concussion, such as second-impact syndrome. A working knowledge of other concerns, such as permanent neurologic damage secondary to cumulative trauma and postconcussion syndrome, is also necessary.

Return-to-play decisions are always difficult, especially in the face of pressure from uninformed coaches, athletes or parents. It is therefore vital that the sideline physician be familiar with the various guidelines for managing concussion and offer consistent, well thought-out treatment plans. The lack of consensus on this subject makes the clinician's role even more challenging. However, by focusing on the areas in which the different guidelines agree rather than those in which they differ, the clinician can feel prepared for most scenarios. 44

Appropriate provision of trained medical staff seems to be a commonly recurring theme in recommendations for avoiding brain damage after players receive concussions.

44 Ibid.
Categories of preventative measures

A study by Park, Bell and Baker, published in 2008, proposes that methods of prevention of traumatic brain injury could be categorised as follows:

Approaches to preventing traumatic brain injury can be described as primary, secondary and tertiary. Primary prevention aims to prevent the trauma altogether. Efforts range from changing public policies (e.g., speed limits, helmet use, safety standards, road engineering) to changing public culture (e.g., alcohol abuse, helmet use in recreational activities and preventing sports-related concussions). Secondary prevention is aimed at minimizing the whole biological injury resulting from the trauma. Tertiary prevention refers to maximizing patients' functional abilities and restoring their daily life following an established brain injury. These include various approaches to neuro-rehabilitation as well as symptom management. Tertiary prevention also includes increasing awareness of the consequences of mild traumatic brain injury and understanding the relation between imaging, function and underlying pathology.45

This is a very useful categorisation, as it helps to explain the preventative methods at each step in the process. This categorisation will be used to suggest risk mitigations for practitioners of historical European martial arts.

Risk mitigations for HEMA practitioners

A strike does not need to knock out a practitioner for it to be damaging; a powerful blow can concuss a fencer very obviously, but a less powerful blow may still impart some subconcussive effects: causing concussion-like damage, without causing a knockout, that can accumulate with several such blows. HEMA practitioners who train at a higher level of intensity, and who compete regularly on the international scene, may be at risk of chronic traumatic brain injury (as described by Jordan) that may manifest later in life.

Although professional boxers hit each other significantly harder than most HEMA practitioners, we have nonetheless seen concussions in the HEMA community at events and club practices when equipment has not been sufficient or the behaviour of fighters has been inappropriate.

It is unlikely that the majority of HEMA practitioners will receive the same force of blows to the head as professional boxers, and are even less likely to receive blows that affect the spinal column as much as the strong cross punch from a boxer. Furthermore, in the HEMA community there is a strong culture of wearing protective equipment to reduce the chance of injury; as long as practitioners wear sufficient protective gear when training or sparring intensely, this should serve well to reduce the opportunity for concussion or related brain issues.

I will now provide my thoughts and recommendations for risk mitigation in HEMA, working within the classification proposed by Park, Bell and Baker.

Primary prevention in HEMA

According to Park, Bell and Baker, "primary prevention aims to prevent the trauma altogether."\(^46\)

HEMA practitioners have access to a variety of pieces of safety gear for the head, much of which performs very well at the task of protecting the wearer.

The fencing mask is a strong and well-made piece of equipment, constructed to provide a significant amount of protection to the head and throat.\(^47\) However, the fencing mask was designed for modern Olympic style fencing, and not for the types of weapons and techniques found in historical fencing systems. Therefore, when practicing with weapons that strike with significantly more force then Olympic fencing weapons, it is imperative that the mask is supplemented with additional protection.

The mask itself should be a CEN level 2 fencing mask. This rating means that it has been tested in the laboratory and the mesh can withstand more impact

\(^{46}\) Park, Bell and Baker. "Traumatic brain injury: Can the consequences be stopped?" 2008.
force than the mesh of a CEN level 1 fencing mask. The level 1 mask may be sufficient for beginners, who need simple protection at an entry level in order to begin their studies, but these are not sufficient to protect a fencer’s head against sword blows that strike with significant force. Anyone who wishes to compete, or even just to practice at an intense level, should ensure that they wear a CEN level 2 fencing mask.

The mask should be supplemented with rigid back of head protection, which itself should be complemented with padding placed between the rigid protector and the head. The protection should cover the whole of the back of the head, and should also cover the back of the neck.

The top and sides of the mask on the outside should be supplemented with reasonably thick and competent padding. This will help to reduce the shock of incoming blows, especially when the blows are repetitive in a training environment. A couple of thin layers of padding are not sufficient; there should be sturdy padding that can deaden an impact competently.

Underneath the mask, between the mesh and the head, the practitioner should wear something like a rugby scrumcap. A re-enactment style padded coif may be appropriate, if the padding is thick enough, although modern rugby caps have been proven to reduce concussion in rugby players and also tend to be designed with ventilation in mind.

There have been suggestions that wearing a mouthguard may help to prevent concussions, but there is “no compelling evidence that mouth guards protect athletes from concussion”. Therefore, practitioners might choose to wear a mouthguard, but it does not need to be recommended for the purpose of preventing concussion.

In terms of mental state, practitioners should be refused participation in any physical HEMA activities if they have suffered a concussion in the last 24-48 hours or if they suffer from post-concussive syndrome.

In terms of behaviour during training, there is no need for practitioners to hit each other hard enough to give concussions. Club instructors should ensure that students conduct themselves in an appropriate and responsible fashion, and should put a stop to any unsafe behaviour or inappropriate levels of force. Students should learn from the moment they start training just how much force is acceptable, and when the force of striking is unacceptable. Students should take responsibility for their own safety and for the safety of their training partners. It would be a very good thing for this sort of mindset to become pervasive in clubs.

49 Newton. "Mouth Guard Study."
Instructors who give private tuition, who receive repeated strikes to the head as part of these lessons, should ensure that they have the best possible protective gear and that the student does not hit overly hard. While a certain level of solid contact is required in order for strikes to be meaningful, it is not even remotely reasonable for instructors to receive concussive or subconcussive blows while providing teaching services. If the student is hitting too hard, then the instructor must draw attention to the problem and provide correction.

In terms of behaviour during competition, striking with force is obviously part of performing in a competitive situation. However, an important element of competitive skill for martial artists is that of control: self control and self discipline, control of one’s own body, control of one’s weapon (and ideally the opponent’s weapon), control of distance, and control of the fight. Control in all aspects is important.

Therefore, fighters should discipline themselves while competing so that they hit hard enough to remain competitive, yet still remain in control of themselves, their weapon and the fight in general, so that they do not lose their composure and concuss their opponent with an uncontrolled action. Accidents do happen, of course, but competitors should seek to achieve sufficient control of themselves and of the fight that they do not damage their opponent through lack of control. Tournament organisers could perhaps do more to discourage uncontrolled, powerful hits, or to penalise those competitors who damage their opponents through lack of control.

*Note: this is not to say that hitting hard is bad, nor to say that competitors should play gentle games of tag. That is far from the truth. Martial artists should train to produce force by means of structure, mechanics, speed and strength; and in terms of competitors with similar technical skill, better athletes should place higher in competitions than people who neglect their athletic training. Application of strength and force is important in practice and in tournament settings, but the skill of control, in all of its forms and elements, is something to which all martial artists should aspire.*

In terms of general competitive strategy, practitioners should consider how often they place themselves in harm’s way. For their *Sports Illustrated* article, Boyle and Ames consulted with Dr Ira Casson, a board-certified neurologist at Long Island Jewish Medical Center:

> Casson describes himself as a sports fan; he will watch a fight on TV. "No matter what anybody says, boxing will continue," he says. But he thinks that young boxers could reduce their chances of injury by passing up unnecessary bouts at the lower levels and fighting only to advance their careers. "Even bums hit you in the head," he observes.\(^51\)

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It is good to approach tournaments in a strategic fashion in any case, to use them as part of a structured plan for development. If practitioners choose participation carefully, as part of a structured plan, and perhaps limiting themselves to just a handful of important tournaments per year, this may help people avoid the “unnecessary bouts” that Dr Casson described.

If practitioners wear appropriate protective gear, train in a safe and sensible fashion, and compete in a responsible fashion, then it will be less likely that any practitioner will receive concussions.

**Secondary prevention in HEMA**

According to Park, Bell and Baker, “secondary prevention is aimed at minimizing the whole biological injury resulting from the trauma.”

If a practitioner receives a concussion, then medical professionals should examine them as swiftly as possible. If there is not a trained medical professional at the event, then an ambulance should be called immediately. A first aider should do as much as is possible, reasonable and legal under the circumstances (for example, cleaning a cut on the head that resulted from the concussive strike and calling the ambulance), but should not overstep. Only the medical professionals should treat the concussion directly.

First aiders at events such as tournaments, where concussion may be most likely to occur, should receive training to deal with these injuries. This may be as simple as event organisers providing a leaflet to describe precisely what needs to happen in the case of such injury (for example, stop the nearby fighters, clear the area, make sure the individual is still breathing, call an ambulance, and then do nothing but look after the casualty until the ambulance arrives).

Any practitioner who receives a concussion should not be allowed to participate in further activities for the next 24-48 hours, depending on advice from the medical professionals. This is not a decision that the first aider should make; it should be the doctor at the hospital who decides when the individual may begin to participate again. This may well mean that the individual can no longer take part in the event, and the event organisers should enforce such a ruling.

Where possible, trained medical professionals should be present at events, and well meaning but amateur first aiders should not bear the brunt of dealing with such injuries.

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Tertiary prevention in HEMA

According to Park, Bell and Baker, "tertiary prevention refers to maximizing patients' functional abilities and restoring their daily life following an established brain injury."\(^\text{54}\)

Making such recommendations is far outside my area of expertise. If a practitioner is concussed so badly that brain injury ensues, then they should seek proper, professional help. Well meaning HEMA practitioners, event organisers or first aiders should not attempt to supplant trained professionals in such important matters.

\(^{54}\) Ibid.
Conclusions

In general, I do not believe that HEMA practitioners are likely to suffer from dementia pugilistica to the same extent as professional boxers, as long as sensible risk mitigations are adopted. Professional boxers, and indeed professional athletes in general, are exposed to a much greater intensity of training and performance than are most HEMA practitioners. However, as the HEMA community grows, and as more practitioners engage in higher intensity training and fighting, and commit a greater amount of time to the sport, the problem of dementia pugilistica may become more relevant. It is better to become aware of the potential risks now, learn lessons from other sports, and to craft a safer environment for practitioners, competitors and instructors so that the problem does not manifest in our community.

Event organisers and club leaders should mandate an appropriate and competent outfit of protective gear for the head, for all practitioners who wish to engage in activities that may involve blows to the head. Furthermore, development of a safe and healthy environment in clubs and at events, where fencers take responsibility for their own safety and for the safety of their training partners, would be a very good thing that club instructors can influence directly and early.

Event organisers should consider developing a “concussion policy” in a similar fashion to the NFL guidelines, and should make all first aiders aware of this policy, to avoid an enthusiastic amateur trying to help but making matters worse. Developing and printing some leaflets or posters describing the concussion policy that can be displayed in competition areas so that everyone is aware of the event’s policy would be a good thing.

This article has been difficult to research and difficult to write, because I am not a neurologist or psychologist, nor do I have any medical training beyond some UK first aid certificates. Therefore, it would be most sensible to treat this article as an entrance point to the subject. I have no doubt that a more qualified person will be able to build upon this work in the future, to provide a more comprehensive guide to the subject for the HEMA community. Given the limitations of this article, my recommendations should be seen as simply that: recommendations for good practice, but not legal or professional advice.

This article probably only scratches the surface of this medical issue, and there is probably much more research that can be undertaken by people who have more access to scientific journals, and who have a background in medicine or neurology. I hope that people are inspired by this article to think about the issue of concussion in training and in competition, about the issue of suitable protective equipment for the head, and about maintaining healthy and non-damaging engagement in the martial art over a period of many years into later life.

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Finally, I must thank Daria Izdebska, whose edits and suggestions have improved the structure and quality of this article immensely.

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