

# THE HISTORY AND CURRENT PRINCIPLES OF CONCUSSION MANAGEMENT IN BOXING

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## HISTORY

Boxing or fighting with clenched fists is one of the most ancient of all recorded sports. Depictions of boxing on Sumerian relief carvings discovered in Iran are thought to be from around 3000 BC and frescos discovered in ruins from ancient Greece date from 1500 BC.

In the Shang Dynasty (1766 to 1122 BC), which is the first documented era of China, it is recorded in ancient manuscripts that boxing skills were practiced.

In India, around 1000 BC, fighting with the clenched hand or fist was part of warrior training, from the Ksatreyas (a warrior caste of ancient India), to the lowly foot soldier.

This form of boxing was called Vajramukhti, meaning 'thunderbolt closed (or clasped) hands'. The word Vajramukti was derived from the vajra maces of traditional warfare. The fists being compared to the solid head of the mace<sup>1</sup>. It would appear that fighting with fists is practiced worldwide and in many different cultures, the only limit to tracing the origins of boxing seems to be the limit of recorded history itself.

It is postulated that the fist was the first weapon available to early humans. The fist could be explained by a hypothesis that humans have the hand proportions we have today because of the evolutionary advantage attributed to humans' ability to

fight with clenched hands or fists<sup>2</sup>. Humans are the only member of the great apes where the proportion of the finger length to the palm length is short enough to make a fist. The force generated by striking with a fist is much greater than that of an open hand. It is suggested that the more efficient a human was at perfecting a fist, the more successful that human would be at gaining a sexual partner and so passing on the gene that allows the formation of a solid fist or a vajra mace, as it was called by the ancient Hindus.

The greatest knowledge of boxing in ancient times comes from the writings, statues and poetry of the Ancient Greeks.

The ancient Greeks considered boxing an integral part of education<sup>3</sup>. The gods and several of the earliest heroes are described as distinguished boxers, such as Apollo, Heracles, Tgdeus and Polydeuces. Apollo was the guardian of the sport, as mentioned in the Homeric hymn: "Wherever (in Delos) the Ionians gather with their long tunics to honour you, along with their children and modest wives, with every event they please you with boxing, joy and songs."

Homer also described perhaps the first recorded concussion in boxing:

"Great Epeios came in, and hit him as he peered out from his guard, on the cheek, and he could no longer keep his feet, but where he stood the glorious limbs gave. As in the water roughened by the north wind a fish jumps in the weed of the beach-break, then the dark water closes above him, so Euryalos left the ground from the blow, but great-hearted Epeios took him in his arms and set him upright, and his true companions stood about him, and led him out of the circle, feet dragging as he spat up the thick blood and rolled his head over on one side.

He was dizzy when they brought him back and set him among them."

Boxing was established as an Olympic sport at the 23rd Olympiad in 688 BC<sup>4</sup> and continued as an Olympic sport until the end of the Ancient Olympics. Although boxing almost certainly continued through the dark ages, there is little recorded until boxing re-emerged in England in the 18th century with the re-discovery of the classical world and the concept of leisure. There seems to be two distinct groups within boxing at this time, with the social elite, educated in Ancient Greek and familiar with the works of Plato and Homer and a less well educated group who were interested in the more base entertainment of bare knuckle boxing in the boxing booths at travelling fairs and racecourses. Much like in the sport of horse racing, these two groups frequently mixed.

The elite group is epitomised by the romantic poet Lord Byron who was a keen boxer and a strong advocate of boxing.



The other group represented the longer established bare knuckle prize fighters who fought professional contests in public houses, country fairs and at racecourses. A popular form of boxing at this time was the boxing booth where a professional prize fighter would take on all comers. Booth fighters would amass thousands of fights in a career.

Boxing therefore brought together the opposite ends of society in one sport and Lord Byron, keen to learn how to box, employed a prize fighter 'John Jackson' to teach him. When chided by his friends for keeping company with pugilists he insisted that Jackson's manners were "indefinitely superior to those of the fellows of the college I meet at the high table". Lord Byron's appreciation for Jackson is shown in the following lines in *Hints from Horace*:

"And men unpracticed in exchanging knocks

Must go to Jackson if they dare to box."

Boxing became strongly associated with the British establishment and was considered an English sport, as opposed to sword fencing, which was considered a French sport. Fighting with the fists was considered noble whereas fighting with a weapon was considered cowardly. Sorting out disputes with a boxing contest was also far less lethal than a duel with swords.

Prize fighting had few rules, resulting in a high incidence of serious injury and death in the ring. This was one of the reasons prize fighting and bare knuckle boxing were made illegal in England. This type of boxing only gained respectability with the introduction of the first safety-based rules drawn up by Lord Queensbury (first published in 1867). These rules made the wearing of gloves mandatory and also introduced the concept of 3-minute rounds, with a 1-minute break between rounds. Another rule which was innovative at the time was the 10 second count. This allowed the referee to stop the



contest if the stricken boxer was unable to recover (defend themselves) in 10 seconds. The Queensbury rules, however, did not place a limit on the number of rounds, it was assumed that the fight would end when one boxer was unable to continue, was counted out or gave up.

The Queensbury rules were improved with the addition of awarding points to boxers for defined, scoring blows. This allowed a winner to be pronounced after a limited number of rounds, introducing the concept of winning on points rather than winning because the opponent was unable to continue either due to submission or unconsciousness. The concept of scoring points in a fight was readily taken up by the professional promoters, as it meant that the number of rounds could be limited (rounds were initially limited to 45), this allowed a venue to be booked, as the maximum time of the fight would be known.

#### OLYMPIC BOXING

Amateur or Olympic boxing (now known as AOB) was introduced into the modern

Olympic Games at the second modern Olympiad in 1900 using the new amateur rules and, apart from being absent from the 1912 Stockholm games, has been present in every other Olympic Games since.

The requirement for a pre-contest medical examination for AOB boxers was introduced in 1906. In 1950, medical cards for every amateur boxer were introduced. Today all boxers carry a medical card, which records all the bouts they have taken part in, together with the outcome, any head injury sustained and any mandatory suspensions imposed. This ensures that injuries are known at subsequent bouts. Medical cards also ensure that boxing experience is known, so that the boxer can be fairly and safely matched to an opponent. An AOB boxer cannot compete without this card. All boxers get a full medical every year, until they retire at the age of 40. In addition to medicals, boxers are medically examined by a doctor immediately prior to every contest. There is always a doctor at the ring side who is trained and equipped for resuscitation. Where the doctor is not trained or equipped

for resuscitation there are always suitably trained paramedics present.

Concern about damage to boxers from head blows occurred around the time of work published by Martland<sup>5</sup> in 1928. This paper was the first to propose the possibility of chronic brain damage caused by repeated blows to the head that do not cause obvious clinical brain damage at the time of the blow. This phenomenon was termed 'chronic traumatic brain encephalopathy' (CTBE) and is characterised by a group of neurological abnormalities which become apparent at a later date. It was this paper that coined the term 'punch drunk', forever linking CTBE to boxing. Martland described CTBE in three stages; mild, moderate and severe. Mild forms of CTBE are described as unsteadiness or dragging of one leg and slight mental confusion and slowness of muscular action. Moderate cases are characterised by hesitancy in speech, tremors of the hands and nodding movements of the head. The severe syndrome has the characteristics of Parkinson's syndrome



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with vertigo, deafness and eventual mental deterioration requiring commitment to an asylum. Martland postulated a mechanism for this process of brain injury based on 309 consecutive post-mortem findings of people dying from head injury (none of them boxers). In 9 of these cases the author described a ring of microscopic haemorrhages between the white and grey matter in the brain, advancing the theory that the repair of these haemorrhages with gliosis leads to progressive degenerative changes. The clinical description employed by Martland was based on the observations of fight fans, promoters and sporting writers as the author states: “the observation of shrewd laymen...are perhaps more substantial than the opinion of medical experts”. Martland included a list of fighters, described by a boxing promoter as being ‘punch drunk’ claiming to have examined five boxers with ‘punch drunk syndrome’, however only one was presented as a case study. Later studies have, in part, supported the work of Martland, leading the boxing authorities to adopt significant rule and equipment changes to reduce the prevalence of head injury in boxing.

Head guards were introduced for the Los Angeles Olympic Games in 1984 as the American Medical Association would not allow boxing in the Olympics without them. At the time there was no evidence that head guards in boxing would reduce the concussion rate.

A standing 8 second count has been introduced that allows the referee to pause the contest if a boxer receives a blow which diminishes their ability to defend themselves. This is because it was recognised that blows in professional boxing which caused serious head injuries were often delivered to dazed boxers who could not adequately defend themselves.

Recent work<sup>6</sup> suggested that when the wearing of head guards became mandatory in international amateur boxing, the number of stoppages due to head blows increased.

Head guards were removed from Olympic boxing in 2013. Interestingly, initial figures from the international governing body, AIBA, suggest that the number of stoppages due to head blows has halved since the removal of the head guards.

Several theories have been advanced to explain this, from improved vision without the head guard, to the head guard increasing the diameter of the head and so a blow producing increased torque about the axis of the skull. In other sports, head gear gives the wearer more confidence and as a consequence they take more risks and are more likely to get injured<sup>7</sup>.

#### CURRENT TREATMENT OF CONCUSSION IN OLYMPIC BOXING.

The international governing body of Olympic boxing, AIBA, has recognised the consensus statement on concussion from the 4th International Conference on Concussion in Sport held in Zurich, November 2012<sup>8</sup> – and adapted its rules to fit with the recommendations. In the consensus statement concussion is defined as:

“A brain injury; and is defined as a complex pathophysiological process affecting the brain, induced by biomechanical forces. Several common features that incorporate clinical, pathological and biomechanical injury constructs that may be utilised in defining the nature of a concussive head injury include:

- Concussion may be caused either by a direct blow to the head, face, neck or elsewhere on the body with an ‘impulsive’ force transmitted to the head.
- Concussion typically results in the rapid onset of short-lived impairment of neurological function that resolves spontaneously. However, in some cases, symptoms and signs may evolve over a number of minutes to hours.
- Concussion may result in neuro-pathological changes, but the acute clinical symptoms largely reflect a functional disturbance rather than a structural injury and, as such, no abnormality is seen on standard structural neuroimaging studies.
- Concussion results in a graded set of clinical symptoms that may or may not involve loss of consciousness. Resolution of the clinical and cognitive symptoms typically follows a sequential course. However, it is important to note that in some cases symptoms may be prolonged.”

There has long been concern about concussion and the effects of mild traumatic brain injury in boxing. The awareness of this issue has increased in sport participants, sports governing bodies and the public arena. This has been highlighted by a series of multi-million dollar class action lawsuits brought against the NFL by retired professional American football players suffering from the effects of chronic traumatic brain encephalopathy, claiming this was caused by playing American football.

It has been known for some time that traumatic brain injury can result in the production of Tau proteins<sup>9</sup> in the brain and that these are in turn associated with chronic traumatic brain encephalopathy. Some people appear to be more susceptible to the production of Tau protein and there may well be a genetic predisposition associated with a polymorphism in the region of the Apo protein E gene<sup>10</sup>.

There are other reasons why a boxer (or any other athlete) should avoid competing if still concussed. If their brain chemistry has not returned to the pre-concussion state, the chance of further concussion is increased. A boxer is likely to box badly as their decision-making ability may be impaired. Partaking in physical activity while concussed will often prolong or worsen the symptoms of concussion.

TABLE 1

- “What venue are we at today?”
- “Which half is it now?”
- “Who scored last in this game?”
- “Which team did you play last week/game?”
- “Did your team win the last game?”

Table 1: Maddocks questions.



TABLE 2

**Assessment**

The care of the unconscious boxer is beyond the scope of this article. The concussed boxer discussed here does not require resuscitation and has had their cervical spine cleared.

Immediate assessment of concussion can be challenging. If the boxer has been knocked out then the diagnosis is easier, however even in these circumstances boxers will often become belligerent and difficult to assess.

Maddocks questions were designed for rapid assessment of a potentially concussed player; these test memory from short-term through to longer-term memory (Table 1). While originally designed for Australian Rules Football, Maddocks questions can easily be adapted for other sports including boxing. A useful on-field assessment is summed up in the pocket concussion recognition tool<sup>11</sup>. Maddocks questions are incorporated into the Zurich 2012 consensus SCAT3 (Sport Concussion Assessment Tool – 3rd edition)<sup>12</sup>, which is a useful tool if more time is available, to make a decision on a possible concussion. The SCAT3 covers the symptoms of concussion, some basic cognitive testing and tests of balance, which is often affected with concussion. Examination of the neck is also part of the SCAT3. It is important to examine the neck, as it is often put through a wide range of motion during a concussive injury. Neck injuries can also produce concussion-like symptoms.

If a boxer is thought to be concussed, they should receive a suspension (Table 2). The decision to diagnose a concussion should always be a clinical one, using the various assessment tools as a guide.

**Ongoing assessment.**

Concussion is often an evolving process, so once the boxer is removed from the ring, serial assessments are often useful to detect any deterioration of their condition. The time of examinations should be noted to help monitor any change in condition; the time recorded in the notes will also allow any subsequent medical practitioners to know when the last assessment was done.

Once the boxer is removed from the ring, a full history and examination should be carried out, paying particular attention

### **Minimal suspension periods after knockout and RSCH (Referee Stops Contest – Head)**

#### **Single occurrence of knockout or RSCH**

*No loss of consciousness: if a boxer suffers a knockout as a result of blows to the head or if the bout is stopped by the referee because the boxer has received heavy blows to the head, then the boxer may not take part in boxing or sparring for a period of at least 30 days afterward.*

*Loss of consciousness less than 1 minute: the boxer may not take part in boxing or sparring for a period of at least 90 days afterward.*

*Loss of consciousness more than 1 minute: the boxer may not take part in boxing or sparring for a period of at least 180 days afterward*

#### **Double occurrence of knockout or RSCH**

*If during a period of 90 days after a boxer's suspension for a knockout, the boxer is knocked out a second time or stopped by the referee due to the boxer having received heavy blows to the head, then the boxer may not take part in boxing or sparring for a period of 90 days after the second occurrence. If the first suspension was 90 days, the repeat suspension will be 180 days. If the first suspension was 180 days, the new suspension will be 365 days.*

#### **Triple occurrence of knockout or RSCH**

*If during a period of 365 days the boxer suffers a third knockout from head blows, then he may not take part in boxing or sparring for a period of 365 days after the third occurrence. Any combination of knockouts or RSCHs that equal three under these circumstances qualifies for the 365 day suspension.*

#### **Other**

*Any boxer who loses a difficult bout as a result of many blows to the head or who is knocked down in several successive competitions may be barred from taking part in boxing or sparring for a period of 30 days after the last contest on the advice of the Medical Jury.*

*All these protective regulations apply when the knockout or severe head trauma occurs in training or in any other activity (other sports, car accidents etc.).*

#### **Medical certification after the end of the suspension period**

*Before a boxer is allowed to fight after the aforementioned periods have elapsed, he must be passed as fit by his physician or a neurologist, if possible after a specialist examination has been conducted and computerised tomography or MRI of the brain has been carried out.*

**Table 2:** Suspensions in AOB.

to any neurological signs. If the boxer is considered stable then they can be sent home with supervision, a head injury advice sheet, (part of the SCAT 3) should be given to the person accompanying the concussed boxer.

If the boxer's condition deteriorates then they should be sent to hospital as an emergency to exclude an intracranial bleed.

There are many tools to help monitor concussion, from measuring eye movements, vestibular function and pen and paper tests, to computerised psychometric testing or a combination of tests. Testing concussion is much more useful if a baseline is obtained before the season starts or when the boxer is known not to be concussed. The SCAT3 is a useful monitoring tool

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which requires no special equipment and can be carried out in the remotest parts of the world. Many professional clubs use a computerised psychometric system which will measure short-term memory, reaction time and cognition. These systems are thought to be less easy to cheat and are often used as a guide to return to play in professional sport.

### Persistent concussion

About 10 to 15% of concussion lasts for longer than 10 days and occasionally for many months. If symptoms of concussion continue for more than 2 weeks an MRI scan of the brain is advisable to rule out an intracranial bleed. Recovery can be charted using the SCAT3.

Symptoms of depression should be taken very seriously and there should be a low threshold for introducing treatment with an appropriate anti-depressant medication. Increasing physical and cognitive activity should be introduced as symptoms allow. Caring for a patient with persistent concussion is best done using a multi-disciplinary approach, led by a sports physician who is experienced in treating concussion.

### Concussion in children

Concussion in children should be taken seriously and should be considered in all children who have a blow to the head, as children may present with different signs and express their symptoms in a different way from adults. In children, the Child SCAT3<sup>13</sup> should be used; this is suitable for children from the ages 5 to 12. In suspected concussion in children there should be a low threshold for referral to hospital for specialist neurological opinion.

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