

Running Head: Manual Osteopathy for the Sports-Related Concussion

Osteopathic Manipulative Medicine for the Management of the Sports-Related Concussion

Spencer Jean, CBIS

National Academy of Osteopathy

The effectiveness of manual osteopathic care for the sports-related concussion has been a research topic highly publicized on a global platform in consideration of the recent research regarding the consequences and inherent effects of concussions in sport. Concussion is a brain injury and is defined as a complex pathophysiological process affecting the brain, induced by biomechanical forces (McCrorry et al, 2013). It is estimated that as many as 3.8 million concussions occur annually in the United States in competitive sports and recreational activities (Harmon, et al, 2013). The majority of concussions resolve in a short (7-10 day) period (McCroy P, Johnston K, Meeuwisse W, et al. 2004); however, persistent symptoms (>10 days) are generally reported in 10-15% of concussions, which is diagnosed as post-concussion syndrome (McCrorry, et al. 2013). The therapeutic specificity of manual osteopathy represents an appropriate solution to this type of complex health problem (Druelle, 2011).

Manual osteopathy is a system of health care that focuses on osteopathic diagnosis and treatment of the physical body's structure in order to optimise physiological functioning. The principles of osteopathy are: (1) The body is a unit; (2) Structure and function are reciprocally inter-related; (3) The body possesses self-regulatory mechanisms; (4) The body has the inherent capacity to defend and repair itself; (5) When the normal adaptability is disrupted, or when environmental changes overcome the body's capacity for self-maintenance, disease may ensue; (6) The movement of body fluids is essential to the maintenance of health; (7) The nerves play a crucial part in controlling the fluids of the body; and (8) There are somatic components to disease that are not only manifestations of disease, but also are factors that contribute to maintenance of the disease state.

Symptoms of patients who have been subjected to cranial trauma causing concussion (Mild Traumatic Brain Injury) are varied. The diagnosis of acute concussion usually involves the assessment of a range of domains including clinical symptoms, physical signs, cognitive impairment, neurobehavioural features and sleep disturbances (McCrorry, et al. 2013). If symptoms are persistent (>10 days), patients are diagnosed with post-concussion syndrome (PCS). If a person suffers a second concussion before symptoms from a previous concussion have subsided, they may become a victim of Second Impact Syndrome (SIS); in which, occurs when the brain swells rapidly and catastrophically (Cifu D and Drake D, 2006). The cause of SIS is uncertain, but research suggests that the brain's arterioles lose their ability to regulate their diameter, and therefore lose control over cerebral blood flow, causing massive cerebral edema (Cantu RC, 1998). The condition is often fatal, and almost everyone who is not killed is severely disabled. Concussions and mTBIs may lead to degenerative brain diseases which may include but not limited to: (1) Mild Cognitive Impairments; (2) Chronic Traumatic Encephalopathy; (3) Dementia; and (4) Alzheimer. The consequences of concussion are substantially great, in which makes the management of concussions by manual osteopaths significantly important.

The cornerstone of sports-related concussion management is physical and cognitive rest until the acute symptoms resolve and then a graded programme of exertion prior to medical clearance and return to play (McCrorry, et al. 2013). Osteopathic manipulative therapy has been proven to reduce post-concussive symptoms.

In the case of National Hockey Player Matthew Lombardi, Philippe Druelle DO along with the Collège d'Études Ostéopathiques of Montréal were able to effectively treat Lombardi's concussion which forced him out for the entire 2010-2011 hockey season (Druelle, 2011). Lombardi presented different symptoms that prevented him from playing hockey and from enjoying his life. After 3 manual osteopathic treatments, his condition greatly improved. He was treated until he was able to return to the 2012 Toronto Maple Leafs training camp and ultimately returning to play with his full abilities.

The osteopathic palpation used in Lombardi's case was able to identify cerebral zones where are suffering, which was objectified at the Institut Chévénov in St. Petersburg, in the department of evolutionary physiology and biochemistry with Pr Alexandre Shépolvanikov PhD and Yuri Moskalenko PhD by the tridimensional electroencephalography and by the transcranial dopler (Druelle, 2011). During the double blind experimentation, the hand of the Osteopath each time was able to indicate, with precision, the affected zones and to treat the zone until there was vascular and functional improvement. The measurements objectified a return of the systemic activity towards the norm right after the osteopathic endocranial treatment. Measure of the cranial system activity after the normalization and stimulation of the lateral ventricles and of the limbic system. The activity went from 0.17 to 0.11; the norm is 0.10 (Druelle, 2011).

Dr. Philippe Druelle, at the Collège d'Études Ostéopathiques of Montréal proposed a clinical methodology and strategic sites that evaluate and treat most patients that present with symptoms of cerebral concussions:

- i. The first step is to normalize the discocorporal lesions or subluxations, especially those situated in the upper thoracic spine. This type of lesions affects the vasomotion, by compressive or separation forces on the sympathetic ganglion leading to troubles with adaptation and blood flow of the active tissues in the cranial sphere. The more a tissue works, the more blood it needs. This natural and involuntary phenomenon becomes dysfunctional after a concussion and in the long term will affect the quality of the vascularization and therefore their functions, the efficiency of drainage and the immunity system locally and at a distance.
- ii. The CO-C1-C2 junction is also key to improved vascularization of the endocranium. The superior cervical ganglion, the perforation of the dura mater by the vertebral artery, the fact that its pathway has a 90 degree turn in it are determining factors and essential for the integrity of health. The translation part of the phenomenon of a pseudorotation is the most damaging parameter due to the vertebral artery and the tensions on the dura mater.
- iii. The foramen lacerum can be injured with significant compressive consequences on the vagus nerve which anastomoses with the first cervical nerve roots and the first sympathetic cervical ganglion. If the parasympathetic nerve has any dysfunction, a great deal of visceral functions will be affected.
- iv. The trajectory of the carotid artery from the brachiocephalic trunk should be free from all forms of constraints. We have found that the risk is principally located where the carotid turns 90 degrees in the petrous portion of the temporal bone. We have observed a great deal of improvement when we released the intraosseous tensions in the petrous portion

and also the tensions that were applied to the walls of the carotid artery. We have in place specific methodology to obtain a good result in this region. In reality many of the troubles spontaneously resolve when we release the carotid artery and the structures that surround it. The middle cerebral artery itself is solely responsible for 70% of the vascularization of the brain.

- v. The carotid sinus is one of the key cerebral vascular adaptors. In addition, in the petrous portions we have several elements that intervene in the balance and in the management of several adaptive cerebral functions: the internal carotid nerve, the deep petrosal nerve that gives way to the sphenopalatine ganglion, the facial nerve, the greater petrosal nerve, the geniculate ganglion, the tympanic cavity, the vestibular system, etc.
- vi. The Posterior fossa, and the brainstem are strategic and fragile areas always affected by a concussion. Especially with whiplashes, the cerebral mass is projected against the foramen magnum often with micro-hemorrhages or concussion like states. This region is in relation to the autonomic nervous system, the vital cardiac, pulmonary and digestive functions, the majority of functions linked to the maintenance of life processes, the fourth ventricle, the passage of CSF before it enters in the central canal of the spinal cord, the roots of the majority of the cranial nerves, coordination, etc.
- vii. At the time of a physiological trauma of the encephalon, the solid aspect, the fluid flow, the blood flow, and the distribution of the electromagnetic fields, principally those emitted by the thalamus region, are vital for the global systemic activity of the functions of the brain. It is therefore important to work all these levels according to the individual needs of the patient. Those who have suffered from a concussion, almost always have endocranial spasms or zones of cranial dysfunction affecting regular daily function.
- viii. The vascular pump between the superficial arteries like those found in the pia mater and the deep arteries like the basilar artery is essential. It assures the dynamic and the regularization of the fluidic rhythms in the endocranium. We demonstrated with Pr Yuri Moskalenko PhD that this synergy between surface and depth almost does not exist anymore in those that have undergone a cranial trauma and that this synergy does return towards normality after endocranial osteopathic treatment.
- ix. The lateral ventricles have an indirect action on the limbic system, on the dynamic fluctuation of the CSF and on the region of the third ventricle and thalamus. The technique should be done as regularly as possible since it significantly raises the systemic activity of the cranium, as we were able to observe in the department of Professeur Chépolvanikov PhD. This action, according to our observations, allowed the development of an important rehabilitation factor for neural plasticity (Druelle and Moskalenko, 2011).

The clinical methodology of Dr. Philippe Druelle and Pr Yuri Moskalenko, PhD proposes that in the case where the patient is currently suffering or if the concussion is recent it is desirable to start work peripherally. In osteopathy this method is excellent to fight against inflammation and the irritation of the nerves (Druelle, 2011). William Garner Sutherland explained that through the fluctuation of the cerebral spinal fluid, there is a movement that diverges naturally, this *Fluid Flow*, towards the area which is suffering. The compression of the lateral ventricles considerably increases the systemic activity of the brain (Chépolvanikov and Druelle, 2007). This also

stimulates the neural plasticity, the quality of synaptic exchanges and the production of neuromodulators like serotonin, noradrenalin, gamma-amino butyric acid (GABA), acetylcholine, etc.

It is preferable to treat a patient for short periods at the beginning, but more often (10-15 minutes each day). As soon as the osteopathic manipulative practitioner senses progress, they can increase the length of each treatment. After about a week, they can space out the frequency of treatments as well. The tissues and their mechanisms cannot take on more than the capacity of their resistance (Druelle, 2011). It should be noted that each individual may inherit conditions and symptoms which may alter the frequency of treatments.

In the case of Heidi Bedford, a prep school hockey player, craniosacral therapy developed in osteopathic manual medicine over 100 years ago proved to be an effective method of treatment (Feldman, 2011). Dr. Edward Feldman described how craniosacral therapy. As well as the use of the Feldenkrais Method can help concussion recovery. Craniosacral therapy dissipates concussive forces trapped in the body's tissues, restoring movement to otherwise healthy tissue, whereas the Feldenkrais Method "deconstructs" habitual patterns of movement and increases neuroplasticity, essentially rewiring the brain (Feldman, 2011). Concussions can affect multiple components of the craniosacral system, including abnormal membranous tensions, bone articulations (cranial sutures), and structural immobility. These adversely affect the free flow and stable pressure of cerebral spinal fluid (CSF), blood flow, neural conduction as well as many other physiological functions. Craniosacral therapy allows the normal physiological functioning to return. These methods help the body's self-healing, self-organizing mechanisms, which have evolved over millions of years, to work to organize the cells and tissues in the body, in order for the nervous system to be restored (Feldman, 2011). Just like in the case of Matthew Lombardi, just after 3 osteopathic manipulative treatments Bedford's post-concussive symptoms were less severe.

It was until National Hockey Leagues' superstar, Sidney Crosby, possibly the most scrutinized concussion victim of the sport, experienced similar symptoms of concussion due to a neck ailment, most practitioners focused on treating the brain injury while overlooking a possible cervical spine injury. The lowest threshold to cause brain trauma in animals is approximately 60 g of force, whereas the limit of tolerance to whiplash is an acceleration of about 14 g (Mallison et al, 1998). Thus, one can presume that if a patient has suffered a concussion or injury to the brain, they have also sustained an injury to the cervical spine. Based on the research at the University of Buffalo (UB), one can conclude that some patients who have been diagnosed with a concussion, and who's symptoms persist for several months may actually have suffered a neck injury in addition to a concussion (Leddy, 2014). Many symptoms of concussion closely resemble cervical spine injuries which makes the diagnosis extremely difficult. This evidence as well as the mechanisms a concussion can occur suggests that osteopathic manual practitioner's should incorporate a cervical spine examination into every concussion examination.

Although osteopathic manipulative techniques have been medically proven to treat post-concussion symptoms, there are modalities which can aid the practitioner in the treatment process.

Low Level Laser Therapy (LLLT) has showed marked improvement in cognition, executive function, memory and sleep with light emitting diode (LED) treatments (Hashmi JT et al, 2010). It is hypothesized that an overall protective response occurs with repeated LED treatment and that the therapy may reduce oxidative damage and chronic inflammation that occurs in the brain following a concussion, in addition to increasing cerebral blood flow (Oron A, Oron U, Streeter J. et al. 2007). LLLT has been effectively used to treat acute and chronic cervical spine pain. Treatment of the cervical spine may positively affect the brain stem, cerebrospinal fluid and blood circulation of the cerebral hemispheres, thereby reducing the effects of the initial trauma (Yuen et. Al, 2013).

Dr. Ted Carrick, a chiropractic neurologist suggests the use of the “GyroStim”, which is essentially a mechanical chair that rotates slowly around in all different directions in an attempt to stimulate the vestibular system. The vestibular system is a powerful activator of brain functions and its stimulation may be associated with an improvement of many functions with a decrease of symptoms including head pain, fogginess, concentration, balance, gait and motor coordination (Carrick, 2011). Dr. Carrick utilized the GyroStim as well as previously mentioned osteopathic manual medicine and modalities in the treatment protocol of Sidney Crosby. The only negative side of utilizing the GyroStim is in fact utilizing the machine. The machine, which takes two to three months to manufacture, cost practitioners \$200,000. Unfortunately, the machine is still pending FDA approval which means that insurance companies will not cover the patient’s cost of treatment. This makes it very difficult for practitioners to feasibly comprehend the purchase of the GyroStim; thus, creating a financial barrier for the implementation within patient treatment plans.

Concussion studies have found that concussions whether one or numerous have a great effect on vision. The actual prescription may not change but the eye focus may be pushed medially. This will cause the patient to see words, people or objects in the background of what they are looking at blurry. A prime example is demonstrated while reading. While reading a sentence, the patient may see only one word at a time as clear and the rest may appear blurry. This symptom is all too familiar, in my personal case which is published in the novel “The Untold Truth”. As a collegiate and professional hockey player, I sustained 15 diagnosed concussions within the span of 6 years. After forced into retirement due to a career ending concussion, I had not been able to “read”. After multiple tests, it was diagnosed that my eyes were indeed pushed medially, as well as other symptoms. After becoming a Certified Brain Injury Specialist, I developed an inexpensive rehabilitation device (built into glasses) in order to retrain my eyes. This helped push my vision outward allowing my eyes to focus more clearly. The goal is to retrain the eyes. After a carefully developed treatment plan I was finally able to see perfectly. I have used this rehabilitation device on many of my patients within my practice as a certified brain injury specialist with tremendous results.

Within the scope of practice of an osteopathic manipulative practitioner, nutritional advice is warranted. Nutritional supplements have been proven to aid in the process of recovering from a concussion: A July publication of The Journal of Neurosurgery, Dr. Julian Bailes and Dr. Barry Sears found that supplementing patients with EPA/DHA fish oil for 30 days after head injuries

had a greater than 98 percent reduction in brain damage compared with those who did not receive the supplement (Sears, 2014). It is hypothesized that the omega-3 fatty acids in the fish oil reduced the inflammation induced by the concussion injury; Dietary consumptions of Branch Chain Amino Acids (BCAA's) restored hippocampal BCAA concentrations to normal, reversed injury-induced shifts in net synaptic efficacy, and led to the reinstatement of cognitive performance after concussive brain injury (Sears, 2014); Magnesium Sulfate significantly reduces the brain edema following brain injury and has no adverse effects. B-Complex should be recommended, specifically B12, folate and B6 in consideration that they are all involved in neurotransmitter synthesis in the brain; Antioxidants aids in the process of neutralizing oxidative stress and decreasing inflammation; and Lion's Mane, which is a hot water extract from a mushroom, stimulated the nerve growth factor which accelerated the growth of the myelin sheath. After a concussion, significant damage is done to the myelin sheath of the nerve leading to the brain cell, thus regenerating the myelin sheath is a crucial step towards recovery (Swanson, 2014).

The application of neuropsychological (NP) testing in concussion has been shown to be of clinical value and contributes significant information in concussion evaluation (Collie et. Al, 2001). Although cognitive recovery largely overlaps with the time course of symptom recovery in most cases, it has been demonstrated that cognitive recovery may occasionally precede or more commonly follow clinical symptom resolution, suggesting that the assessment of cognitive function should be an important component in the overall assessment of concussion and, in particular, any return to play protocol (McCrory, 2012); however, NP assessment should not be the sole basis of management decisions. Athletes should undergo baseline NP testing prior to the initiation of the sporting season in order to aid in a clinical interpretation to any post-injury NP testing (McCrory, 2012). This baseline NP testing gives the osteopathic manipulative practitioner a chance to educate the athlete on the significance of the injury. Athlete concussion education has been statistically proven to reduce the undiagnosed rate of sports-related concussion by 78.5% (Jean, 2013). Knowledge transfer (KT) of the education of athletes, colleagues and the general public is significantly important. The osteopathic manipulative practitioner must educate athletes, referees, administrators, parents, coaches and health care professionals regarding the detection of concussion, its clinical features, assessment techniques and principles of returning to play (McCrory, 2012).

The baseline (pre-participation) examination should include: (1) Detailed concussion and health history; (2) Concussion Education; (3) Maxillofacial and cervical spine examination; (4) Physical examination; (5) Balance examination; (6) Reaction time examination; and (7) Neuropsychological/ Neurocognitive testing (McCrory et. El, 2012). Suggested NP examinations for the sports-related concussion include: (1) Sport Concussion Assessment Tool 3<sup>rd</sup> Edition (SCAT3); (2) Sports Concussion Assessment Tool 3<sup>rd</sup> Edition – Child Version; (3) Balance Error Scoring System; and (4) Immediate Post-Concussion Assessment Testing Test (ImPACT Test). The test which is used most often in sports is the ImPACT Test. The ImPACT Test is a sophisticated, research-based computer tool developed to help clinicians evaluate recovery

following concussion. ImPACT promotes an athlete's full recovery from injury and assists practitioners in making a safe return-to-play decision and reducing the chance of follow-up concussions (Mayers and Redick, 2012).

Returning to sport after sustaining a concussion can be very dangerous which is why the British Journal of Sports Medicine has recommended Graduated Return to Play Protocols which follows a stepwise process. The stepwise process entails the following 6 steps: (1) No activity; (2) Light aerobic exercise; (3) Sport-specific exercise; (4) Non-contact training drills; (5) Full contact practice; and (6) Return to play. With this stepwise progression, the athlete should continue to proceed to the next level if asymptomatic at the current level (McCrary et al, 2012). Generally, each step should take 24 hours so that an athlete would take approximately 1 week to proceed through the full rehabilitation protocol once they are asymptomatic at rest and with provocative exercise. If any post-concussion symptoms occur while in the stepwise programme, then the patient should drop back to the previous asymptomatic level and try to progress again after a further 24 hour period of rest has passed (McCrary et al, 2012).

A range of 'modifying' factors may influence the investigation and management of concussion. Modifying factors the osteopathic manipulative practitioner should be aware of include: (1) Symptoms – Number, duration (>10 days), severity; (2) Signs – Prolonged LOC (>1 minute), Amnesia; (3) Sequelae – Concussive convulsions; (4) Temporal – Frequency (repeated concussions over timing), Recency (recent concussion or TBI); (4) Threshold – Repeated concussions occurring with progressively less impact force or slower recovery after each successive concussion; (5) Age – Child and adolescent (<18 years old); (6) Comorbidities and pre-morbidities – Migraine, depression or other mental health disorders, attention deficit hyperactivity disorder (ADHD), learning disabilities (LD), sleep disorders; (7) Medication – Psychoactive drugs, anticoagulants; (8) Behaviour – Dangerous style of play; (9) Sport – High-risk activity, contact and collision sport, high sporting level; and (10) Gender (McCrary et. al, 2012).

In accordance of the above research material, the following protocols the osteopathic manipulative practitioner should implement into the management of the sports-related concussion are as follows:

1. Pre-Injury: (a) Detailed concussion and health history; (b) Concussion Education; (c) Maxillofacial and cervical spine examination; (d) Physical examination; (e) Balance examination; (f) Reaction time examination; and (g) Neuropsychological/ Neurocognitive testing.
2. Diagnosis: (a) Detailed concussion and health history; (b) Palpation – Tridimensional Electroencephalography by the transcranial dopler; (c) Symptom evaluation; (d) Neuropsychological testing comparing with baseline data; (e) Balance examination; (f) Reaction time examination, and (g) Maxillofacial and cervical spine examination.
3. Treatment: The following is a generalized recommended treatment protocol; each patient should be treated based on individual symptoms and patient history. The osteopathic manipulative practitioner should educate the patient and their legal representatives of the treatment plan they have develop for the individual patient.



- a. Endocranial Osteopathic Treatment: (i) Normalize the discocorporal lesions or subluxations; (ii) The CO-C1-C2 junction; (iii) Foramen lacerum; (iv) Free the trajectory of the carotid artery from the brachiocephalic trunk from all forms of constraints; (v) Carotid sinus; (vi) Posterior fossa; (vii) brainstem; (viii) Physiological trauma of the encephalon, the solid aspect, the fluid flow, the blood flow, and the distribution of the electromagnetic fields, principally those emitted by the thalamus region; (ix) The vascular pump between the superficial arteries like those found in the pia mater and the deep arteries like the basilar artery is essential; and (x) The lateral ventricles.
  - b. Craniosacral Osteopathic Manipulative Therapy
  - c. Cervical Spine: (i) Osteopathic Manipulative Techniques (OMT); (ii) Osteopathic Muscle Energy Techniques (MET); (iii) Osteopathic Soft Tissue Therapy; and (iv) Therapeutic Exercise.
  - d. Modalities: (i) Low Level Laser Therapy (LLLT); and (ii) GyroStim.
  - e. Vision Therapy
  - f. Nutritional Advise: (i) Fish Oil; (ii) Branch Chain Amino Acids (BCAA's); (iii) Magnesium Sulfate; (iv) Anti-Oxidants; (v) Lion's Mane; and (vi) B-Complex.
  - g. Reaction Time Training
  - h. Balance Training
4. Frequency of Treatment: (i) Beginning – Short periods, but more often (10-15 minutes per day); (ii) Increasing length – Increase length of treatment when the osteopathic manipulative practitioner senses an increase in progress; (iii) Frequency – After about a week, space out the frequency of treatments; and (iv) Note that each individual may inherit conditions and symptoms which may alter the frequency of treatments.
  5. Stepwise Graduated Return to Play Protocols: (i) No activity; (ii) Light aerobic exercise; (iii) Sport-specific exercise; (iv) Non-contact training drills; (v) Full contact practice; and (vi) Return to play.
  6. Aware of modifying factors which can influence treatment and management.

In conclusion, the osteopathic manipulative practitioner holds an important role in the management of the sports-related concussion. The therapeutic specificity of osteopathy represents an appropriate solution to the complexity of concussion. Osteopathy manipulative medicine is scientifically proven to significantly improve patient's experiencing a sports-related concussion. The osteopathic manipulative practitioner has not only a role in the treatment of concussion but a role in the proactive approach to sport-concussion management as well as reinsertion into sport. Osteopathic manipulative therapy is scientifically proven to be an effective treatment and management of the sports-related concussion.

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