

# **Handbook of Neurological Sports Medicine**

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## **Learning Objectives**

### *Handbook of Neurological Sports Medicine*

**After completing this course participants will be able to:**

1. Know the history of Sports Medicine and how it impacted current management strategies.
2. Understand the evolution of Sports Medicine in the present day, which includes the roles of parents, coaches, athletic trainers, therapists, and physicians.
3. Learn the primary neurological injuries that occur with American Football, Archery and Bow Hunting, Australian Rules Football and Rugby, Automobile Racing, Ballet and Dance, Baseball and Softball, Basketball, Bowling, Boxing, Bungee Jumping, Canoeing and Kayaking, Cheerleading, Cricket, Cycling, Darts and Lawn Darts, Diving and Swimming, Dodge ball, Equestrian Sports, Golf, Gymnastics, Hang Gliding, Hockey, Hurling, Skating, Lacrosse, Martial Arts, Motorcycle racing, Mountain Climbing and Hiking, Racket Sports, Rodeo, Rowing, Shooting Sports, Skiing and Snowboarding, Snowmobiling, Soccer, Surfing, Volleyball, Wakeboarding and Water Skiing, and Wrestling.
4. Understand that more than 62% of sports injuries will occur during practice.
5. Learn and be able to utilize the definition of negligence and the four criteria that must be met to establish negligence.
6. Understand legal duty and breach, violation of statutory duty, and how this can impact on the field decisions.
7. Be able to define and utilize Standard of Care and understand how this pertains to a court of law.
8. Understand the Good Samaritan Laws and know that they vary from state to state.
9. Learn what assumption of the risk implies and the theories of negligence.
10. Review pivotal court cases that have led to the advancement of athlete safety through history.
11. Realize the implications of the lawsuit against the NFL in 2013 for allowing head injuries to occur and not allowing appropriate recovery before resuming play.
12. Learn how to develop an Emergency Action Plan and the practice that it will require to implement.
13. Understand the importance of equipment, communication, transportation, venue location, medical care facilities, and the documentation of the emergency action plan.

14. Understand what is required for the primary survey, secondary survey, sideline assessment, and the need for spine boarding and stabilization.
15. Learn the function of the twelve cranial nerves and how a defect would be determined.
16. Learn the spinal nerve motor root distribution for the entire spinal column and how to test for deficiencies.
17. Understand the responsibilities of the host medical team and how these are established before the beginning of the competition or season.
18. Understand the biomechanics and physics of how a concussion can occur, including force, torque, linear acceleration, and rotational acceleration.
19. Understand the forces within the skull during a concussion injury, such as acceleration-deceleration, coup-contrecoup, and brain slosh.
20. Be able to explain the NFL's history and research into preventing concussions and the implications of impact frequency, impact magnitude, and concussion threshold.
21. Understand the risk of concussive injuries in boxing, hockey, and soccer.
22. Learn the pathophysiology of concussions and the neurometabolic cascade that occurs at both the neuron and axon.
23. Understand why previous attempts to grade concussions failed to determine the amount of brain injury, and that loss of consciousness is not the key predictor of concussion outcome.
24. Learn how to grade a traumatic brain injury with the Glasgow Coma Scale
25. Understand the signs and symptoms of concussions and how to test for them on the sidelines.
26. Understand the effect of age, gender, and pre-existing conditions, which may increase the likelihood of concussions or their severity.
27. Learn the various methods of neuroimaging for brain injuries and what information each method will provide.
28. Understand the importance of neuropsychological assessment in determining the extent of the concussion injury.
29. Learn what common neuropsychological assessments are testing for, including paper testing, ImPACT, ANAM, CogSport, HeadMinder, and Concussion Vital Signs.
30. Know how underlying psychological problems can complicate the recovery from a concussion.
31. Understand the importance of balance assessment after a concussion and the three systems in the body that contribute to balance.
32. Learn several testing methods to determine the extent of the balance compromise from the concussion.
33. Understand how biomarkers may be the future of assessing the extent of brain injury from a concussion.
34. Learn the definition and symptoms of Postconcussion Syndrome as well as two different ways to determine if it is present.
35. Learn how preexisting psychological disease can increase the chances of Postconcussion Syndrome.
36. Understand the neuropathology of Chronic Traumatic Encephalopathy and Posttraumatic Encephalopathy, as well as how the two conditions can co-exist.
37. Know the Neuropathologic features of Chronic Traumatic Encephalopathy.

38. Be able to define subconcussions and learn the changes in brain function that may occur.
39. Understand the impact that concussions and subconcussions have on young athletes when the brain has not completely developed.
40. Learn the causes for the decreased prevalence of severe head injuries and be able to define a brain contusion.
41. Learn the definition, cause, and possible complications of traumatic subarachnoid hemorrhage, subdural hematomas, skull fractures, epidural hematomas, and diffuse axonal injury.
42. Understand the causes of arterial dissection and how arterial dissection can lead to stroke.
43. Know the sports and risk factors that can lead to athlete fatalities and posttraumatic seizures.
44. Understand the significance of Second Impact Syndrome and the rapid neurological deterioration that occurs.
45. Understand the impact of the neurological injury on return to play.
46. Learn the stages of concussive injury and the symptoms that occur in each stage.
47. Understand the current guidelines to follow for concussion recovery and return to play.
48. Learn about brain abnormalities which can occur from the concussion or be pre-existing which will impact a player's ability to continue sports, such as Chiari Malformation, Arachnoid cysts, ventriculoperitoneal shunts, prior craniotomy, and Epilepsy.
49. Understand that most concussions will resolve with physical and cognitive rest, but if symptoms are severe, pharmacological treatment may be required.
50. Learn the types of medications used and their side effects for the treatment of headaches, dizziness, fatigue, nausea, sleep disturbances, emotional symptoms, and cognitive impairment.
51. Understand that concussion rehabilitation can be improved through education on the concussion symptoms and neurocognitive rehabilitation.
52. Learn which supplements have been shown in animal or human studies to have a neuroprotective effect, including Eicosapentaenoic Acid, Docosahexaenoic Acid, Curcumin, Resveratrol, Creatine, Green Tea, Caffeine, and Vitamins E, C, and D.
53. Gain perspective on possible future forms of treatment for traumatic brain injury, such as Scutellaria Baicalensis, Salvia miltiorrhiza, Pycnogenol, and Hyperbaric Oxygen therapy.
54. Understand the various types, causal mechanisms and clinical features of cervical, thoracic, and lumbar spinal injuries.
55. Learn the cause and definition of spinal cord injuries including Cervical Neurapraxia, Central Cord Syndrome, Brown-Sequard Syndrome, Anterior Spinal Artery Syndrome, and Nerve Root or Plexus damage.
56. Know the vascular, soft tissue, bone, disc, and fractures that commonly impact athletic performance.
57. Understand the initial care, rehabilitation, surgical possibilities, and return to play guidelines for cervical, thoracic, and lumbar spine injuries.



CEC/CEU Test for Handbook of Neurological Sports Medicine

Please choose the BEST answer for each question

- 1. Where did the earliest form of sports medicine begin?**
  - A. Russia
  - B. United States
  - C. Greece and Rome
  - D. Istanbul
  
- 2. During the time of the first Olympics, athletic trainers were expected to understand all of the following except?**
  - A. Massage
  - B. Diet
  - C. Physical Therapy
  - D. Sleep Habits
  
- 3. When was the first game of intercollegiate football first played?**
  - A. 1832
  - B. 1869
  - C. 1904
  - D. 1921
  
- 4. What is the estimate for the total number of participants in the United States who played football in 2011?**
  - A. 1.5 million
  - B. 2.7 million
  - C. 3.6 million
  - D. 4.2 million

- 5. For the four deaths from catastrophic injury in U.S. football in 2011, what was the general cause of death?**
- A. Neurological
  - B. Congenital heart defects
  - C. Internal bleeding
  - D. Respiratory distress
- 6. Which of the following can result from repetitive head injuries?**
- A. Stroke
  - B. Chronic traumatic encephalopathy
  - C. Toxic encephalopathy
  - D. Viral meningitis
- 7. Mononeuropathies have been seen to occur in football in all of the following nerves except:**
- A. Axillary nerve.
  - B. Trigeminal nerve
  - C. Suprascapular nerve.
  - D. Median nerve.
- 8. What is the most common cause of neurological damage in Archery and Bow Hunting?**
- A. Brachial Nerve Palsy
  - B. Carpal Tunnel Syndrome
  - C. Falling out of the hunting tree stand.
  - D. Spinal Nerve Root Impingement.
- 9. During two seasons of Australian Rules football, what percentage of the 234 head injuries resulted in concussions?**
- A. 55%
  - B. 65%
  - C. 75%
  - D. 85%

- 10. In automobile racing, what percentage of the neurological injuries are to the head?**
- A. 60%
  - B. 70%
  - C. 80%
  - D. 90%
- 11. One-third of dance related injuries are due to:**
- A. Head trauma resulting in a bleed.
  - B. Concussions.
  - C. Ankle sprains.
  - D. Muscle strains.
- 12. Which of the following is not a main mechanism of injury in Baseball and Softball?**
- A. Spondylolysis
  - B. Being struck by the ball
  - C. Repetitive motion
  - D. Sliding
- 13. Which type of neurological injury is most common in basketball?**
- A. Subdural hematomas
  - B. Spinal injuries
  - C. Epidural hematomas
  - D. Subarachnoid bleeds
- 14. In bowling, "cherry pitter's thumb" refers to damage to which of the following nerves?**
- A. Digital nerve
  - B. Median nerve
  - C. Ulnar nerve
  - D. Brachial nerve
- 15. When did the earliest forms of boxing first occur?**
- A. 2000 B.C.
  - B. 1500 B.C.
  - C. 1000 B.C.
  - D. 1500 A.D.



**16. Which of the following was not one of the Rules of Boxing?**

- A. There is no ring or enclosed area.
- B. There is a three-minute limit on rounds.
- C. Boxing matches were open to anyone.
- D. The fight is won when the opponent is disabled.

**17. Which of the following is not a common area injured while boxing?**

- A. Head
- B. Abdomen
- C. Hands
- D. Face

**18. All of the following are common neurological injuries sustained during Cheerleading except:**

- A. Skull Fractures
- B. Intracranial hemorrhages
- C. Diffuse cerebral edema
- D. Sacral atrophy

**19. When was the first competitive bicycle race held?**

- A. 1802
- B. 1843
- C. 1862
- D. 1897

**20. In what percentage of cyclists do neck & back pain cause complaint?**

- A. 20%
- B. 50%
- C. 60%
- D. 90%

**21. When was the sale of lawn darts banned due to the risk for injury to the face or head?**

- A. 1988
- B. 1992
- C. 2004
- D. 2012

- 22. What is the fourth leading cause of spinal cord injury in the United States?**
- A. Horseback riding
  - B. Gymnastics
  - C. Cheerleading
  - D. Diving
- 23. What is the most common site of injury for professional male golfers?**
- A. Wrist
  - B. Elbow
  - C. Low Back
  - D. Shoulder
- 24. In Gymnastics, where do most spinal cord injuries occur?**
- A. Cervical Spine
  - B. Thoracic Spine
  - C. Lumbar Spine
  - D. Sacral Spine
- 25. In which country is Hurling one of the three national games?**
- A. Italy
  - B. Brazil
  - C. Ireland
  - D. Russia
- 26. Which of the following forms of martial arts is not one that primarily involves grappling?**
- A. Judo
  - B. Taekwondo
  - C. Sumo
  - D. Brazilian jiu-jitsu
- 27. All of the following are examples of peripheral neurological damage seen in Racket sports except:**
- A. Posterior interosseous nerve entrapment.
  - B. Suprascapular injury.
  - C. Ulnar nerve palsy.
  - D. Long thoracic nerve injury.

- 28. Where do most skiing-related spinal injuries occur?**
- A. Cervical Spine
  - B. Thoracolumbar region
  - C. Sacral Spine
  - D. Brainstem
- 29. Where did Soccer originate?**
- A. Brazil
  - B. Argentina
  - C. England
  - D. China
- 30. Which football player was the first to file a disability claim with the NFL for repetitive brain injuries?**
- A. Joe Montana
  - B. Mike Webster
  - C. Mickael Ricks
  - D. Peyton Manning
- 31. What progressive degenerative disease was diagnosed post-mortem in the player from the question above?**
- A. Acute subdural bleed
  - B. Acute subarachnoid hemorrhage
  - C. Viral Meningitis
  - D. Chronic traumatic encephalopathy
- 32. What percentage of sport injuries occur during practice according to the National Center for Sports Safety?**
- A. 43%
  - B. 57%
  - C. 62%
  - D. 89%
- 33. According to the CDC, how many sport/recreation-related concussions occur in the U.S. per year?**
- A. 2.8 million
  - B. 3.9 million
  - C. 5 million
  - D. 7.2 million

- 34. Which king in history is believed to have had psychological changes after repeated head injuries during jousting?**
- A. King Henry of France
  - B. King Henry VIII of England
  - C. King Francis of France
  - D. King Phillippe of Italy
- 35. All of the following are required for the claimant to prove in a case of negligence except:**
- A. A duty or obligation that requires a certain standard of conduct for the protection of others against unreasonable risk that is recognized by the legal system.
  - B. A failure to comply with the duty/obligation by not meeting the standard of care.
  - C. The damage or injury must have been caused by the failure to meet the standard of care.
  - D. Punitive damages whether an actual loss or damage occurred or not.
- 36. Which state in the U.S. started the process for concussion legislation?**
- A. Washington
  - B. New York
  - C. Pennsylvania
  - D. California
- 37. An expert on the Standard of Care will possess all of the following except:**
- A. Knowledge
  - B. Education
  - C. Inexperience
  - D. Training
- 38. Which of the following is a "must-read" for any team physician?**
- A. Heads Up: Concussions in High School Sports
  - B. Heads Down: Concussions in High School Sports
  - C. Preventing head injuries in intercollegiate sports
  - D. The ABC's of preventing head injuries.

- 39. What is the legal term that means there must be a connection between the negligent act and the damages?**
- A. Immediate Cause
  - B. Proximal Cause
  - C. Direct Fault
  - D. Indirect Fault
- 40. Which of the following is not an example of a negligence claim that commonly appears in sports-related injury cases?**
- A. Failure to train properly
  - B. Failure to be adequately credentialed
  - C. Poor supervision
  - D. Equal matching of opponents
- 41. Which court case found the coach and staff negligent for requiring a “player to wear available protective equipment to minimize the risk of a player being injured when tackled, even by actions that violate game rules”?**
- A. Harvey v. Ouchita Parish School Board
  - B. Maldonado v. Gateway Hotel Holdings, LLC
  - C. Cerny v. Cedar Bluffs Junior/Senior Public School
  - D. Pinson v. State of Tennessee
- 42. Which court case awarded \$13.7 million in compensatory damages because appropriate emergency medical care was not available?**
- A. Harvey v. Ouchita Parish School Board
  - B. Maldonado v. Gateway Hotel Holdings, LLC
  - C. Cerny v. Cedar Bluffs Junior/Senior Public School
  - D. Pinson v. State of Tennessee
- 43. In which court case was the case dismissed despite a broken neck resulting in quadriplegia because the player assumed the risk of the sport?**
- A. Pinson v. State of Tennessee
  - B. Rosada v. State of New York
  - C. Regan v. State of New York
  - D. Fox v. Board of Supervisors of Louisiana State University and Agricultural and Mechanical College

- 44. In the class action lawsuit against the NFL by former players that was settled in September 2013, what was the judgment against the NFL?**
- A. 20 million
  - B. 90 million
  - C. 330 million
  - D. 765 million
- 45. What percentage of schools has an athletic trainer present and available during all athletic events, including practice?**
- A. 34%
  - B. 44%
  - C. 64%
  - D. 75%
- 46. What is frequently the basis for claims and suits based on negligence?**
- A. Improper coaching
  - B. Lack of an emergency plan
  - C. Ignoring the possible medical concern
  - D. Treating the medical concern without medical supervision.
- 47. Implementing an emergency plan involves all of the following except:**
- A. Writing the plan down.
  - B. Education of the players and staff.
  - C. Practice of the emergency plan.
  - D. Coaches being able to deliver medical treatment plans.
- 48. If an athlete is unconscious after an injury, the first responder/athletic trainer should also suspect which of the following?**
- A. Subarachnoid hemorrhage
  - B. Cervical spine injury
  - C. Ocular damage
  - D. Thoracic spine injury

- 49. What is the first attempt that a first responder should try?**
- A. Expose the airway
  - B. Neurological exams
  - C. Move the spine into neutral alignment.
  - D. Prescribe anti-inflammatory medications
- 50. If spine immobilization is required, all of the following should be moved as one unit except:**
- A. Head
  - B. Neck
  - C. Trunk
  - D. Legs
- 51. How many people will it require to do the lift-and-slide technique?**
- A. 1-3 people
  - B. 2-4 people
  - C. 4-5 people
  - D. 6 or more people
- 52. Which cranial nerve would be affected if the athlete were unable to look medially and down?**
- A. Olfactory nerve
  - B. Oculomotor nerve
  - C. Trochlear nerve
  - D. Trigeminal nerve
- 53. Which cranial nerve injury would result in fasciculations of the tongue and deviation of the tongue toward the side of the injury?**
- A. Glossopharyngeal nerve
  - B. Vagus nerve
  - C. Spinal accessory nerve
  - D. Hypoglossal nerve
- 54. Which spinal nerve roots are responsible for the Quad reflex?**
- A. C1-C4
  - B. C5-C6
  - C. T2-T9
  - D. L3-L4

- 55. Which of the following laws of physics comes into play with head and brain acceleration.**
- A. Force=mass x acceleration
  - B. Force=mass x angular acceleration
  - C. Force=mass x deceleration
  - D. Force=torque x acceleration
- 56. How can torque be calculated for a head injury?**
- A. Torque=mass x acceleration
  - B. Torque=mass x angular acceleration
  - C. Torque=mass x deceleration
  - D. Torque=moment of inertia x angular acceleration
- 57. How much larger is the mass behind the strike when a player hits with their head, neck, and body in alignment compared to an upright hit?**
- A. They are the same.
  - B. 1.21 times
  - C. 1.48 times
  - D. 1.67 times
- 58. All of the following pertain to the mechanism of concussion injuries except:**
- A. Penetrating head trauma
  - B. Acceleration-deceleration injury
  - C. Coup-contrecoup injury
  - D. Brain slosh
- 59. Which position in football is associated with a higher incidence of head impact of 80 g acceleration?**
- A. Defensive lineman
  - B. Offensive backs
  - C. Defensive backs
  - D. Offensive lineman



- 60. In boxing, what percentage of the hits are to the head?**
- A. 50%
  - B. 60%
  - C. 70%
  - D. 80%
- 61. Heading in soccer, or hitting the ball with the head, includes all of the following stages except:**
- A. Pre-impact
  - B. Ball contact
  - C. Cervical extension
  - D. Follow-through
- 62. Which of the following is not part of the neurometabolic cascade that occurs after shear stress to the neurons?**
- A. Controlled ion flux
  - B. Liberation of potassium
  - C. Release of glutamate, an excitatory amino acid
  - D. Calcium influx into the neuron
- 63. All of the following are a result of mechanical strain on the axon except:**
- A. Membrane permeability.
  - B. Repolarization.
  - C. Mitochondrial alterations.
  - D. Ionic flux.
- 64. Which of the following diseases is not associated with breakdown of the blood-brain barrier?**
- A. Alzheimer's Disease
  - B. Amyotrophic Lateral Sclerosis
  - C. Multiple Sclerosis
  - D. Meningioma

- 65. What are the cells in the brain that initiate a neuroinflammatory response?**
- A. Eosinophils
  - B. Macrophages
  - C. Monocytes
  - D. Microglia cells
- 66. What score on the Glasgow Coma Scale would a person have if they present with eyes opening in response to pain, inappropriate verbal responses, and extensor posturing?**
- A. 15
  - B. 11
  - C. 7
  - D. 0
- 67. Which of the following would not be a symptom indicating that emergent medical care is required?**
- A. Momentary confusion
  - B. Decreased or irregular heart rate or breathing
  - C. Lateralized weakness
  - D. Unequal pupils
- 68. Which of the following is not associated with a concussion?**
- A. Headache
  - B. Nonreactive pupils
  - C. Nausea or vomiting
  - D. Difficulty with concentration
- 69. Which of the following is the definition of retrograde amnesia?**
- A. Amnesia that occurs sporadically
  - B. Inability to recall the events leading up to the injury
  - C. Inability to form new memories after the injury
  - D. Inability to recall events from childhood
- 70. What percentage of concussion resolve within 7 to 10 days?**
- A. 10-20%
  - B. 30-40%
  - C. 50-70%
  - D. 80-90%

- 71. At what age does the most significant maturation of the brain occur?**
- A. Birth to age 5
  - B. Age 6-14
  - C. Age 14-18
  - D. Age 18-22
- 72. Which of the following has the longest recovery time to pre-concussion baselines?**
- A. Weekend warriors
  - B. High School athletes
  - C. College athletes
  - D. Professional athletes
- 73. Which of the following is not a modifying factor for concussions?**
- A. Sport
  - B. Age
  - C. Behavior
  - D. Gender
- 74. Which of the following questions would not be a test for anterograde amnesia?**
- A. Who came to your assistance after the hit?
  - B. Who helped you to the sideline?
  - C. What was the score before you got hit?
  - D. How did you get to the hospital?
- 75. Which of the following is not part of the sideline neurological exam following a concussion?**
- A. Assessment of speech
  - B. Assessment of pupil size, position, and reactivity to light
  - C. Assessment of facial movements
  - D. Assessment of thoracic range of motion

- 76. How long does the Standardized Assessment of Concussion approximately take to complete?**
- A. 4 to 5 minutes
  - B. 6 to 8 minutes
  - C. 10 to 15 minutes
  - D. 20-30 minutes
- 77. What is the neuroimaging test of choice for emergency departments for possible brain injury?**
- A. CT scan
  - B. MRI
  - C. X-ray
  - D. PET scan
- 78. Which of the following types of scans do not expose the patient to radiation?**
- A. X-ray
  - B. CT scan
  - C. MRI
  - D. PET scan
- 79. Which advancement in MRI scans can identify shearing injuries not show on T2-weighted, FLAIR, or gradient-echo sequences?**
- A. Brain segmentation
  - B. Voxel-based morphometry
  - C. Diffusion Tensor Imaging
  - D. Diffusion-Weighted Imaging with apparent diffusion coefficient
- 80. Which type of test is a noninvasive way to measure concentrations of compounds in the brain?**
- A. CT scan
  - B. Functional Magnetic Resonance Imaging
  - C. Magnetic Resonance Spectroscopy
  - D. Cerebral shunt

- 81. Which of the following scans uses radioisotopes?**
- A. X-ray
  - B. CT scan
  - C. MRI
  - PET scan
- 82. When was the National Football League Neuropsychology Program developed?**
- A. 1972
  - B. 1987
  - C. 1993
  - D. 2007
- 83. Which of the following is a 5 minute test that assesses orientation, attention, and verbal memory?**
- A. The Standardized Assessment of Concussion
  - B. The Glasgow Coma Scale
  - C. Sports as a Laboratory Assessment Model
  - D. The Sideline Emergency Assessment Plan
- 84. All of the following are reasons an athlete may underreport their symptoms except:**
- A. Lack of understanding that they have a concussion.
  - B. Severe headache and vomiting.
  - C. Thinking the injury was not severe enough to need medical attention.
  - D. Wanting to be back in the game.
- 85. After a concussion, cognitive function can be adversely affected in all of the following ways except:**
- A. Attention deficits.
  - B. Processing speed.
  - C. Reaction time.
  - D. Increased resting heart rate.

- 86. What percentage of high schools with at least one athletic trainer use computerized neurocognitive assessment for their athletes?**
- A. 20%
  - B. 40%
  - C. 60%
  - D. 80%
- 87. The Immediate Post-Concussion Assessment and Cognitive Testing will provide information regarding all of the following except:**
- A. Agility.
  - B. Verbal and visual memory information.
  - C. Information processing time.
  - D. Reaction time.
- 88. Which computerized testing battery was originally developed by the Department of Defense for the military?**
- A. ImPACT
  - B. CogSport
  - C. ANAM
  - D. HeadMinder
- 89. When concussion protocols were first developed, what was the initially recommended time for post-injury testing.**
- A. 4 to 6 hours
  - B. 12 to 18 hours
  - C. 24 to 48 hours
  - D. 3 to 4 days
- 90. Currently, when are athletes tested cognitively after a concussion in most cases?**
- A. 24 to 48 hours
  - B. 2 to 3 days
  - C. 2-3 weeks
  - D. When they are asymptomatic.

- 91. Which of the following is not a psychological disorder warranting additional care in those with prolonged concussion symptoms?**
- A. Anxiety Disorders
  - B. Autism
  - C. Depressive Disorders
  - D. Malingering
- 92. Which of the following is not involved in maintaining equilibrium or balance?**
- A. The Visual system
  - B. The Somatosensory system
  - C. The Vestibular system
  - D. The Olfactory system
- 93. What percentage of the time are concussions associated with balance problems?**
- A. 10%
  - B. 20%
  - C. 30%
  - D. 40%
- 94. Which sensory system involving balance is the most often affected after a concussion?**
- A. Somatosensory system
  - B. Visual system
  - C. Olfactory system
  - D. Vestibular system
- 95. All of the following have been shown to influence the Balance Error Scoring System (BESS) except:**
- A. Headache.
  - B. Ankle instability.
  - C. Exertion.
  - D. Fatigued.

- 96. What is a common consequence of concussion?**
- A. Improved balance
  - B. Reaction time attenuation
  - C. Increased attention span
  - D. Improved visual tracking
- 97. Which of the following is not a symptom of Postconcussion Syndrome according to the Diagnostic and Statistical Manual of Mental Diseases, 4<sup>th</sup> edition?**
- A. Cognitive deficits in memory or attention
  - B. Fatigue
  - C. Headache
  - D. Antisocial personality traits
- 98. According to the World Health Organization ICD-10 Clinical Criteria for Postconcussional Syndrome, which of the following features would not meet the diagnostic criteria?**
- A. Headache
  - B. Dizziness
  - C. Fatigue
  - D. Improved memory
- 99. What percentage of people who have a concussion will develop Postconcussion Syndrome?**
- A. 1 to 5%
  - B. 10 to 30%
  - C. 30 to 50%
  - D. 60-70%
- 100. Which of the following statements does not pertain to Chronic Traumatic Encephalopathy?**
- A. It only occurs as a result of repetitive concussions.
  - B. It is defined as a progressive neurodegenerative syndrome.
  - C. It can be caused by a single blunt force impact to the head.
  - D. It can be caused by repetitive acceleration-deceleration forces to the brain.



**101. Which of the following is not a symptom in Omalu's Constellation of Chronic Traumatic Encephalopathy?**

- A. Very short latent period between the initial injury and the observance of symptoms
- B. Loss or disturbance of memory
- C. Loss of executive function
- D. Poor money management

**102. Which of the following is not an example of disinhibition or poor judgment commonly seen with Chronic Traumatic Encephalopathy according to Dr. Omalu?**

- A. Criminal behavior
- B. Violent tendencies
- C. Substance abuse
- D. Agoraphobia

**103. What is the percentage of people who have irritability and moodiness due to Chronic Traumatic Encephalopathy (CTE)?**

- A. 51%
- B. 6%
- C. 23%
- D. 69%

**104. Which of the following is not a common term used interchangeably with CTE?**

- A. Meningioma
- B. Delayed traumatic apoplexy
- C. Dementia traumatica
- D. Traumatic hysterias

**105. Posttraumatic Encephalopathy (PTE) differs from Chronic Traumatic Encephalopathy in all of the following ways except:**

- A. It is not a neurodegenerative disease.
- B. It is progressive.
- C. It is a condition which temporarily follows brain injury.
- D. It is caused by focal or diffuse destruction of brain tissue caused by primary or secondary brain trauma.

**106. All of the following would be seen in an individual who has both CTE and PTE, as seen in boxers, except:**

- A. Fenestrations of the septum pellucidum.
- B. Brainstem herniation.
- C. Lobar contusional necrosis.
- D. Topographic lobar infarcts.

**107. Which of the following is not a neuropathologic feature of CTE?**

- A. The brain may appear normal on both CT and MRI scans.
- B. Lack of xanthochromia of the dura or arachnoid mater
- C. Excessive lobar cortical cavitory contusional necrosis
- D. No cerebellar folial atrophy

**108. Which of the following does NOT pertain to subconcussions?**

- A. Head impact which results in typical symptoms of a concussion.
- B. Head impact which results in no symptoms.
- C. Cranial impact that does not result in a diagnosis of concussion.
- D. They have their greatest impact with repetitive occurrences.

**109. The tertiary phase of traumatic brain injury includes all of the following except:**

- A. Abnormalities in glucose utilization.
- B. Abnormalities in Membrane fluidity.
- C. Abnormalities in Synaptic dysfunction
- D. Structural integrity

**110. Which of the following is not a reason for American football to have a higher incidence of concussions?**

- A. Type of play
- B. High impact rate
- C. Helmets
- D. Number of participants

**111. What percentage of American football players are youth players?**

- A. 20%
- B. 40%
- C. 50%
- D. 70%

- 112. Which of the following is not a reason for the significant decrease in severe head injuries over the past 30 to 40 years?**
- A. Increased expectation of winning
  - B. Changes in rules
  - C. Equipment changes
  - D. Heightened awareness
- 113. What is another name commonly used for intraparenchymal hemorrhage?**
- A. Subdural hematoma
  - B. Subarachnoid bleed
  - C. Traumatic intracerebral hemorrhage
  - D. Epidural hemorrhage
- 114. Which of the following is not consistent with a brain contusion?**
- A. Hemorrhage
  - B. Cerebral infarction
  - C. Cerebral necrosis
  - D. Neurofibrillary tangles
- 115. How is a brain contusion usually diagnosed?**
- A. Sideline neurological exam
  - B. X-Ray
  - C. Laboratory test for chemical markers associated with brain injury
  - D. CT scan
- 116. Which of the following is not a factor that contributes to the occurrence of delayed traumatic intracerebral hemorrhage?**
- A. Local or systemic coagulopathy
  - B. Ischemia
  - C. Hemorrhage into a previously contused area
  - D. Necrotic brain softening
- 117. What is the most common form of severe or lethal brain injuries in athletes?**
- A. Traumatic Subarachnoid Hemorrhage
  - B. Subdural Hematoma
  - C. Epidural Hematoma
  - D. Supraarachnoid Hemorrhage

**118. When do acute subdural hematomas usually present?**

- A. Immediately after the injury
- B. Within 12 to 24 hours
- C. Within 48 to 72 hours
- D. Within 4 to 5 days

**119. Which of the following does not normally occur with a depressed skull fracture?**

- A. Tachycardia
- B. Hematomas
- C. CSF leak
- D. Infection

**120. Where does blood accumulate in an Epidural Hematoma?**

- A. Between the dura and the skull
- B. Between the dura and subarachnoid space
- C. Below the subarachnoid space
- D. In the cerebral ventricles

**121. Which of the following is not seen in the neurological deterioration that occurs after an Epidural Hematoma?**

- A. Severe Headache
- B. Hyperkalemia
- C. Obtundation
- D. Contralateral hemiparesis

**122. Which of the following is responsible for one-third of all deaths from head injuries?**

- A. Subarachnoid Hemorrhage
- B. Subdural Hematoma
- C. Epidural Hematoma
- D. Diffuse Axonal Injury

**123. What is the most significant complication seen with craniocervical arterial dissection?**

- A. Myocardial infarction
- B. Respiratory Failure
- C. Stroke
- D. Seizure

**124. What syndrome is defined as a fatal and uncontrollable increase in intracranial pressure caused by cerebral edema that happens when a head injury is sustained before a prior head injury has healed completely?**

- A. Multiple Sclerosis
- B. Second Impact Syndrome
- C. Posttraumatic Hydrocephalus
- D. Brainstem Herniation

**125. Which of the following sports does not have a high incidence of blows to the head?**

- A. Tennis
- B. American football
- C. Boxing
- D. Mixed martial arts

**126. What is another term for Mechanoporation?**

- A. Intracranial bleed
- B. Depressed skull fracture
- C. Epilepsy
- D. Neuronal membrane disruption

**127. Which of the following is not on the spectrum of postconcussive disease?**

- A. Postconcussion Syndrome (PCS)
- B. Severe seizure disorders
- C. Mild cognitive impairment
- D. Dementia Pugilistica

**128. What is the leading environmental cause of Parkinson's disease, which will occur later in life?**

- A. Aluminum toxicity
- B. Hyperkalemia
- C. Prior brain injury
- D. There is not environmental cause of Parkinson's disease.

- 129. Which of the following is associated with personality and emotional disturbances, relationship issues, depression, substance abuse and suicidal thoughts or actions?**
- A. Acute concussion
  - B. Postconcussion syndrome
  - C. Prolonged postconcussion syndrome
  - D. Chronic traumatic encephalopathy.
- 130. How long do symptoms have to persist for a diagnosis of prolonged postconcussion syndrome?**
- A. 2 to 3 weeks
  - B. 4 to 6 weeks
  - C. 6 weeks to 3 months
  - D. Greater than 3 months
- 131. Which of the following is not a current recommendation for return to play guidelines?**
- A. Start cognitive testing immediately after the head injury.
  - B. Physical and cognitive rest until completely asymptomatic.
  - C. Aerobic exercise at greater than 70% intensity
  - D. Sport-specific exercise
- 132. What state passed the Lystedt Law in 2009, which makes medical clearance for return to play a requirement in anyone under the age of 18 after a concussion?**
- A. New York
  - B. Texas
  - C. Washington
  - D. Florida
- 133. All of the following are the most common symptoms of concussion except:**
- A. Headache
  - B. Gastrointestinal distress
  - C. Dizziness
  - D. Balance problems

**134. Which of the following is not a contraindication for returning to play?**

- A. Persistent symptoms of the concussion
- B. Asymptomatic full contact practice
- C. Brain Mass
- D. Hydrocephalus

**135. What is the average age for onset of symptoms from a Chiari malformation?**

- A. 5 years old
- B. 10 years old
- C. 15 years old
- D. Greater than 20 years old

**136. What is the incidence of Arachnoid cysts in the general population?**

- A. 1%
- B. 10%
- C. 23%
- D. 35%

**137. Which of the following is not a factor in ending a sport's career?**

- A. Chiari malformation
- B. Intracranial hemorrhage
- C. Increased cognitive abilities
- D. Chronic Traumatic Encephalitis

**138. How many days will it take for most concussions to resolve with appropriate physical and cognitive rest?**

- A. 2 to 3 days
- B. 5 to 7 days
- C. 7 to 10 days
- D. 15 to 20 days

- 139. Concussions can compromise brain function in all of the following ways except:**
- A. Brainstem herniation
  - B. Altered mitochondrial function
  - C. Cerebral blood flow control
  - D. Cerebrovascular reactivity
- 140. When medicating the symptoms of a concussion, avoid medications that cause all of the following except:**
- A. Lower seizure threshold
  - B. Confusion
  - C. Cognitive slowing
  - D. Mental Clarity
- 141. What is the most common symptom reported after sustaining a concussion?**
- A. Vomiting
  - B. Headache
  - C. Blurred Vision
  - D. Vertigo
- 142. Which type of medication used for the treatment of headaches after a concussion should not be used in patients with Asthma?**
- A. Anti-depressants
  - B. NSAIDs
  - C. Anticonvulsants
  - D. Beta-adrenergic antagonists
- 143. Which anti-convulsant's side effects include dizziness, headache, anxiety, blurred vision, problems with memory, motor tics, and an increase in appetite?**
- A. Valproic acid
  - B. Topiramate
  - C. Gabapentin
  - D. Depakote



**144. Which anti-depressant medication has been associated with significant improvement in headaches after a concussion?**

- A. Amitriptyline
- B. Doxepin
- C. Prozac
- D. Abilify

**145. Which of the following is not a medication that can be used to treat persistent postconcussive dizziness?**

- A. Diphenhydramine
- B. Meclizine
- C. Scopolamine
- D. Dimenhydrinate

**146. Which neurostimulate medication used to treat fatigue after a concussion injury has the side effect of headache, dizziness, agitation or nervousness, nausea, diarrhea, insomnia, hallucinations, dry mouth, and depression?**

- A. Lorazepam
- B. Modafanil
- C. Dextroamphetamine
- D. Amantadine

**147. What is the predominant central nervous system polyunsaturated fatty acid?**

- A. Leucine
- B. Isoleucine
- C. Eicosapentaenoic acid (EPA)
- D. Docosahexaenoic acid (DHA)

**148. What is the predominate dietary polyunsaturated fatty acid?**

- A. Eicosapentaenoic acid
- B. Valproic acid
- C. Linolenic acid
- D. Hydrochloric acid

**149. What effect does supplementing with docosahexaenoic acid (DHA) have after a traumatic brain injury?**

- A. Decreased number of swollen, disconnected and injured axons
- B. Increased sodium flux out of neurons
- C. Increased potassium flux out of neurons
- D. Improvement in creatine phosphate levels

**150. Which of the following statements regarding Curcumin is incorrect?**

- A. It is a flavonoid compound.
- B. It is the yellow color associated with curry.
- C. It is a strong antioxidant with anti-inflammatory properties.
- D. It is unable to cross the blood-brain barrier.

**151. What agent/supplement can be used for protection of synaptic plasticity?**

- A. Resveratrol
- B. Eicosapentaenoic Acid
- C. Fish oil
- D. Glutamine

**152. Which agent/supplement has been shown to protect the blood-brain barrier?**

- A. Curcumin
- B. Eicosapentaenoic Acid
- C. Fish oil
- D. Glutamine

**153. All of the following statements regarding Resveratrol are correct except:**

- A. It is a naturally occurring phytoalexin and stilbenoid compound.
- B. It is found in beets, turnips and radishes.
- C. It was discovered in 1940
- D. It is able to cross the blood-brain barrier.

**154. Which of the following is not a mechanism of neuroprotection provided by Resveratrol?**

- A. Antioxidant
- B. Anti-inflammatory
- C. Alters intraneuronal mediators
- D. Increases excitotoxicity

**155. Which of the following amino acids is not a precursor for synthesis of creatine within the central nervous system?**

- A. Methionine
- B. Glycine
- C. Arginine
- D. Glutamine

**156. Dietary creatine is primarily found in the following foods except:**

- A. Spinach
- B. Beef
- C. Fish
- D. Poultry

**157. Which of the following are at the core of the neuroprotective properties of green tea?**

- A. Methionine
- B. Epigallocatechin-3-gallate (EGCG)
- C. Theanine
- D. Methoxyxanthine caffeine

**158. A population-based study of green tea's neuroprotective effect was shown to reduce the risk of what neurological disease?**

- A. Myocardial Infarction
- B. Alzheimer's Disease
- C. Ischemic Dementia
- D. Parkinson's Disease

**159. What is the potent derivative of alpha-tocopherol?**

- A. Valproic acid
- B. Alpha-tocotrienol
- C. Alpha-leucine
- D. Theonine

**160. How is endogenous Vitamin D created?**

- A. From the essential amino acid Valine
- B. From glutamine
- C. From cholesterol in the skin
- D. From calcium in bone

**161. Which of the following is not one of the flavonoids in Scutellaria Baicalensis?**

- A. Arginine
- B. Baicalein
- C. Baicalin
- D. Wogonin

**162. Which anti-inflammatory and antioxidant compound has been shown to slow progression of Alzheimer's disease?**

- A. Leucine
- B. Diphenhydramine
- C. Pycnogenol
- D. Isoleucine

**163. Peripheral nerve injuries can result from all of the following except:**

- A. Direct trauma
- B. Repetitive trauma
- C. Sport specific exercise
- D. Compression

**164. Spinal injuries can involve all of the following except:**

- A. Soft tissue.
- B. Bony structural elements.
- C. Spinal cord.
- D. Subarachnoid hemorrhage.

**165. What percentage of traumatic spinal injuries are due to sport-related activity?**

- A. 2%
- B. 11%
- C. 17%
- D. 23%

**166. Which of the following is not one of the most severe consequences of nervous system damage?**

- A. Piriformis syndrome
- B. Spinal cord injury
- C. Nerve root injury
- D. Brachial plexus injury

**167. Where does the spinal cord usually end?**

- A. L1
- B. L2
- C. L3
- D. L4

**168. After a spinal cord injury, a player cannot return to activity until there is a complete resolution of all of the following except:**

- A. Radicular pain.
- B. Sensory abnormalities.
- C. Weakness
- D. Full Range of Motion

**169. Which nerve root injury will result in a Cremasteric reflex?**

- A. T4-10
- B. L1-3
- C. L4
- D. L5

**170. Which spinal nerve is responsible for the Achilles reflex?**

- A. C5
- B. C8
- C. L2
- D. S1

**171. What would be the muscle strength grading for a muscle that can control antigravity movement without assistance?**

- A. 1
- B. 2
- C. 3
- D. 4

**172. According to the American Spinal Injury Association Impairment Scale for Spinal Cord Injury, what would be the class for normal motor and sensory function?**

- A. B
- B. C
- C. D
- D. E

**173. What is the neurological pattern in Central Cord Syndrome?**

- A. Weakness and sensory deficits that are disproportionately greater in the distal upper extremities in relation to the lower extremities.
- B. Weakness and sensory deficits that are disproportionately greater in the distal lower extremities in relation to the upper extremities.
- C. Weakness and sensory deficits on the dominant side
- D. Weakness and sensory deficits on the non-dominant side

**174. What percentage of those with Anterior Spinal Artery Syndrome recovers meaningful motor function?**

- A. 10% to 20%
- B. 20% to 30%
- C. 30% to 40%
- D. 40% to 50%

**175. A "clay shoveler's fracture" is a fracture of what?**

- A. Spinal facets
- B. Spinous process
- C. Vertebral bodies
- D. Base of the skull

**176. Which of the following is a congenital narrowing of the spinal canal?**

- A. Osteophyte formation
- B. Disc herniation
- C. Congenital cervical stenosis
- Scoliosis

**177. What percentage of athletes in contact sports will experience a brachial plexus injury?**

- A. 20%
- B. 30%
- C. 40%
- D. 50%

**178. Poor squat technique can result in all of the following spinal lesions except:**

- A. Vertebral compression fractures
- B. Disc degeneration
- C. Facet fracture
- D. Spondylolisthesis

**179. What should be addressed first when an athlete sustains a spinal injury?**

- A. Sensory perception
- B. Strength
- C. Airway, breathing, and circulation
- D. Paralysis

**180. After an Acute Cervical Spine Injury, when should athletic equipment be removed?**

- A. Immediately
- B. In the locker room
- C. In the ambulance
- D. At the hospital

**181. Which of the following is not an acceptable reason to remove the helmet on the field?**

- A. Athlete's choice
- B. Unstable cardiopulmonary status
- C. Inability to establish an airway
- D. Life-threatening hemorrhage under the helmet

**182. What is the goal systolic blood pressure in an athlete with Spinal shock?**

- A. Greater than 70
- B. Greater than 90
- C. Greater than 110
- D. Greater than 130

**183. Which of the following will be at an increased risk for injury with a lumbar spine injury?**

- A. Lumbar spine
- B. Brain stem
- C. Spinal cord
- D. Cerebral vasculature

**184. The initial phase of rehabilitation after an injury will focus on all of the following except:**

- A. Increasing range of motion.
- B. Decreasing pain.
- C. Controlling inflammation.
- D. Promoting primary tissue healing.

**185. What is the medication of choice in spinal injuries for inflammation and pain?**

- A. Prednisone
- B. Testosterone
- C. NSAIDs
- D. Narcotics



**186. All of the following are things to focus on during the subacute phase of the injury except:**

- A. Bed rest
- B. Maintaining aerobic capacity
- C. Deficit correction
- D. Strengthening exercises to increase spinal flexibility and stability

**187. Which of the following is not an absolute contraindication for return to sport?**

- A. Odontoid abnormalities
- B. Os odontoidium
- C. Spina bifida occulta
- D. C1-C2 ligamentous instability

**188. Which of the following is not an appropriate treatment for an acute lumbar disc herniation?**

- A. Activity restriction
- B. Full range of motion training
- C. Analgesics
- D. Muscle relaxants

**189. Which nerve is most affected by peripheral nerve injuries in the lower extremities?**

- A. Femoral nerve
- B. Brachial plexus
- C. Median nerve
- D. Peroneal nerve

**190. Which of the following is not a common mechanism of peripheral nerve damage in athletes?**

- A. Repetitive micro trauma
- B. Friction
- C. Decompression
- D. Traction

**191. Which of the following sports is not associated with direct trauma to the spinal accessory nerve?**

- A. Wrestling
- B. Lacrosse
- C. Hockey
- Football

**192. Which of the following sports is not associated with direct trauma to the posterior interosseous nerve?**

- A. Tennis
- B. Golf
- C. Racketball
- D. Frisbee

**193. What sport is associated with direct trauma to the Pudendal nerve?**

- A. Boxing
- B. Golf
- C. Gymnastics
- D. Cycling

**194. In an athletic population, which of the following would not be a common presentation of headaches?**

- A. Sinusitis
- B. Headaches related to activity
- C. Headaches that occur with exertion or activity
- D. Headaches that occur after a traumatic injury

**195. Which of the following is the most serious form of heat injury?**

- A. Heat Cramps
- B. Heat syncope
- C. Heatstroke
- D. Heat exhaustion

**196. Headaches can be attributed to all of the following except:**

- A. Dural pain fibers.
- B. Pain receptors on the brain surface.
- C. Periosteum of the skull
- D. Sinusitis

**197. All of the following are primary causes of headaches except:**

- A. Migraine headaches.
- B. Tension headaches.
- C. Cluster headaches.
- Headache caused by head or neck trauma.

**198. What percentage of women are affected by migraine headaches?**

- A. 6%
- B. 15%
- C. 23%
- D. 57%

**199. Which type of headache commonly starts with an aura?**

- A. Migraines
- B. Tension headaches
- C. Sinus headaches
- D. Post-traumatic headaches

**200. What is the most common type of primary headaches?**

- A. Migraines
- B. Cluster migraines
- C. Tension-type headaches
- D. Sinus/allergic headaches