The Concussion Dilemma: Are They Preventable?

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Over the past decade, there has been a 60% increase in the number of sports and recreation-related emergency room visits due to concussions and traumatic brain injury.1 As a result, concussions are at the forefront of media coverage, prompting investigations into management of concussions at multiple levels of play. This has also prompted a surge of research into concussion management and prevention, including the well-known Heads Up campaign. Concussions are highest in football and girls soccer, however, athletes playing sports such as volleyball are not immune. In recent years, there has been an increase in the number of volleyball related concussions. This may be due to improved awareness but may also be connected to the more competitive nature of the game over the past decade. The danger to volleyball athletes, especially defensive specialists and libero’s, is repeated diving, contact with the floor, contact with another player, and contact with a volleyball traveling at up to 50 miles per hour. In the volleyball news has also been the use of headgear to prevent concussions. A number or college-level players have been in the news wearing headgear for concussion prevention, prompting a surge in the use of headgear in volleyball. There is minimal research to support that concussions are preventable however, there are ways to modify the factors involved in the mechanism of concussions. Thus far, the majority of the focus has been on modifying external factors such as soft helmets and other headgear versus within the players themselves. The goal of this article is to educate coaches, parents, and athletes about the signs and symptoms of a concussion as well as to explain potential injury prevention strategies.

A concussion is defined as “…a complex pathophysiological process affecting the brain, induced by traumatic biomechanical forces.”2 What does this actually mean? A concussion can occur as a result of a direct blow to the head, face, neck, or any other part of the body where the force is transmitted to the head. This usually occurs during sports or as a result of a fall or car accident. This trauma usually results in short-lived neurological symptoms (headache, dizziness, tingling, numbness, vision changes) that typically resolve quickly on their own. These symptoms reflect a change in function of the brain but usually do not cause an injury evident on imaging. Basically, a decrease in blood flow to the brain causes an energy crisis. With exercise, blood is pulled away from the brain to support the lungs and muscles that work to sustain activity. Therefore, if an athlete attempts to return to sport before their brain heals, too much stress is placed on the brain. This can cause continued symptoms and place the brain at risk for further damage including Second Impact Syndrome.

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Figure 1
Symptoms of a concussion may include: loss of consciousness, confusion, headache, dizziness, nausea, vomiting, loss of memory from before or after the injury, mumbling, drowsiness, blank stares, personality change, irritability, mood swings, exaggerated emotions, seizures, poor performance during athletics, unsteady gait, poor balance, slow speech, poor coordination, difficulty concentrating, ringing in the ears, double or blurred vision, sensitivity to light or sound, feeling mentally foggy, and numbness or tingling. Both males and females report headaches as the most common post-concussion symptom. Females most often report drowsiness and sensitivity to noise versus females who report amnesia and confusion. If any of these signs or symptoms are present in an athlete after a blow to the body or head, the athlete should be removed from play until cleared by a medical professional specializing in concussion management. Never return an athlete to play on the same day.

Recovery from a concussion varies. The metabolic dysfunction (change in blood flow) that occurs in the brain after a concussion is commonly present for up to two weeks. About 80% of high school athletes recover within 3 weeks which means the remaining 20% of these athletes have continued symptoms lasting longer than 3 weeks (protracted recovery). Recovery may be longer in athletes with: memory loss, confusion, loss of consciousness, dizziness, and vomiting after the concussion as well as those athletes with a pre-existing learning disability, prior concussions, migraines, younger age, and athletes who tend to over-exert themselves.

Many important factors may increase the likelihood of suffering a concussion in volleyball and therefore, prevention programs should aim to modify these factors. Females are more likely to sustain a concussion due to differences in head-neck strength as compared to males. However, this being said, females are also more likely to report their symptoms. There is an increased risk of concussion in the 10-19 year old female athlete since they start to compete at a higher level in athletics but have not yet developed the strength and awareness to control their body. This stage of growth and development in the female is usually filled with Core awareness and control as well as visual tracking. As young athletes grow, their ability to stabilize their body rapidly decreases, placing them at risk for a multitude of injuries. A few simple changes to strength and conditioning regimens may be enough to decrease the risk of head contact with another player or the floor. Improving an athlete's body awareness, heads-up play, and ability to brace their body with contact.

Another important factor in concussion prevention is visual tracking and postural awareness. Volleyball athletes must be able to quickly change directions while diving, hitting, passing, blocking, and digging the ball. Since the libero often spend a moderate amount of time diving to the floor, contact with the floor, the ball, or another player is relatively common. Therefore, volleyball athletes must be able to follow the ball effectively with their eyes and head while paying attention to their surroundings. Often, young athletes do not make protecting their head a priority. While digging or blocking, the focus should be on good form while learning the skill. However, many times young athletes will place themselves in dangerous situations in which they do not yet have proper control of their body, resulting in a fall without control or contact with a teammate. Occasionally, young athletes will even close their eyes prior to the time of contact, losing control of their body and head. This loss of visual control and awareness may increase the likelihood of head contact with another player or the floor. Improved education about correct digging and falling mechanics as well as practice to improve visual tracking will only make for a better volleyball player. Some strategies to improve visual tracking are listed in the exercise table as well. Improved visual tracking may decrease the likelihood of concussions in youth volleyball by improving an athlete's body awareness, heads-up play, and ability to brace their body with contact.

Although many other strategies exist for potential concussion prevention, the main focus should be on improving core strength and control as well as visual tracking. As young athletes grow, their ability to stabilize their body rapidly decreases, placing them at risk for a multitude of injuries. A few simple changes to strength and conditioning regimens may be enough to decrease the risk for concussions. A number of additional strategies for decreasing the likelihood of concussions are listed below.

Concussion injury prevention strategies:

- **Know the signs and symptoms of a concussion**: The sooner an athlete is removed from play, the more likely they are to recover. Remember, just because they didn’t get “knocked out”, doesn’t mean they don’t have a concussion.
- **Play heads up volleyball**: Always watch the play happening around you, even when you aren’t involved. Concussions occur
when an athlete is unable to effectively brace their head and neck.

- **Posture**: Keep your head in a neutral position especially when digging, blocking, and hitting. Improving your shoulder mobility and strength also decreases the strain on the head and neck in volleyball.

- **Body contact**: Attempt to avoid body contact with your teammates as this is dangerous to both athletes. Learn how to control your body when falling to the floor. Practice this on softer surfaces at first.

- **Avoid excessive contact at practice**: This decreases the unnecessary force through the brain because as few as 50-60 blows to the head per week may lead to a change in brain function. Practice maintaining proper head and core control during digging and falling while on soft mats.

- **Head contact with the ball**: Maintain good posture (chin tucked) when head contact with the ball is anticipated.

- **Complete an injury prevention program**: Improving your posture, awareness, core strength, and visual tracking may decrease your likelihood of concussion.

- **Improve your visual tracking**: Just like any other muscle in the body, the eye muscles require use and exercise to get stronger. There are many exercises to improve your visual tracking. An easy way is to start tracking the ball with your eyes every time you set, hit, block, serve, or dig. Writing a different number on each of your practice balls and having the player call out the number as the ball approaches them will help with this. Also practice maintaining head control and visual tracking during agility activities.

- **Develop core strength**: A strong core (including hips, shoulders, neck, and abs) helps to stabilize your head during contact, thus decreasing the strain through your neck and brain with contact. Proper shoulder strength (including shoulder blade muscles) help to decrease strain on both your shoulder and neck.

- **Improve your conditioning**: The better your conditioning, the less likely you are to place your body into poor situations. You must be able to stabilize your body during all athletic activities. As fatigue increases, body control decreases, increasing your likelihood for injuries such as ACL tears and concussions. Cardiovascular fitness, flexibility, strength, agility, power, balance, and control are all important to injury prevention.

- **Correct your asymmetries**: Have a medical professional assess side-to-side differences with strength, flexibility, and posture to prevent injury.

- **Cross-train**: Find an activity or sport outside of volleyball that you enjoy and do it! Playing volleyball all year without a break or change in training leaves certain muscle groups weaker.

- **Growth and development**: If the athlete is smaller (especially pre-pubescent females with longer necks) but plays with larger athletes, focus on improving their core control prior to participation.

- **Nutrition and hydration**: The better your nutrition and hydration, the more likely your brain can prevent and recover from a trauma (including smaller, repeated traumas).

- **Skip the head gear**: Understand that headgear may or may not prevent concussions (the research is mixed). Often athletes feel invincible with more protective equipment, which may leave them more vulnerable.

- **ImPACT testing**: Remember ImPACT tests are of little value without baseline testing. Consultation of a skilled professional is also needed to interpret the results.

Here is a sample of postural exercises aimed at improving core strength, posture, and visual tracking:

**Postural & Core Strengthening Exercises**

*Complete these exercises at least 3 times per week to improve postural and core strength, endurance, and tracking*

**Chin Tuck & Curl**

Lie on your back in a comfortable and relaxed position. Gently tuck your chin as if you are trying to make a double chin. Second, slowly curl your head up off the floor while maintaining a chin tuck. Hold for 3-5 seconds. Slowly uncurl your neck THEN un-tuck your chin once your head is flat on the floor. Complete 2-3 sets of 10. This improves your deep neck flexor muscle strength.
Tall Planks With Arm Reaches
Get into a plank position with straight arms. Make sure hands are under shoulders and chest is lifted away from the floor. Without moving your trunk or hiking your shoulders, lift your right arm straight out in front of you. Hold for 3 seconds then switch arms. Perform 10 times. To improve your visual tracking, follow your hand with your eyes.

Side Plank With Rotation
Start in a side plank with top arm straight up towards the ceiling. While keeping abs pulled tight, rotate top arm down and under like you are attempting to reach behind your back at the level of your hip. Pause and return to start position. Repeat for repetitions or time (i.e. 30 reaches x 3 or 30 seconds x 3). To improve your visual tracking, complete this exercise with eyes and head following your thumb.

Medicine Ball Chops and Lifts
Stand in an upright position with feet shoulder width apart holding a medicine ball or weight. Draw abdominals tight and keep back flat. Reach up and out to one side over your shoulder then squat down, moving ball towards the opposite foot. Repeat 3 sets of 15 reps on each side. Use your core to drive the motion. Make sure to sit hips back and don’t let knees come forward past your toes. Chest should stay upright. To improve your visual tracking, follow the ball with your eyes.

Kneeling Trunk Rotation
Start in a half-kneeling position perpendicular to the resistance. You can use a cable column handle or tubing hooked in a doorway. Place the knee closest to the resistance down and the other knee up. Place feet under knees and legs in line with hips. Make yourself as tall as you can. Hold the resistance with straight arms out in front of you. Keep lower body still and arms locked as you twist over your knee. Return back to neutral (do not go further than your chest). Complete 3x8 with a moderate amount of resistance. To improve your visual tracking, follow your thumbs with your eyes. This can also be completed as a diagonal ball toss to a partner as you follow the ball with your eyes.

Saccades
Stand in a comfortable position and place two targets on the wall in front of you about 18 inches apart (Post-It notes with letters work well). Look from one target to the other quickly, without stopping in between. If you do not have Post-It note with the letters “A” and “B”, you can use both of your thumbs. Remember, eyes move, not your head. Repeat with eyes closed. Repeat this from side-to-side, up-down, and diagonal.

Walking With Head Turns
Stand in a hallway. Pick a point on the opposite side of the room at eye level. Keep your eyes focused on the target as you begin walking at a comfortable pace. If able, slowly shake your head from side to side about 45° in either direction while maintaining your focus on the target. Gradually increase pace as tolerated and repeat as many times as tolerated.