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Michael A. Lee, MD, Editor

Adolescent Concussions—Management Guidelines for Schools

Michael A. Lee, MD and Vito A. Perriello, Jr., MD

Our knowledge of concussions has increased and our treatment has changed substantially in recent years based on new research. Some of the major changes include the awareness that "minor head injuries," frequently called "bell-ringers or dings," are in fact concussions; many relatively minor head injuries take longer to heal than previously believed; concussions can occur without loss of consciousness, vomiting or other symptoms. Often times, headache, dizziness, "fogginess," poor attention span and unusual behavior are the signs of concussions. Another major change is the knowledge that thinking, "exercising the brain" and nearly all cognitive tasks have the same effect on prolonging concussion symptoms and slowing recovery as does physical exertion. Consequently, the management of even these minor head injuries has changed dramatically. **Restricting mental exertion and physical exertion until asymptomatic and then gradually increasing each is the cornerstone of this treatment strategy.**

Over the past several years increasingly larger numbers of adolescents are sustaining concussions. This may partially be due to our greater awareness. While caring for them, it has become evident that concussed individuals need modification of their school day in order to recover most expeditiously.

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Getting Cut

Benjamin Gardner, MD, FAAP

Cut—"pare or detach or trim or shape" (Webster's)

The word "cut" starts the unfortunately negative side of picking a team at the beginning of a season. Everyone understands that the right size team needs to be established with usually the best players available in that age group. So what is an article about "cutting players" doing in a sports medicine newsletter?

Quite simply, in my 37 years as a coach in several sports at levels from mini-mites in hockey to head varsity coach in boys high school lacrosse, I have learned that being cut from a team can be more traumatic to a child (and the coach, and the parent) than many of the injuries so often discussed in this newsletter. Here are some ideas to help mitigate the trauma.

1. **Team structure:** Fewer all-star and select teams with younger ages would help. Whenever it is possible to have equal teams, intramural teams and house leagues in place of travel, select or regional teams, the need to tell any of the players that they are "worse" than the other players is eliminated. However, at some age—perhaps at 12—teams selected based on ability are inevitable. Instead of a child being cut from the first team and ending up on the second team by default, consider the process as assigning

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Posterior Cruciate Ligament Injuries: What do we do?

Amit Lahav, MD

Posterior cruciate ligament (PCL) injuries commonly occur during sports participation or as a result of motor vehicle accidents. They make up 3-37% of all ligament injuries and in the trauma population. Isolated PCL injuries are more common in the athletic population while multi-ligamentous injuries occur more commonly in the trauma population.

The anatomy of the PCL consists of three components: the larger anterolateral bundle, smaller posteromedial bundle, and the menisiofemoral ligaments (ligament of Humphrey and Wrisberg). The anterolateral bundle gets tight in flexion while the posteromedial bundle gets tight in extension.

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Editor's Column

In this issue, a new article on concussion management summarizes the adaptations schools must make to help individuals who have sustained a concussion recover more rapidly.

Increasing numbers of concussions are being reported due to greater awareness of the signs and symptoms. The treatment of concussions has evolved over the last few years based on the latest research. Terms such as Grade 1, 2, or 3, mild, moderate or severe are no longer used to describe concussions. Concussions are now classified as simple if the symptoms last less than 30 days, or complex if the symptoms last longer. There were once over 20 guidelines created in order to manage concussions that are no longer valid. Since each concussion is different, each must be managed individually. The best initial treatment is rest and avoidance of any physical or mental exercise until the symptoms are gone. Mental exercise causes the same symptoms as physical exercise. This article updates physicians, nurses, certified athletic trainers and guidance counselors caring for student-athletes of the modifications necessary when they return to school.

Dr. Gardner, in his article, discusses a difficult problem faced by all aspiring athletes: being cut from the team. This creates great stress for both the athlete and the family and Dr. Gardner offers some excellent suggestions for managing this problem more effectively.

Posterior cruciate ligament knee injuries, while not occurring often, are difficult to treat. There is controversy about their management especially in younger patients. Dr. Lahav summarizes some of the current recommendations.



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Adolescent Concussions

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At the high school level, returning the student-athlete to school is generally the highest priority and the one that carries the lowest risk once symptoms have disappeared. The school nurse, guidance counselor, certified athletic trainer, athletic staff, psychologist and social worker should be made aware of the student-athlete's injury and work as a team to coordinate these accommodations. This will ensure a smooth transition to this new activity plan during this difficult period.

Attending school presents a major problem for student-athletes suffering from a concussion whether it is at the high school or college level. Teachers and professors often believe that the student-athletes are malingering and they can be less than sympathetic when student-athletes are excused from tests, or need extra time for tests and turning in papers. Team coaches often fail to understand the severity of the injury and may want their athlete, especially the star athlete on the team, to return to play before they are fully recovered. Coaches may be unsympathetic to the needs of the injured student-athlete and may be unaware of *Second Impact Syndrome* or more common risks of re-injury and prolonged recovery. The absence of visible signs of injury, such as a cast, brace or bandage, contributes to this misunderstanding by coaches and others.

Adolescents with concussions may want to attend school out of fear they will miss necessary work and get too far behind. They often want to socialize with their friends and continue to participate in their usual activities. If they have a part-time job they may also want to continue their usual work schedule.

Since student-athletes with concussions seem to recover more rapidly with rest, we recommend that activities should be restricted for several days following the injury until they are headache free. **Exercise, whether it is physical or mental, will usually increase their symptoms: headache, dizziness, nausea and lightheadedness.** Most student-athletes will have difficulty with concentration, memory (both working and short term), and their processing speed—which negatively affects their school learning and performance. In turn, struggling to learn and perform "overuses" the brain at a time when it is working hard to recover, and can negatively affect recovery. As a result, the guidelines for return to school are listed below:

NO SCHOOL INITIALLY

A concussed individual should not return to school until his/her headaches and other symptoms have cleared. At home, the student-athlete should rest. To minimize increased oxygen demands on the injured vulnerable brain cells, athletes should not participate in the following activities: reading, computer use, videogames, text messaging, physical exercise, hot tubs and socializing with friends. Attending movies may cause a marked increase in symptoms if the student-athlete experiences difficulty with light or noise.

When student-athletes are headache free, they can begin trying brief periods of reading or studying. If headaches or other symptoms return they should discontinue the activity and resume rest. They may return to school for gradually increasing periods of time when they can tolerate a couple of hours of thinking. Some student-athletes may require starting school later in the day in order to sleep longer. They should be driven to school to avoid noise on the bus or the exercise of walking to school. Student-athletes may attend classes unless they develop symptoms (usually a headache). If they become symptomatic they should go to the nurse's office, lie down, and skip the next period. **(Rest periods often may be necessary when student-athletes first return to school.)** If symptoms occur again in the next period, after resting, they should return home. Math and chemistry classes may need to be avoided initially since they seem to cause more symptoms than other classes. If a student-athlete can only attend school part-time, non-core classes should be avoided in favor of core subjects (English, History, Science and Language).

School Nurse's Role.—After sustaining the concussion, and before the student-athlete returns to school, the nurse should receive a letter from the physician. The letter will describe the student-athlete's injury and the specific and necessary modifications to the school day. This letter will serve to notify all parties involved that the day must be modified and that the student-athlete is not malingering. The nurse will serve as a liaison between the teachers, athletic trainers and coaches to facilitate the changes. If no school nurse or athletic trainer is available, the student-athlete's guidance counselor should be the contact person for the physician.

TEST TAKING

Most student-athletes are so symptomatic in the early postinjury phase they are unable to take tests. If they do attempt to take tests before they are recovered sufficiently, they may become dizzy and nauseous or manifest other postconcussion signs and symptoms that negatively affect their performance. If the student-athlete has taken any tests during the time he/she is recovering and received poor test scores, it is appropriate to ask that these grades be voided or discounted. SAT, ACT, AP, and GRE tests may need to be postponed and some student-athletes may need to obtain permission beforehand for extra time while taking these examinations. Final examinations may need to be delayed until school breaks, the next semester or during the summer.

When student-athletes do return to school they may need to have untimed tests due to their decreased processing speed. Taking tests should be spaced out and limited to no more than one per day. Tests may need to be taken in a quiet place, free of distraction, since some postconcussion student-athletes have ADHD-like characteristics such as distractibility and difficulty with concentration.

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Unfortunately, there may be some student-athletes with prolonged symptoms who will need to miss an extended period of school during the recovery. Teachers should take this into account when assigning grades. Possible solutions for this problem include: exempting student-athletes from tests, especially if they have done well previously, or assigning grades for that period of time, based on their previous work.

PAPERS, PROJECTS AND HOMEWORK

Term papers and projects may need to be delayed and spaced out. Extensions for work should be given. Extra time for homework may be necessary. Preprinted class notes or copies of class notes are often helpful. Recordings may be helpful for student-athletes with reading difficulty due to their symptoms. Having someone read material to student-athletes may be of benefit. Some student-athletes may need tutors to help them with schoolwork, including test preparation and organization.

PHYSICAL ACCOMMODATIONS

Elevators.—Initially, student-athletes should not walk up stairs if there are elevators in the school. An elevator pass should be given unless the student-athlete becomes lightheaded or dizzy when riding the elevator.

Noise.—If noise is not well tolerated by these student-athletes they should be excused from music class. It is recommended they sit in a quiet spot during lunch (not in the noisy cafeteria) and should avoid assemblies, school dances or sports events. It may also be helpful for these student-athletes to leave class a few minutes early to go to the next class in order to avoid the noise in the hall. Construction noise at school may also increase symptoms.

Light.—Student-athletes, especially those with injuries to the back of the head, can have difficulty with light. Bright fluorescent lights or watching movies in a dark room may cause or increase symptoms such as headaches. They may need to wear sunglasses in and out of school. If light is a problem, student-athletes may have difficulty driving at night due to the glare of headlights. Activities with strobe lights should be avoided.

Preferential Seating.—Student-athletes who develop ADHD-type symptoms following their concussions are advised to sit in the front of classrooms and to sit away from windows and doors to avoid distractions.

GYM CLASS and SCHOOL SPORTS TEAM

Both should be avoided initially. Attending a team's practice or game can increase symptoms due to the noise, light and "rough-housing" with their friends. Student-athletes might sustain another head injury if they are inadvertently struck with a ball. As they recover, they may attend—but not participate in—practice and games as long as the symptoms do not increase.

Return-to-play.—An athlete is allowed to start an exercise program when they are not taking pain

medication and are both symptom free and have normal neurocognitive test results (if available). They may walk the first day, jog the following day and run the third day (see guidelines from the last *International Conference on Concussions in Prague*). When the steps are completed without symptoms, they may practice sport specific drills with their team and then finally, full participation, including contact, is allowed. This is usually a five-day process. Some athletes who have missed many weeks of play may need to recondition before returning to sports.

STUDENT-ATHLETES WITH PROLONGED ABSENCES

Approximately 10% of student-athletes with concussions have symptoms lasting over a month and they are considered to have a *Complex Concussion* (the newest terminology) or what in the past was described as Postconcussion Syndrome. Some student-athletes may need to have a 504 plan adopted and some student-athletes who cannot tolerate the active school environment may require home tutoring. The guidance counselor may be asked to expedite some of these accommodations.

Psychiatric Issues.—Some student-athletes may develop depression either as a result of the injury or because they are unable to attend school and participate in sports. They may become irritable and more emotional than usual. Support for this problem may be addressed by the psychologist, guidance counselor, or social worker on the school staff.

SUMMARY

While many clinicians do not allow concussed individuals to return to physical exertion after sustaining a concussion, they are allowed to return to school with the admonition "if your symptoms increase you need to discontinue the activity." This is difficult for most adolescents to follow once they are in school attending classes and socializing with their friends.

To prevent worsening of symptoms and possible prolonged recovery in concussed individuals, both mental and physical exertion is not recommended during the early stages of recovery. We recommend a return to school once the symptoms have cleared. A summary of the recommendations in this article are outlined below.

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HEADS UP CONCUSSION IN YOUTH SPORTS

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THE STUDENT-ATHLETE RETURN TO PLAY PROTOCOL

Initial Treatment:

- No physical activity should occur until the athlete's symptoms are gone
- Avoid mental (cognitive) exertion; school attendance, test taking, reading, studying, computers, videogames, and text messaging

*(Note: The student-athlete may watch television, listen to books on tape or soft music for brief intervals as long as **the symptoms do not increase.**)*

When no symptoms are present:

- Step 1.** Advance by beginning short periods of reading, focusing, and abbreviated school attendance
- Step 2.** Advance when a full day of school is tolerated, begin low impact activity such as walking, stationary bike, etc.
(Gradually increase the intensity and duration as tolerated)
- Step 3.** Advance to aerobic activity fundamental to the specific sport such as skating, running, etc.
- Step 4.** Advance to noncontact activity drills to the specific sport such as dribbling, batting, shooting
- Step 5.** Advance to full contact in a practice setting

(Note: The student athlete must remain asymptomatic to advance through the various levels or return-to-play as described above. If symptoms return, while exercising, the athlete should return to the previous activity after waiting a day).

If all the above is accomplished without any return of signs and symptoms, they may return to play following final clearance. Some athletes, especially if they had multiple previous concussions, should consider having a baseline computerized neuropsychological test performed because of the increased risk of concussion.

Getting Cut

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- a child to a team. For example, naming the teams, if possible, by color (the red and blue teams) takes away the potentially ego-wounding names such as second team or “B” team. At some level, hopefully not until high school, the terms varsity and junior varsity are inevitable. Consider teams by age: very few freshmen are insulted by being required to be on a ninth-grade team for one year (if there are no exceptions) and having a policy that they can’t play varsity until at least tenth grade. This also helps considerably on the physical injury risks of young athletes, even when talented, playing with much bigger and older athletes. This is better sociologically as well.
- 2. The plan:** First, have a plan in advance. All of those “going out” for the team should know how many the coach plans to keep, why that number means something (league rules, number of lockers, right number for practices/scrimmage, similar numbers on first and second teams etc.), when and how the “cuts” will be made, and what the coach is looking for.
 - 3. Tryouts:** Parents and athletes may have more confidence in the process if the decisions are made by a small group, the coach and his or her assistants, perhaps with input from the team captains or established veterans rather than by one omnipotent individual. Although coaches frequently know after merely a half hour of tryouts who may or may not be on the team, it is important to have several days or more of actual tryouts so that no one (especially parents) will believe that they didn’t have a fair chance to show themselves. During tryouts, try to not segregate the best players from the weaker ones since this “shows your hand” long before you have posted a list. Those trying out read a lot into which end of the field they are practicing, what color practice jersey they are wearing, which coach is watching, what other players they are playing with and whether or not you can remember their name! Arrange for the athlete to tape his/her name on the helmet if there is one.
 - 4. The decision:** There aren’t a lot of absolutes in the process of establishing teams, but one absolute is to not announce team rosters and/or cuts to an assembled group. Announcing the selections in this way and then have those who didn’t make it have the “walk of shame” while those who did make it whoop and holler can be devastating. Instead, a list posted at an established time can be helpful (if you post it at 4 am you rarely have parents standing by the posting place waiting to see the results). And if you post a list, post BOTH lists, i.e. “The following are on the Varsity team and the following are on the Varsity B team.”
 - 5. The personal note:** On the really tough selections, such as a player who might have been on the team the previous year but is not reselected, or the child of the school’s biggest booster, or splitting best friends or brothers/sisters, consider a personal visit or phone call to the child and/or the parent, before the list is posted.
- A standing offer to meet privately with any child after “cuts” to talk about why they were cut and what they need to do to maximize the chances of making the team subsequently is supportive.
- 6. After tryouts:** For players who are pretty talented, but were cut because the hockey team just can’t have more than 22 players on the bench, you might consider having them practice at times with the top team. If you do promise this option, be sure to follow through: offering such practice time and then never fulfilling this promise is worse than no offer at all.
 - 7. Up from the ranks:** Cuts are easier if the athlete ending up on the lower team can see that players from the lower teams in previous years have “worked their way up” to the top teams subsequently. Try to develop the lower teams as true feeder teams for the top teams. Remember to remind the players that a lot of playing time on the lower team is usually more fun and better preparation for future years than sitting on the bench of the top team ... although it is the rare school athlete who will voluntarily make such a choice. The lower teams should have close to the same amount of practice time, similar facilities, same quality of equipment, good coaches and reasonably similar number of games. If the lower level team is treated very seriously and qualitatively, being assigned to that team is not nearly as problematic. The coach of the top team should occasionally attend the second team’s practices or games and provide advice and encouragement to those players.
Consider calling up the top players at the end of the lower team’s season when the top team still has a game to play. Practicing that last week and dressing and sitting on the bench with the top team at the end of the season can do wonders for an ego ... but remember that in doing so the athlete’s expectations for the following year are raised.
 - 8. Communication: Be available:** Don’t be one of those coaches who avoids parents, doesn’t answer the phone, goes out the back door or won’t talk to the student or the parent. Clearly that does not mean that a coach needs to take any verbal abuse. If such a conversation is on the rough side, defer further conversation to another time when tempers have eased.
Tryouts are traumatic and “cutting” wonderful young athletes from the team they want to be on is tough and inevitable. But with prior planning, careful consideration of the process, sensitivity towards their feelings and consistent processes, it can be manageable.
- Benjamin Gardner, MD** is a Medical Director at Choate Rosemary Hall School. He has coached lacrosse since 1970 and hockey since 1984, and is the parent of four children who have played sports at a variety of levels. A graduate of Dartmouth Medical School and Dartmouth-Hitchcock pediatric residency, he is a clinical instructor at Yale University.

Posterior Cruciate Ligament Injuries: What do we do?

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The PCL is the primary restraint to posterior tibial translation, secondary restraint to external rotation and varus/valgus loads in full extension (with the anterior cruciate ligament). The PCL consists of Type I collagen. The posterior articular branch of the posterior tibial nerve generally supplies proprioception innervation. Average width is 13 mm and decreases in diameter from proximal to distal.

Mechanism of injury can be hyperflexion or hyperextension in sports. Hyperflexion occurs with pretibial trauma with a posterior force on the tibia or downward force on the anterior thigh. Hyperextension injury is usually associated varus/valgus force. Careful history taking and a comprehensive physical examination are generally sufficient to identify PCL injuries. A patient's symptoms may be vague. There is usually no real sensation of giving way such as with anterior cruciate ligament injuries. Examination consists of range of motion evaluation, knee effusion, pain, hamstring spasm and instability exams. Useful tests when examining a patient include the posterior draw test, posterior lachman, posterolateral rotatory laxity at 30 and 90 degrees, posterior sag test, and quadriceps active test. Assessment of possible associated injuries should be done. Grading of the PCL injury is important for management and is based on posterior tibial translation. Grade I 0–5 mm posterior translation (tibia still anterior to the femoral condyles in flexion), Grade II 5–10 mm posterior translation (tibia is flush with the femoral condyles), and Grade III >10 mm (tibia is posterior to femoral condyles). MRI is a very sensitive test to confirm PCL injuries making it the imaging technique of choice for evaluating this ligament.

Not all PCL injuries require surgical treatment. Non-operative treatment for acute isolated PCL tears is generally recommended. This includes acute Grade I or II laxity and chronic injuries without symptoms. This involves initial splinting in extension followed by range-of-motion and strengthening exercises and protected weight bearing. Recovery of quadriceps strength is necessary to compensate for posterior tibial subluxation, facilitate return to pre-injury activity levels, and to counteract posterior tibial translation. Return to sports can be in two to four weeks for Grade I/II injuries. In Grade III injuries, three months are suggested before returning to sports. Patients should be braced in extension for two to four weeks with protected weight bearing. Quadriceps rehabilitation is still important. Full weight bearing can be started at four weeks with functional exercises such as biking and leg press.

In isolated PCL tears, surgical treatment is reserved for acute ligament with attached bone avulsions and symptomatic chronic high-grade PCL tears. Grade III acute injuries should be repaired. When a PCL injury occurs in combination with other ligament injuries, most patients will require surgical treatment. Chronic isolated PCL injuries with symptoms should be reconstructed. Arthroscopic single-tunnel reconstruction techniques will improve posterior laxity only moderately. Newer double-tunnel and tibial-inlay techniques offer theoretical advantages, but the available clinical results are only preliminary.

In summary, the PCL is the primary stabilizer to posterior translation. The anterolateral bundle is the strongest and largest. Effects on instability are unclear. Combined ligament injuries and symptomatic patients should be reconstructed. Isolated injuries are still controversial regarding surgical intervention. A recent study reviewed multiple publications about PCL injuries. Overall, studies indicate that PCL deficiency results in posterior tibial translation with combined injuries (such as posterolateral or multiligament injuries) displaying greater laxity. Results are inconsistent for rotational stability, but deficiency increases joint contact pressure and may result in articular damage, especially over time with incidence of 10%–74%. With chronic injuries, the patellofemoral and medial compartment of the knee can show radiographic changes. A loss of proprioception can occur but the effect on strength and kinetics is inconclusive. There is a lack of evidence for compensatory muscle activity, although maintaining quadriceps strength appears important. Return to activity is possible for the majority of nonoperatively treated grade I and II isolated injuries. More challenging decisions occur with higher grade injury or associated ligamentous injuries.

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