

# Hoopin' it Up!

## The Ergonomics of Basketball

By Tamara Mitchell

Edited by Sally Longyear



Basketball is one of the most popular sports in the United States and worldwide. It's a relatively new sport, invented in 1891 by James Naismith when a new indoor sport for winter was needed.<sup>1,2</sup> James nailed a peach basket to the wall of the gym at a YMCA and used a leather soccer ball.<sup>1,2</sup> The ball was retrieved after each shot by climbing a step ladder.<sup>2</sup> Clearly the equipment and the game have evolved, but the essential elements of running, jumping, cutting, stopping, and shooting on a hard floor are the same as the original game. In 1903, the first rules for women were adopted. In 1936, basketball was first played as an Olympic sport.

Most of the injuries in basketball are traumatic injuries; that is, they occur suddenly or from a forceful blow. The injuries experienced in basketball are similar to those in volleyball, however volleyball involves vertical movement from a stationary position, while basketball involves much more running and cutting.<sup>2</sup> Overuse injuries in basketball are caused by repeatedly stressing an area until it is damaged. In many cases, traumatic injuries are unavoidable due to contact with other players and the complex, rapid movements required. Overuse injuries and some traumatic injuries can be minimized or avoided through a proper conditioning program and attention to preventive measures.

### Traumatic Injuries

The most common basketball injury is an ankle sprain, however knee injuries can be more serious.<sup>1,3,4</sup> Women, regardless of age, are more likely to be injured and are more likely to injure their knees than men.<sup>1</sup>

*Ankle sprains and foot injuries.* Most of these injuries occur from landing improperly from a jump or twisting when falling.<sup>2</sup> The player lands on another's foot or the ankle rolls too far outward.<sup>1,4</sup> In a study of basketball players, 92% had suffered an ankle sprain at least once while playing!<sup>1</sup>

*Knee injuries* are the second most common injury and are the most common cause of missed games.<sup>1</sup> Knee injuries can occur from contact, sudden changes in direction, or overuse. Acute knee injuries can occur to the meniscus (cushioning tissue between the upper and lower leg bones in the knee), ligaments, and patella (kneecap).

*Wrist and hand injuries.* Sprains, contusions, and dislocations of the fingers, thumb, hand and wrist are more frequent in basketball than other sports.<sup>1</sup> These often occur when deflecting a pass or with sudden changes in the direction of the ball. They can also happen by getting a finger caught in the net or on another player's jersey.

*Other traumatic injuries.* Acute injuries to the shoulder, spine, sacral region, leg and thigh, and eye usually occur as a result of a fall or contact with another player.<sup>1</sup> Most of these injuries are not easily prevented due to the nature of the game.

*Dehydration and heat exhaustion* can be a problem, especially in hot weather.<sup>1</sup> Heat exhaustion can result from a loss of electrolytes and sodium.

### Overuse Injuries

Repeated stresses can result in overuse injuries. In basketball, the most prevalent overuse injuries are patellar tendinitis, or "jumper's knee", Achilles tendinitis, and shoulder and rotator cuff problems. Inadequate warmup, poor

conditioning, improper and ill-fitting shoes, worn out shoes, or a biomechanical deformity almost always causes these injuries.<sup>2</sup>

*Jumper's knee* is characterized by pain in the tendon just below the kneecap. This injury is almost always a result of improper training or conditioning, excessive stress, or fatigue.<sup>1</sup>

*Achilles tendinitis* is common in basketball players because of the repetitive eccentric loading of the tendon.<sup>1</sup> The forces during running and jumping are approximately eight times body weight.

*Shoulder problems* include impingement syndromes and rotator cuff or bicep tendon strains.<sup>1</sup> Repetitive shooting and rebounding drills can lead to this problem, so this is one case where over training can lead to injury.

*Shin splints* are common in basketball from the impact forces of running and jumping. They may also occur from excessive pronation of the foot.

*Hamstring strains* often result from training errors. Insufficient warm-up may be a factor. In addition, excessive quadricep training to increase vertical jump height and running speed can contribute to a quadriceps-hamstring strength imbalance.<sup>1</sup>

### **Injury Prevention**

Injury prevention involves preparing the athlete's body for this intensive sport throughout the season as well as attending to the physical, environmental, and psychological factors which can lead to injuries.

*Shoes and foot support.* The importance of proper shoes cannot be emphasized enough. Considerable research has been done with regard to shoes and the advantages of ankle support. High-topped basketball shoes offer ankle support and are specifically designed to withstand the multidirectional forces and shock absorption encountered during play.<sup>1, 2,3,5</sup> Basketball players should wear shoes that fit well and acrylic socks to avoid blisters.<sup>2</sup> Use of orthotics can prevent shin splints.<sup>1</sup>

It is recommended that players use taping or bracing in addition to wearing high-top basketball shoes. Players who do not tape their ankles **and** who wear low-top shoes have the highest incidence of injury.<sup>1</sup> However, it has been shown that use of bracing adversely affects vertical jump height. The Active Ankle brace was shown to impair performance the least out of support devices tested.

Shoes need to be replaced frequently. When shoe materials break down, stress to the foot, leg, and related soft tissue and bone structures increases. Over time these stresses result in fatigue injury. It is recommended that shoes be replaced monthly during the season in practice and during games.<sup>5</sup> Professional players have been found to have much lower injury rates when shoes are frequently replaced, to the point where they will often replace shoes every two to three days or games.<sup>5</sup> Shoes are expensive, but so are injuries! The average high school basketball player will use only one new pair of basketball shoes per season.<sup>5</sup>

*Warm-up, stretching, and cool-down.* Important in all sports and physical activities, warming up for 5-10 minutes by jogging or stationary cycling to the point of perspiration can decrease injuries by increasing blood flow and oxygenation of the blood, increasing muscle temperature, nerve response and speed, and increasing relaxation and concentration.<sup>1,2,3</sup>

The use of static stretching has not been found to reduce injuries in sports. Please read our article on the Great Stretching Debate, for more information about this. We do recommend a form of dynamic stretching, which incorporates drills that cover the length of the basketball court that prepare the body with a progression of sport-specific movements with increasing intensity:<sup>1</sup>

- Forward/retro jogging
  - Lateral shuffles and cariocas (stepping exercises)
  - High-knee skips
  - Bounding
-

- Butt-kick runs
- Angle cuts
- High-knee runs

Ballistic stretching, which involves bouncing at the end range of motion, may cause muscle or tissue damage and is not recommended.<sup>1</sup>

*Strengthening.* The entire body needs to be strong, yet flexible. Focus first on the hips and legs, then core strength (including the abdominals, obliques, and back extensors), and finally, the upper body. Compound movements that include several joints are best.

*Power.* Power, usually developed during the off-season, develops explosive muscle energy. Plyometric exercises enable the muscles to reach maximal strength in as short a time as possible.<sup>1</sup> They develop speed strength where gravitational forces are used to store potential energy in muscles. Plyometrics require caution, however. If the athlete does not have excellent strength, flexibility, balance, and proprioception, injuries can occur. (Proprioception is the neuromuscular feedback system that gives you a sense of your body's position, movement, and force). It is important to progress from basic to difficult and from low to high intensity.<sup>1</sup> Power can also be developed through Olympic lifts such as power and hang cleans, snatches, and power pulls.<sup>1</sup>

*Conditioning.* Basketball requires high-intensity anaerobic bouts with rest periods during brief time-outs, between periods, or if the player is substituted out of the game. Players must have an excellent aerobic base to meet the demands of the game. Aerobic conditioning should be developed in the off-season. Anaerobic training takes place in the last phase of the off-season and preseason through interval training runs of 400, 200, and 100m.<sup>1</sup> Conditioning drills are also used to develop anaerobic power and agility for jumping, lateral moves, and core strength, power, and quickness.

*Surface.* The surface of the court should be clean, dry, and free of debris.<sup>1</sup> Indoor wood courts are the best surfaces because they offer shock absorption and can reduce stress on the body.<sup>1,2</sup> Outdoor asphalt courts are more dangerous. Concrete courts are the hardest of all and can result in lower extremity injuries such as stress fractures and shin splints.<sup>1,2</sup>

*Temperature and hydration.* The higher the temperature, the more important fluid replacement becomes.<sup>1</sup> With dehydration, athletes become fatigued, which in turn increases the chances for injury.<sup>1</sup> Fluids need to be colder than air temperature for quicker absorption. Use of drinks with electrolytes, carbohydrates, and sodium are recommended during prolonged activity. Athletes should weigh themselves before and after exercise and drink 16oz. of water for every pound lost.

*Schedule.* The game schedule can influence susceptibility to injury. It has been found that peak performance is achieved with 3 days rest between games.<sup>1</sup>

*Seasons, and over training.* There are four distinct seasons in basketball: pre-season, in-season, postseason, and off-season. Over training is highly probable if the training program does not take into account the stresses of each season. Over training either aerobically or anaerobically can lead to anomalies of the resting heart rate and blood pressure, decreased performance and recovery, sleep disturbances, prolonged illnesses, and mood changes or irritability, among other symptoms. Training errors can also contribute to overuse injuries.<sup>1</sup>

Preseason is the 2- to 4-week period from the start of practice to the first game. To prevent overuse injuries during this period, there should be a reduction in strength training, endurance and plyometric activity. Exercise should be sport specific, including basketball drills.<sup>1</sup>

In-season training should maintain the improvements developed in the off-season. Intense, quality basketball practices eliminate the need for additional conditioning, jumping plyometrics, and agility drills, except for players who are not playing in the games. In-season weight training should be twice a week, with a focus on a total-body program of compound movements.<sup>1</sup>

Postseason is the 2- to 4-week period of active rest following the basketball season. It is a period of recovery, so fitness activities should include such activities as swimming, jogging, low intensity circuit training, racquetball, and volleyball.<sup>1</sup>

Off-season is the time when basketball players can become better players. A good program incorporates skill development, weight training, agility drills, conditioning, jumping plyometrics, quick-feet plyometrics, and medicine ball work.<sup>1</sup>

In all cases, adolescent players should concentrate on skill acquisition and overall conditioning more than sport-specific conditioning drills.<sup>1</sup>

*Officiating.* Player-to-player contact can result in injuries. The majority of contact occurs when playing aggressive defense, when positioning for a rebound or when a flagrant foul is committed. Good officiating can reduce the amount of player-to-player contact and unnecessary resulting injuries.

*Psychological factors.* Often overlooked is the vulnerability to injury caused by stresses experienced by the players. Interestingly, studies looking at stresses in players' lives in relation to the incidence of injuries have found mixed results.<sup>1</sup> Some studies found a positive relationship, while other studies found no such relationship.<sup>1</sup> What is important is how the person perceives the life event, or stressor, and what coping skills that person has to deal with the experience. Coping skills can include self-confidence, relaxation at appropriate times, striving for best effort rather than perfection, managing anger, and recovering emotionally from a mistake during play. It is advised that professionals involved with the care, training, or coaching of athletes address these factors by identifying at-risk individuals and facilitate coping skills development. Psychological skill training (PST) serves not only to prevent injury, is also improves overall skill performance, concentration, and attention.<sup>1</sup>

Children have been found to experience more overuse injuries if winning is stressed more than learning and fun.<sup>1</sup> In addition, parental pressure to win can lead to fictitious injuries. Some children find injury their only escape from pressures imposed on them by parents and coaches.<sup>1</sup> So, be very careful about the attitudes and stresses you place on child athletes!

The American Academy of Orthopedic Surgeons offers the following additional tips for preventing injury:<sup>3</sup>

- Play only your position and know where other players are on the court to reduce the chance of collisions. Don't hold, block, push, charge, or trip opponents. Use proper techniques for passing and scoring.
- Knee and elbow pads will help protect you from bruises and abrasions.
- Use a mouth guard to protect your teeth and mouth.
- If you wear glasses, use safety glasses.
- Do not wear jewelry or chew gum at practices or games.
- Baskets and boundary lines should not be too close to walls, bleachers, water fountains, or other structures.
- Be prepared for emergency situations and have a plan to reach medical personnel to treat injuries.

### **Injury Treatment**

*PRICE.* Whether the injury is traumatic or from overuse, treatment is generally the same. Protect, Rest, Ice, Compression, and Elevation is the recipe for treating injuries. Most importantly, stop playing and get to a doctor if pain does not subside within three to five days.<sup>2</sup> The criteria for returning to playing are:<sup>1</sup>

- Time for tissue healing has been observed (based on the type of injury)
- There is pain free full range of motion of the joint.
- There is no persistent swelling.
- Muscle strength and endurance of the injured limb is at least 90% of the uninjured limb.
- Flexibility is equal bilaterally (injured side/uninjured side equal).
- Joint stability is maintained by muscle control and/or a brace or tape.
- There is good proprioception.
- Cardiovascular fitness is equal to or better than the requirements of competition.
- Skills have been regained.
- There is no biomechanical dysfunction.
- The athlete is ready psychologically.

*Psychological factors.* Athletes are vulnerable to psychological reactions to injury. These reactions can include loss of their identity as a skilled athlete, fear and anxiety regarding future recovery, feelings of separation and loneliness from teammates, lack of confidence in athletic and other skills, and performance decrements related to not properly pacing their return to playing status.<sup>1</sup> Professionals involved in the rehabilitation effort need to respond to the injured athlete by building rapport, advising them of what to expect in the recovery process, preparing them for possible setbacks, and teaching coping skills. The wrong attitude can encourage an athlete to play while hurt, leading to greater injuries.

\*\*\*\*\*

This article and all of our articles are intended for your information and education. We are not experts in the diagnosis and treatment of specific medical or mental problems. When dealing with a severe problem, please consult with a healthcare or mental health professional and research the alternatives available for your particular diagnosis prior to embarking on a treatment plan. You are ultimately responsible for your own health and treatment!

\*\*\*\*\*

#### **REFERENCES:**

1. *Sports Injury: Prevention & Rehabilitation*, by Shamus, E., and Shamus, J.. ©2001, McGraw-Hill, New York. Chapter 13: Basketball, by Shamus, E., Kelleher, Wm., and Foran, B. pp337-371.
2. "Your Podiatric Physician Talks About Basketball and Your Feet", American Podiatric Medical Association. [http://www.apma.org/sports/basketball\\_printable.html](http://www.apma.org/sports/basketball_printable.html)
3. "Basketball High on Injury List: Orthopaedic surgeons Warn of the Most Common Basketball Injuries and Offer Tips to Play it Safe on the Basketball Court", by Schuetz, T., Yasell, C., and Weinstein, M., American Academy of Orthopaedic Surgeons, Public Education & Media Relations. 10/09/2003. [http://www6.aaos.org/pemr/press\\_release\\_print.cfm?PRNumber=201](http://www6.aaos.org/pemr/press_release_print.cfm?PRNumber=201).
4. "Common Basketball Injures: Keep Your Guard Up!" by O'Connell, P., Hughston Health Alert, Hughston Sports Medicine Foundation. <http://www.hughston.com/hha/a.basket.htm>
5. "Replacing Basketball Shoes Frequently Can Decrease Overuse Injuries Says Sports Medicine President", American Academy of Podiatric Sports Medicine (AAPSM), ©1996-2000. <http://www.aapsm.org/mlbball.html>.