

Concepts of Athletic Training

**FIFTH
EDITION**

**Ronald P. Pfeiffer
Brent C. Mangus**

Concepts of Athletic Training

Fifth Edition

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Preface

The primary theme of this book continues to be the care and management of sport and activity-related injuries. Therefore, the target audience includes anyone planning a career in coaching, athletic training, or K–12 physical education. Coaching personnel, especially those in the public school system, continue to serve as “first responders” in the majority of sports-injury situations. This continues to be the case despite the fact that more Board of Certification, Inc. (BOC)–certified athletic trainers are presently employed in the nation’s high schools than ever before. As such, the coach’s initial decisions and subsequent actions are critical in determining the outcome of an injury. In order to make correct decisions, coaching personnel must be properly trained, not only in basic first aid, but in more advanced knowledge in order to properly manage injuries that are complicated by sports equipment such as helmets, face masks, mouth guards, and other equipment. Students majoring in athletic training will also find this new edition extremely relevant to their educational goals. The content will form a solid foundation for more advanced studies in this exciting and constantly evolving allied health field.

The majority of sport and activity-related injuries involve the musculoskeletal system. As such, much of the content of this text is devoted to the recognition, immediate care, and management of injuries such as sprains, strains, dislocations, and fractures in the extremities. Fortunately only a small percentage of sports and activity-related injuries are life threatening or result in permanent disability. However, deaths and permanent disability tragically continue to be an outcome in a small percentage of cases. Most of these injuries are related to trauma to the head and/or neck or are heat related. Detailed information on head and neck injuries as well as prevention of heat disorders is provided in Chapters 9 and 18.

This latest edition continues to feature a chapter devoted to the adolescent athlete. The rationale for this is simple: The vast majority of school-aged athletes (K–12) are, in fact, adolescents or pre-adolescents. As such, they represent an anatomically distinct population when compared to adult athletes. These differences must be recognized and considered by coaching personnel when making decisions regarding not only injury management, but also when designing and implementing injury prevention programs.

The general field of sports medicine continues to be a rapidly evolving field of study. The authors have made every effort to update critical material throughout the text

in order to make the content as current as possible. Some of the major changes since the previous edition include:

- Chapter 1: Revised to reflect the most recent injury epidemiology data available at the time of publication.
- Chapters 1, 11, 12, 15–17: New figures have been added including X-ray, magnetic resonance imaging, and photos of acute injuries and dermatological conditions.
- Chapter 2: As education program requirements have changed recently, the current requirements for students completing entry-level athletic training education programs as well as components of the latest BOC Role Delineation Study have been included.
- Chapter 3: The list of states that now regulate the practice of athletic training has been updated.
- Chapter 4: The information describing the Preparticipation Physical Evaluation has been updated to reflect the latest guidelines from the American Academy of Pediatrics.
- Chapter 6: The “Supplements and Ergogenic Aids” section has been updated to include current information on ephedra, Andro, and creatine with β -alanine.
- Chapter 7: Content describing first response to injuries has been updated to reflect the guidelines provided by the American College of Emergency Physicians.
- Chapter 8: Information on currently available NSAIDs has been included in Table 8.2.
- Chapter 9: New figures showing the correct use of spine boards in the care of head and neck injury have been provided.
- Chapters 13–15: The information on prevention of many different types of injuries has been expanded and includes additional and updated images of the latest types and style of injury prevention equipment.
- Chapter 19: New information on exercise-induced asthma has been included.
- Appendices 1 and 2 have been updated to reflect current guidelines for cardiopulmonary resuscitation, automated external defibrillator use, and management of bloodborne pathogens as recommended by the American College of Emergency Physicians.

Technology Integration

As with the fourth edition, information directing the reader to web sites providing additional information is given at the beginning of each chapter. The links found on <http://health.jbpub.com/book/concepts/5e> provide additional information to the chapter content and encourage students to become more proficient in using the web as a learning resource.

The updated and improved **Instructor's ToolKit** includes an instructor's manual, computerized TestBank, Image and Table Bank, and PowerPoint presentations with more than 500 slides. These slides make transitioning to the fifth edition easier, ensuring that you and your students get the most out of this text. They can be used in classroom presentations or printed directly onto overhead transparencies.

Features

- **What If?** features are "real life" scenarios that encourage students to work on critical decision-making skills. These sections provide the sort of information typically available to coaching personnel when confronted with an injury-related problem. These scenarios can have many applications, such as simple decision-making practice sessions alone or with another student or, ideally, as the script for role-play exercises in a sports-injury class laboratory practice session.
- **Time Out** boxes provide additional information related to the text, such as NATA Athletic Helmet Removal Guidelines, guidelines for working with an injured athlete, how to recognize the signs of a concussion, and first aid for epilepsy.
- **Athletic Trainers Speak Out** boxes feature a different athletic trainer in every chapter who discusses an element of athlete care and injury prevention.
- All relevant chapters begin with an **Anatomy Review** to introduce body parts to students unfamiliar with human anatomy and provide a refresher for students who have had human anatomy.

Conclusion

This book is an outstanding resource for students studying to become physical education teachers, coaches, and athletic trainers. Personnel charged with the responsibility of providing emergency care for athletes must be trained in the first aid procedures appropriate for sports injuries. The content of this text, the accompanying Instructor's ToolKit CD-ROM, and <http://health.jbpub.com/book/concepts/5e> will provide instructors and students with a wealth of informa-

tion on topics related to the care and prevention of sports injuries. The goal, of course, is to give coaching and teaching personnel the necessary knowledge and critical-thinking skills to recognize and differentiate minor from more serious sports injuries. Once decisions are made regarding the nature of the injury, appropriate first aid care and/or medical referral can be instituted.

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Ron Pfeiffer

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The Concept of Sports Injury

MAJOR CONCEPTS

After reading and studying this chapter, the reader will be familiar with the scope and breadth of the topic of sports injury. The chapter presents the most recent data available to provide a quantitative perspective on the number of participants injured while engaging in sport activities. It discusses the most popular definitions of sports injury currently in use, along with a variety of the most commonly used medical terms related to the type and severity of injury. These terms are used throughout the remainder of the book and can also prove useful to the coach when communicating with members of the medical community about sports injuries. The last section of the chapter introduces the concept of epidemiology as it applies to the study of sports injury.



The web site for this book offers many useful tools and is a great source for supplementary information for both students and instructors.

Visit the site at

[http://health.jbpub.com/
book/concepts/5e](http://health.jbpub.com/book/concepts/5e)

to link to the following organizations and sites:

- National Collegiate Athletic Association
- Consumer Product Safety Commission
- National Center for Catastrophic Sport Injury Research

2 CHAPTER 1 The Concept of Sports Injury

Organized competitive high school sports continue to be extremely popular among American children. Recent research indicates that approximately 6.7 million public school children are involved in these activities annually (NFSH, 2003). Along with modest growth in high school sports programs, there has been massive growth in the number of adolescent and pediatric-aged children playing sports. As a result of community-based programs, a total of approximately 30 million school-aged children are involved in sports in the United States (Adirim & Cheng, 2003). Although these sports often involve children as young as 6 to 8 years, the level of competition is often extremely high as attested by the fact that it is common for teams to travel hundreds and sometimes thousands of miles to compete in tournaments. Further, it is not uncommon for children in sports such as tennis and gymnastics to invest as much as 20 hours a week in their chosen activity (Maffulli & Caine, 2005).

With the implementation of the Title IX Education Assistance Act of 1972, growth in the participation of female athletes in the United States has been at 700% (Stanitski, 1989). Ironically, as a result of unfounded fears

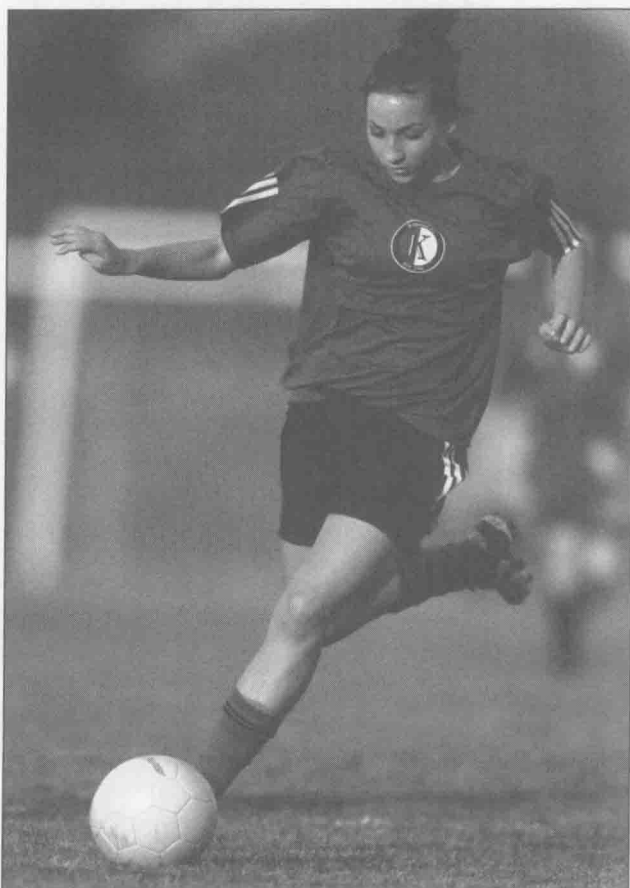


FIGURE 1.1 Data clearly indicate that injuries to female athletes are sport specific.



FIGURE 1.2 Females are at no greater risk for injury when involved in sports than are their male counterparts.

in both the lay and coaching communities that girls were not tough enough to play sports, many young female athletes were historically discouraged from participation. Even more disturbing is the fact that such negative stereotypes still persist in some sports organizations. Fortunately, researchers have produced data demonstrating clearly that, with few exceptions, injuries to female participants are sport specific (Figure 1.1), not gender specific (Collins, 1987). These data support the premise that, overall, females are at no greater risk for **injury** when involved in organized activities than are their male counterparts (Figure 1.2).

In recent years, sports-injury researchers have determined that certain types of knee injuries, specifically, those involving the **anterior** cruciate ligament (ACL), occur more frequently in female high school athletes in two sports—basketball and soccer—than in males in the same sports (Powell & Barber-Foss, 1999). It is interesting to note that this same trend has been found at the collegiate level. Recent research conducted by the National Collegiate Athletic Association (NCAA) via the Injury Surveillance System found the following results: Female basketball players injured their ACLs seven times more often than males during practice and five times more often than their male counterparts in games (NCAA, 1999). The majority of these ACL injuries is classified as non-contact; that is, the injuries do not occur as a result of a collision with an opponent or inanimate object. Rather,

noncontact ACL injuries are related to sports that involve rapid directional changes or deceleration when running, or repeated jumping and landing. Research is ongoing in regard to understanding the precise causative factors, as well as how to prevent such injuries from occurring (Griffin et al., 2000, Hewett, Meyer, & Ford, 2006a, 2006b).

In spite of the best efforts of parents, coaches, and officials, injury continues to be an unavoidable reality for a significant number of participants. For example, Beachy and colleagues studied injuries in 32 sports over an 8-year span in one Honolulu school. They found that football yielded the highest injury rate for boys whereas soccer produced the highest rate for girls. When the football and wrestling results were removed from the analysis, the injury rates for boys and girls were not significantly different. (Beachy, Akau, Martinson, & Olden, 1997). To date, two other large-scale, comprehensive studies of injuries among high school-aged athletes have been completed, and their findings support the premise that injuries are a constant problem associated with sports participation (NATA, 1989; Powell & Barber-Foss, 1999).

Results from a National High School Injury Survey (1995–97) sponsored by the National Athletic Trainers' Association (NATA) found that national injury rates have remained close to those documented by Powell for the 3-year period from 1986 to 1988. For example, the more recent data compared to the 1986–88 data indicate that in sports such as football and basketball (boys and girls) the proportion of minor, moderate, and major injuries was similar (Powell, 1987). In a similar study of high school injuries in the state of Pennsylvania, Grollman and associates (1996) found overall 3069 reportable injuries from 10 sports (boys and girls) across 40 high schools for the 1994–95 school year. The sport with the highest percentage of injuries was tackle football (46.7%), followed by boys' basketball (10%) and wrestling (9.68%). The sport producing the highest percentage of injuries for girls was basketball (7.5%).

Research looking at a broader age distribution was conducted by Damore and colleagues (2003), who studied emergency department admissions of patients ranging in age from 5 to 21 years at four hospitals for two 1-month periods (October 1999 and April 2000). They recorded a total of 1421 injuries in a group of 1275 patients in the age range of their study. Of these injuries, 41% were attributed to sports participation. The average age for such patients in their study was 12.2 years, with sprains, contusions, and fractures being the most common injuries. Males sustained more injuries (62%) to the musculoskeletal system than did their female counterparts.

Radelet and colleagues (2002) studied injuries in a population of children (1659) involved in community sports programs over the course of 2 years. Specifically,

they monitored the injuries in children ranging in age from 7 to 13 years who were involved in baseball, softball, soccer, and football. An injury was defined as "requiring on-field evaluation by coaching staff, or causing a player to stop participation for any period of time, or requiring first aid during an event." They further defined an "athlete exposure" as one athlete participating in one event (game or practice). Their results, expressed as the rate of injury per 100 athlete exposures, were that soccer had the highest rate at 2.1 injuries, followed by baseball at 1.7, football at 1.5, and softball at 1.0. In all sports, there were more injuries in games than in practices, with contusions being the most common injury overall. It is also interesting to note that in soccer, there were no gender differences in injury rates.

Definition of Sports Injury

Though logic would seem to argue that determining what constitutes a sports injury would be simple, just the opposite is the case. Despite the efforts of many in the sports medicine community, a single, universally acceptable definition of sports injury remains unavailable. Debates about precise definitions among academicians may seem petty to the injured athlete; however, from a clinical and scientific viewpoint, having a standard set of definitions would greatly improve the usefulness and impact of future injury studies.

Most current definitions of sports injury incorporate the length of time away from participation (time lost) as the major determinant (DeLee & Farney, 1992). Using this definition, an injury is said to have occurred when an athlete is forced to discontinue play and/or practice for a predetermined length of time—for example, 24 hours. In 1982, the NCAA established the Injury Surveillance System (ISS), which established a common set of injury and risk definitions for use in tracking collegiate sports injuries. To qualify as an injury under the ISS, that injury must meet the following criteria:

1. Occurs as a result of participation in an organized intercollegiate practice or game
2. Requires medical attention by a team athletic trainer or physician
3. Results in restriction of the student athlete's participation or performance for one or more days beyond the day of injury (Benson, 1995)

injury Act that damages or hurts.
anterior Before or in front of.

4 CHAPTER 1 The Concept of Sports Injury

The NCAA monitors injuries at Division I, II, and III institutions across all regions of the country and produces an annual report of the findings.

The NATA has commissioned two national surveys of high school sports injuries, each spanning 3-year periods (i.e., 1986–88 and 1995–97). The injury definitions used in the NATA studies are similar to the ISS because they rely on estimates of time lost from play as the indicator of injury severity (Foster, 1996).

Even though time lost is a convenient method for identifying an injury, such a definition does not lend itself to an accurate reflection of the severity of the injury. Severity of injury determinations may be made by a variety of people, including the coach, physicians or other sports medicine personnel, parents, or perhaps even the athlete. A related problem is that no standard is currently in use by all organizations monitoring sports injuries for the amount of time—hours, days, weeks, or months—that must be lost to qualify as a specific level of injury severity.

From a scientific standpoint, using the amount of time lost as a definition of sports injury is subject to significant error as previously described, depending on the method of data collection and injury definitions employed. However, once an injury is identified, several qualifiers are available to enable sports medicine personnel to better describe the precise characteristics of the injury. These include the type of tissue(s) involved, injury location, and time frame of the injury, that is, either acute or chronic.

A commonly used medical classification system for injuries uses two major categories: acute and chronic. **Acute injuries** have been defined as those “characterized by a rapid onset, resulting from a traumatic event” (AAOS, 1991). Acute injuries are usually associated with a significant traumatic event (Figure 1.3), followed immediately by a pattern of signs and symptoms such as pain, swelling, and loss of function. In the case of an acute injury, **critical force** has been defined as the “magnitude of

a single force for which the anatomical structure of interest is damaged” (Nigg & Bobbert, 1990). The potential for critical force, and subsequent acute injury, is clearly seen in tackle football. Estimates demonstrate that the vertebral bodies in the human cervical spine have a critical force limit of 340–455 kilograms. Researchers, using devices to simulate a typical tackle, have estimated that compressive forces acting on the cervical spine can exceed these limits (Torg, 1982).

Chronic injuries have been defined as those “characterized by a slow, insidious onset, implying a gradual development of structural damage” (AAFP, 1992). Chronic sports injuries, in contrast to acute ones, are not associated with a single traumatic episode; rather, they develop progressively over time. In many cases, they occur in athletes who are involved in activities that require repeated, continuous movements, such as in running (Figure 1.4). Consequently, such injuries are sometimes called overuse injuries, implying the athlete has simply done too many repetitions of the given activity. Overuse injuries in tendons occur when the workload from exercise exceeds the ability of musculo-tendinous tissues to recover (Hess et al., 1989). Thus, activity serves to cause a progressive breakdown of the tissue, leading eventually to failure.

Common sites for overuse injuries are the Achilles tendon, the patellar tendon, and the rotator cuff tendon in the shoulder (Hess et al., 1989). The Achilles tendon is subjected to tremendous stress during running and

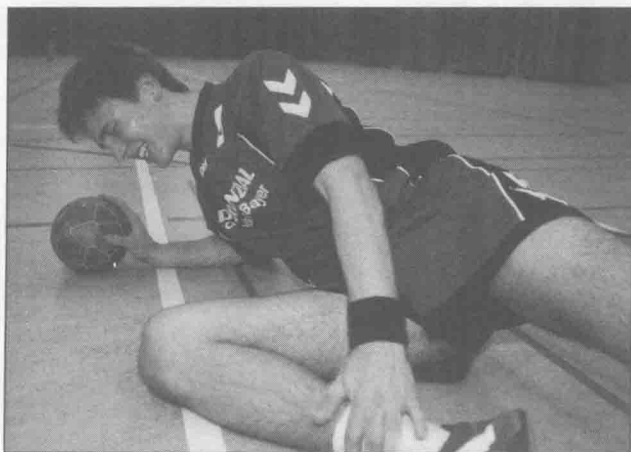


FIGURE 1.3 Acute injury in an athlete.

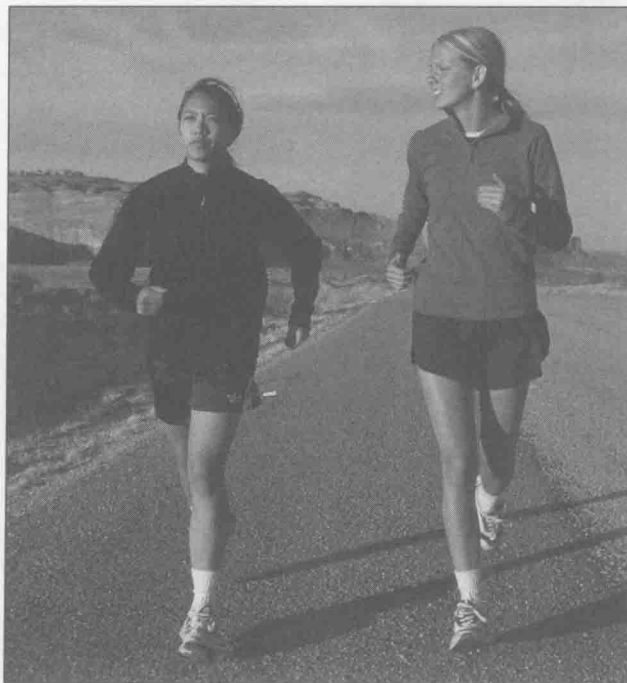


FIGURE 1.4 Chronic injuries are common in high-impact sports such as running.



FIGURE 1.5 Injuries to the Achilles tendon are common in track and field events.



FIGURE 1.6 Jumping and landing, as well as kicking a soccer ball, subject the patellar tendon to stress.



FIGURE 1.7 Tennis places significant stress on the rotator cuff.

jumping (Figure 1.5). Research indicates that these forces may exceed the physiological limits of the tendon, thereby resulting in damage (Curwain & Stanish, 1984). Likewise, the patellar tendon must absorb repeated episodes of stress during sports. For instance, jumping and landing, as well as kicking a soccer ball (Figure 1.6), generate forces in this tendon that are many times greater than those produced during normal gait (Gainor et al., 1978). The rotator cuff tendon, specifically the supraspinatus, is also vulnerable to injury from overuse. Any activity requiring repeated overhead movements of the arm, such as overhead strokes in tennis (Figure 1.7), places significant stress on this tendon. This is especially true during the deceleration phase of a swing or throw, after the arm has reached peak velocity. It is during this period of movement that muscles are undergoing **eccentric contraction**, a type of contraction identified as a causative factor in tendon injury (Curwain & Stanish, 1984). Such stress can cause damage in the supraspinatus

acute injury Characterized by rapid onset, resulting from a traumatic event.

critical force Magnitude of a single force by which an anatomical structure is damaged.

chronic injury One characterized by a slow, insidious onset, implying a gradual development of structural damage.

eccentric contraction The simultaneous processes of muscle contraction and stretching of the muscle-tendon unit by an extrinsic force.