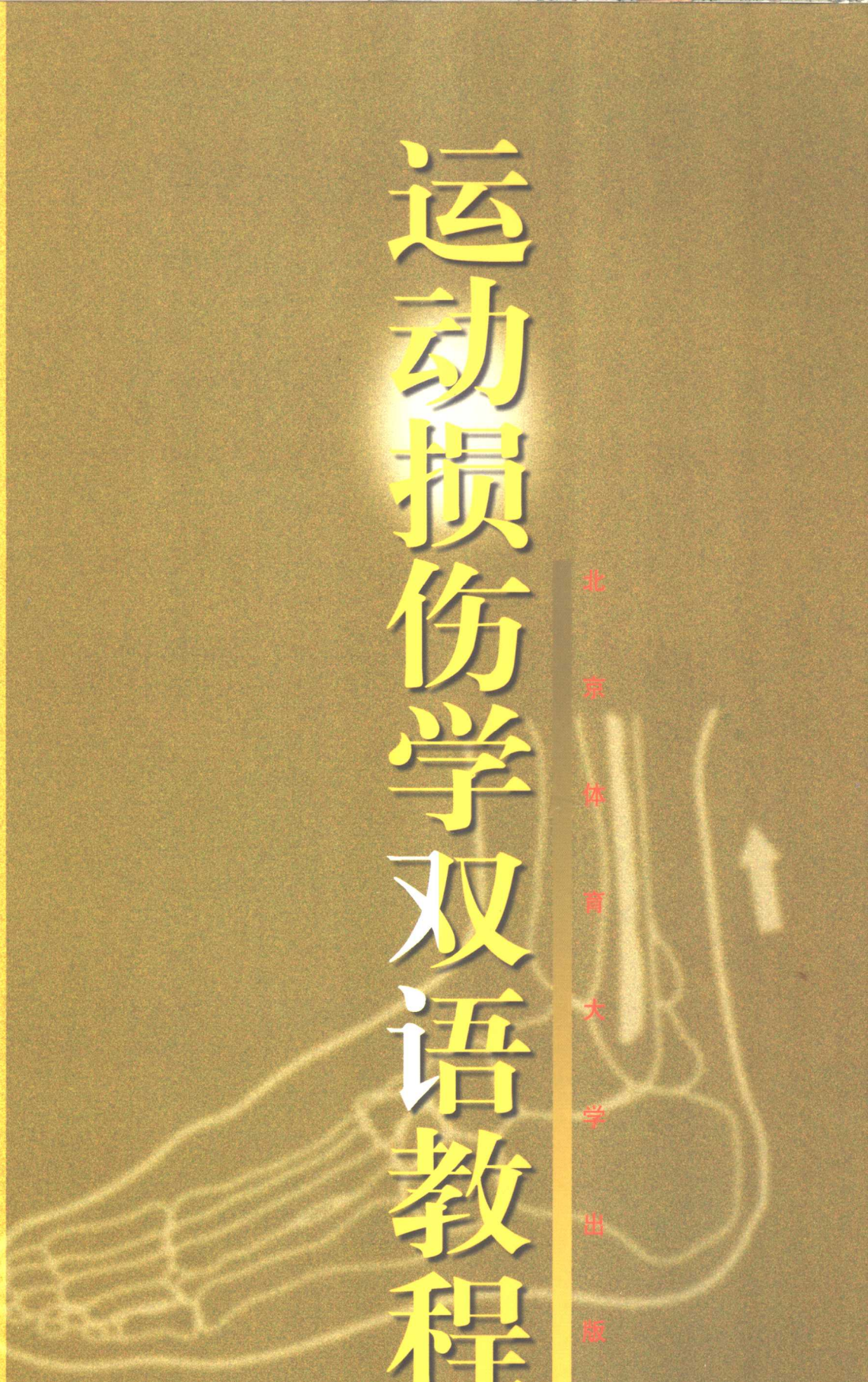
运动损伤学双语教程

矫 玮 等编著

BILINGUAL SPORTS INJURY COURSE

北京体育大学出版社



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Foreword

Bilingual teaching is rarely a new approach. It has been adopted in the teaching of foreign languages. Yet, it is a recent innovation to teach major curriculum subjects in both English and Chinese in the universities in China.

It is noticeable that students often spend a certain amount of time in learning English from the day of being admitted into the colleges. Some people have even voiced warnings about too much emphasis on foreign languages, English in particular. This is partly true. However, due to the development of economic globalization in the last decade, English has become increasingly important. It is the global language of the twenty-first century. Arguably, using English as a means of communication, we can learn modern science and technology from the advanced Western countries, such as America and Britain. Thus, it is essential to combine language study with major subjects' programs in order to produce speedily the modern universalistic and future-oriented talents.

English is not just language itself. It reflects to some extent the Western cultures. Therefore, proficiency in English can help promote cultural exchanges between nations. Making our own culture better understood while trying to understand others is the first step for peaceful co-existence of the world. Sport, as a cultural product, can transcend the racial and geological boundaries between nations.

Given English is used as an official language in most international sports organizations, ignorance in English can cause confusion and misunderstandings. Therefore, to get acquaintance with the international norms and practices needs English; to keep up with the economic progress and the globalization of sport needs English; to face the challenge arising from hosting the 2008 Olympic Games also needs English. For the above reasons, Beijing Sport University has made tremendous effort to provide students with bilingual courses for some curriculum subjects.

With the advancement of science and technology, and the evolution of sport, sports science has gradually systemized in the country. It has acquired such a status as math, physics and many others of first-level academic discipline, with the right to award doctorate. Sport comprises many sub-disciplines such as physical education, sports coaching, society-oriented sport, sports science and traditional Chinese sport. It is clear without saying that it is extremely difficult to identify the courses suitable for bilingual teaching from the vast modules. Such courses require the right textbooks. After time-consuming preparation, including constructing the framework of the series and its contents, and choosing the right and capable writers, the University finally presents the series of English-Chinese textbooks, including Sports Medicine, Sports Injury, Sports Management, Sports Psychology and others to sports students.

This series explores from different perspectives the issues facing the 21st century sport. The authors involved are specialists of their own academic fields and have overseas experiences. Of course, due to limited abilities and inexperience, some errors and unsatisfactory places could be found in the textbooks. Criticism and corrections are welcome from our readers and academic friends.

Finally, we own a great deal to the officials and the editor of Beijing Sport University Press. Their hard work makes the publication of the series a reality.

Prof. & Dr. Bingshu Zhong
Chairman, Teaching Instruction and Textbook Commission
Beijing Sport University
April 2003

序

双语教学不是什么新鲜事，自国人学习外语以来，采用的就是双语教学，母语与所学外语。然而，时间进入21世纪，人们提及的双语教学已不再仅仅是用于外语学习，而是扩展到了专业课程的学习。这里所指的双语大都具体指中文与英文。

大凡学生入校后都要花极大的精力学习英语，不少有识之士曾呼吁不要把大学的专业学习变成了英语学习。的确，随着经济全球化的进程，英语的作用愈加重要。然而，需要弄清楚的是，熟练掌握英语是为了帮助我们学习欧美的现代科技，帮助我们理解不同文化的同时使我们的文化被世人了解。因此，学习英语也就不是单单掌握语言的问题，而是必须把语言的掌握与专业知识的学习相结合。只有这种结合才能加速“面向现代化、面向世界、面向未来”人才的培养。专业课程的双语教学正是这种结合的具体体现。

体育是一种超越种族、超越地域的全球文化现象，相互理解是体育竞赛得以顺利进行的第一步。在多数国际体育组织以英语作为正式语言的背景下，要适应经济全球化、科技革命及2008年北京奥运会的挑战，就必须用英语掌握专业知识与技术。这就是为什么北京体育大学要积极创造条件使用英语进行部分课程的双语教学。

随着体育实践的发展和科学技术的进步，体育科学体系逐步完善和建立起来。在我国，体育学已成为博士学位授予的一级学科，已列为社会科学研究基金一级学科。在教育部本科专业目录体育学下就设立了体育教育、运动训练、社会体育、运动人体科学、民族传统体育5个专业，在体育学博士学位一级学科下设有体育教育训练学、体育人文社会科学、运动人体科学、民族传统体育学4个二级学科。在这样庞大的体系中要挑选出适合双语教学的课程绝非易事。要双语教学就必须有双语教材。北京体育大学从双语教材入手，艰苦准备，精选内容，严挑人员，组织策划出版了体育专业中英文双语教材系列。

这套系列教材，从《运动医学》开始，准备陆续出版《运动损伤学》、《体育管理学》、《运动心理学》等，将面对21世纪的体育进行较深入的探讨。每本教材的作者既是相应课程和学科的专家，又精通英文，大都具有留学经历。在本套教材的编写中我们要求作者语言通俗、生动、鲜明、准确、精炼，符合中英文两种语言各自的特点。当然限于水平，也是第一次尝试，本系列教材不尽如人意的地方在所难免，还希望读者和学界朋友提出批评和指正。

在本教材系列付梓的时候，我们要特别感谢北京体育大学出版社的领导和编辑，这套教材系列得以和读者见面，是和他们的努力分不开的。

钟秉枢

北京体育大学教学指导与教材建设委员会主任委员

2003年4月26日

前　言

2008年北京将举办奥运会，为适应形势的需要，为了提高学生的专业外语水平，扩大对外交流，也为了满足“体育保健康复”专业学生学习的要求，我们编写了《运动损伤学双语教程》。希望通过本书的学习，使大家更好的了解国内外关于运动损伤防治的最新知识。

本教材参考了大量运动损伤学著作，其中包括近年来国内、国际所取得的科研成果及本学科发展前沿的最新资料。在吸收国内外新观点、新知识、新成果的基础上，力求实用性、系统性。本书分为两篇，第一篇主要介绍运动损伤的相关基础知识，第二篇着重介绍了身体各部位的主要损伤。

本教材主要是为各体育院校体育保健康复专业的本科生和研究生编写的，同时可以作为运动队的教练员、队医及运动员的防治运动损伤的参考书，也可以作为各体育专业学生了解运动损伤、扩大知识面的体育专业知识辅导读物。本教材对希望增强防伤防病措施的大众体育爱好者也大有帮助，是一本有实用价值的指导性读物。

由于运动损伤内容广博，编者水平有限，书中有不妥之处，望读者见谅，并提出宝贵意见。

编　者

2003年8月

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Part Ⅰ. Basic Foundations of Sports Trauma

Chapter 1 Characteristics of Sports Trauma

When you finish this chapter, you should be able to

- Explain the biomechanical factors in sports injuries.
- Identify the most common exposed skin injuries.
- Explain the normal structures of soft tissue and the specific mechanical forces that cause skin, internal soft – tissue, synovial joint, and bone injuries.
- Define the terms that describe the major injuries incurred during sports participation.
- Explain how microtraumas and overuse injuries occur.

Trauma is defined as a physial injury or wound sustained in sport and produced by an external or internal force or violence. In this book sports injuries are divided into acute injuries and overuse injurise. There has been a gradual change in the pattern of sporting injuries. Some years ago most injuries were acute, traumatic injuries such as fractures, dislocations, ligament sprains and muscle tears. While these injuries are still common, overuse injuries such as stress fractures, compartment syndromes and tendinopathies appear to be increasingly prevalent. This is undoubtedly due to the increased load placed upon musculoskeletal structures by the increased training demands of modern day sport and the increased popularity of endurance events.

Ⅰ. Acute Injuries

Acute injuries may be due to extrinsic causes, such as a direct blow, either as a result of contact with another player or equipment, or intrinsic causes, such as a ligament sprain or muscle tear. Acute injuries may be classified according to the particular site injured (e.g. bone, cartilage, joint, ligament, muscle, tendon, bursa, nerve or skin) and the type of injury (e.g. fracture, dislocation, sprain or strain).

Ⅱ. Overuse Injuries

Overuse injuries have become an increasing problem in sports medicine and they present three distinct challenges to the clinician – diagnosis, treatment and an understanding of why the injury occurred. Diagnosis requires taking a comprehensive history of the onset, nature and site of the pain along with a thorough assessment of potential risk factors, for example, training and technique. Careful examination may reveal which anatomical structure is affected. It is often helpful to ask patients to perform the maneuver that produces their pain.

A cause must be sought for every overuse injury. The cause may be quite evident, such as a sudden dou-

bling of training quantity, poor footwear or an obvious biomechanical abnormality, or may be more subtle, such as running on a cambered surface, muscle imbalance or leg length discrepancy. The causes of overuse injuries are usually divided into extrinsic factors, such as training, surfaces, shoes, equipment and environmental conditions, or intrinsic factors, such as malalignment, leg length discrepancy, muscle imbalance, muscle weakness, lack of flexibility and body composition.

Ⅲ. Mechanical Injury

Injuries related to sports participation can be caused by external forces directed on the body or can occur internally within the body. To understand sports injuries there must be a knowledge of tissue susceptibility to trauma and the mechanical forces involved.

Tissues have relative abilities to resist a particular load. The stronger the tissue, the greater magnitude of load it can withstand. Strength pressure, or power, is often used to imply a force. A force can be described as a push or pull. Tissue properties are described according to engineering terminology. A load can be a singular or group of outside or internal forces acting on the body. The resistance to a load is called a mechanical stress, and the internal response is a deformation, or change in dimensions. Deformation is also defined as a mechanical strain. All human tissue is viscoelastic; it has both viscous and elastic properties, allowing for deformation. Tissue such as bone is brittle and has much fewer viscoelastic properties when compared to softer tissue. Tissue also is anisotropic, responding with greater or lesser strength depending on the direction of the load that is being applied. When tissue is deformed to the extent that its elasticity is almost fully exceeded a yield point has been reached. When the yield point has been exceeded mechanical failure occurs, resulting in tissue damage.

There are three primary tissue stresses leading to sports injuries: tension, compression, and shear.

Tension is that force that pulls or stretches tissue.

Stretching beyond the yield point leads to rupturing of soft tissue or fracturing of a bone. Examples of stretching injuries are sprains, strains, and avulsion fractures.

Compression is a force that, with enough energy, crushes tissue. When the force can no longer be absorbed, injury occurs. Where there is constant submaximum compression over a period of time, the contacted tissue can develop abnormal "wear." Compression occurs when a muscle or bone is stretched directly or when cartilage bone is directly loaded. Arthritic changes, fractures, and contusions are commonly caused by compression force.

Shearing is a force that moves across the parallel organization of the tissue. Injury occurs once shearing has exceeded the inherent strength of a tissue. Shearing stress can result in skin injuries such as blisters, rips of the hands, abrasions, or vertebral disks injuries.

Ⅳ. Soft – Tissue Trauma

Soft tissue, or nonbony tissue, falls generally under the category of noncontractile and contractile. Noncontractile tissues are skin, joint capsules, ligaments, fascia, cartilage, dura mater, and nerve roots. Contractile tissues are those structures that are a part of the muscle, its tendon, or its bony insertion.

A. Skin Injuries

Generally, trauma that happens to the skin is visually exposed and is categorized as a skin wound: It is defined as a break in the continuity of the soft parts of body structures caused by a trauma to these tissues. Numerous mechanical forces can adversely affect the skin's integrity. These forcesare friction or rubbing, scraping, compression or pressure, tearing, cutting, and penetrating.

Wounds are classified according to the mechanical force that causes them (Table 1 - 1).

Table 1 - 1 Soft - Tissue Trauma

primary Tlssue	Type	Mechanlcal Forces	Condition
Skin	Acute	Rubbing/friction	Blister
		Compression/contusion	Bruise
		Tearing	Laceration
		Tearing/ripping	Avulsion
		Penetrating	Puncture
Muscle/tendon	Acute	Compressional	Contusion
		Tension	Strain
	Chronic	Tension/shearing	Myositis/fasciitis
		Tension	Tendinitis/tenosynovitis
		Compression/tension	Bursitis
		Compression/tension	Ectopic calcification - myositis ossificans, calcific tendinitis

1. Friction Blisters

Continuous rubbing over the surface of the skin causes a collection of fluid below or within the epidermal layer called a blister.

2. Abrasions

Abrasions are common conditions in which the skin is scraped against a rough surface. The epidermis and dermis are worn away, exposing numerous blood capillaries.

3. Skin Bruise

When a blow compresses or crushes the skin surface and produces bleeding under the skin, the condition is identified as a bruise, or contusion.

4. Laceration

A laceration is a wound in which the flesh has been irregularly torn.

5. Skin Avulsion

Skin that is torn by the same mechanism as a laceration to the extent that tissue is completely ripped from its

source is considered an avulsion injury.

6. Incision

An incision wound is one in which the skin has been sharply cut.

7. Puncture Wound

Puncture wounds, as the name implies, are penetrations of the skin by a sharp object.

B. Skeletal Muscle Injuries

Skeletal muscles have an extremely high percentage of sports injuries.

1. Anatomical Characteristics

Muscles are composed of contractile cells, or fibers, that produce movement. Muscle fibers have the ability to contract, plus the properties of irritability, conductivity, and elasticity. Three types of muscles are within the body——smooth, cardiac, and striated. Of major concern in sports medicine are conditions that affect striated, or skeletal, muscles. Within the fiber cell is a semifluid substance called sarcoplasm (cytoplasm). Myofibrils are surrounded by the endomysium, fiber bundles are surrounded by the perimysium, and the entire muscle is covered by the epimysium.

2. Muscle Injury Classification

1) Acute Muscle Injuries

The two categories of acute muscle injuries are contusions and strains.

(1) Contusions. A bruise or contusion is received because of a sudden traumatic blow to the body. The intensity of a contusion can range from superficial to deep tissue compression and hemorrhage.

Interrupting the continuity of the circulatory system results in a flow of blood and lymph into the surrounding tissues. A hematoma (blood tumor) is formed by the localization of the extravasated blood into a clot, which becomes encapsulated by a connective tissue membrane. The speed of healing, as with all soft – tissue injuries, depends on the extent of tissue damage and internal bleeding.

A contusion can penetrate to the skeletal structures, causing a bone bruise. Theextent to which an athlete may be hampered by this condition depends on the location of the bruise and the force of the blow. Typical in cases of severe contusion are the following:

a. The athlete reports being struck a hard blow.

b. The blow causes pain and a transitory paralysis caused by pressure on and shock to the motor and sensory nerves.

c. Palpation often reveals a hard area, indurated because of internal hemorrhage.

d. Ecchymosis, or tissue discoloration, may take place.

(2) Strains. A strain is a stretch, tear, or rip in the muscle or adjacent tissue such as the fascia or muscle tendons. The cause of muscle strain is often obscure. Most often a strain is produced by an abnormal muscular contraction. The cause of this abnormality has been attributed to many factors. One popular theory suggests that a fault in the reciprocal coordination of the agonist and antagonist muscles takes place. The cause of this fault or incoordination is more or less a mystery. However, among the possible explanations advanced are that it may be re-

lated to a mineral imbalance caused by profuse sweating, fatigue metabolites collected in the muscle itself, or a strength imbalance between agonist and antagonist muscles.

A strain may range from a minute separation of connective tissue and muscle fibers to a complete tendinous avulsion or muscle rupture (grade 1, 2, or 3). The resulting pathology is similar to that of the contusion or sprain, with capillary or blood vessel hemorrhage. A grade 1 strain is accompanied by local pain, which is increased by tension of the muscle, and a minor loss of strength. There is mild swelling, ecchymosis and local tenderness. A grade 2 strain is similar to the mild strain but has moderate signs and symptoms and impaired muscle function. A grade 3 strain has signs and symptoms that are severe, with a loss of muscle function and commonly a palpable defect in the muscle. The muscles that have the highest incidence of strains in sports are the hamstring group, gastrocnemius, quadriceps group, hip flexors, hip adductor group, spinalis group of the back, deltoid, and rotator cuff group of the shoulder.

2) Tendon Injuries

The tendon contains wavy parallel collagenous fibers that are organized in bundles surrounded by a gelatinous material that decreases friction. A tendon attaches a muscle to a bone and concentrates a pulling force in a limited area. Tendons can produce and maintain a pull from 8700 to 18,000 pounds per square inch. When a tendon is loaded by tension, the wavy collagenous fibers straighten in the direction of the load; when the tension is released, the collagen returns to its original shape. In tendons, collagen fibers will break if their physiological limits have been reached. A breaking point occurs after a 6% to 8% increase in length. Because a tendon is usually double the strength of the muscle it serves, tears commonly occur at the muscle belly, musculotendinous junction, or bony attachment. Clinically, however, a constant abnormal tension on tendons increases elongation by the infiltration of fibroblasts, which will cause more collagenous tissue to be produced. Repeated microtraumas can evolve into chronic muscle strain that resorbs collagen fibers and eventually weakens the tendon. Collagen resorption occurs in the early period of sports conditioning and during the immobilization of a part. During resorption collagenous tissues are weakened and susceptible to injury; therefore a gradually paced conditioning program and early mobilization in the rehabilitation process are necessary.

3) Muscle Cramps and Spasms

Muscle cramps and spasms lead to muscle and tendon injuries. A cramp is usually a painful involuntary contraction of a skeletal muscle or muscle group. Cramps have been attributed to a lack of water or other electrolytes in relation to muscle fatigue. A reflex reaction caused by trauma of the musculoskeletal system is commonly called a spasm. The two types of cramps or spasms are the clonic type, with alternating involuntary muscular contraction and relaxation in quick succession, and the tonic type, with rigid muscle contraction that lasts over a period of time.

4) Overexertion Muscle Problems

One constant problem in physical conditioning and training is overexertion. Even though the gradual pattern of overloading the body is the best way for ultimate success, many athletes and even coaches believe that if there is no pain, there is no gain.

Exercise "overdosage" is reflected in muscle soreness, decreased joint flexibility, and general fatigue 24 hours after activity. Four specific indicators of possible overexertion are acute muscle soreness, muscle stiffness, delayed muscle soreness, and muscle cramping.

Muscle soreness has long been a problem for the person engaging in physical conditioning. Two major types of muscle soreness are associated with severe exercise. The first, occurring immediately after exercise, is acute

soreness, which is resolved when exercise has ceased. The second and more serious problem is delayed soreness, which is related mainly to early – season or unaccustomed work. Severe muscular discomfort occurs 24 to 48 hours after exercise.

(1) **Acute – onset muscle soreness** Acute – onset muscle soreness is related to an impedance of circulation, causing muscular ischemia. Lactic acid and potassium collect in the muscle and stimulate pain receptors.

(2) **Delayed – onset muscle soreness** Delayed – onset muscle soreness (DOMS) increases in intensity for 2 to 3 days and then decreases in intensity until it has completely disappeared within 7 days.

The cause of DOMS apparently is sublethal and lethal damage to a small group of recruited muscle fibers. The perception of soreness is caused by the activation of free nerve endings around selected muscle fibers. The type of activity that causes the most soreness is eccentric exercise. Muscle fibers may take as long as 12 weeks to repair; therefore athletes need abundant recovery time.

There are many ways to reduce the possibility of delayed – onset muscle soreness. One is a gradual and complete warm – up before engaging in vigorous activity, followed by a careful cool – down. In the early part of training, careful attention should be paid to static stretching before and after activity. If there is extreme soreness, the application of ice packs or ice massage to the point of numbness (approximately 5 to 8 minutes) followed by a static stretch often provides relief.

(3) **Muscle stiffness** Muscle stiffness does not produce pain. It occurs when a group of muscles have been worked hard for a long period of time. The fluids that collect in the muscles during and after exercise are absorbed into the bloodstream at a slow rate. As a result the muscle becomes swollen, shorter, and thicker and therefore resists stretching. Light exercise, massage, and passive mobilization assist in reducing stiffness.

(4) **Muscle cramps** Like muscle soreness and stiffness, muscle cramps can be a problem related to hard conditioning. The most common cramp is tonic, in which there is continuous muscle contraction. It is caused by the body's depletion of essential electrolytes or an interruption of synergism between opposing muscles. Clonic, or intermittent, contraction stemming from nerve irritation may rarely occur.

5) **Chronic Muscle Injuries**

As discussed previously, chronic injuries usually come with a slow progression over a long period of time. Often, repeated acute injuries can lead to a chronic condition. A constant irritation caused by poor performance techniques or a constant stress beyond physiological limits can eventually result in a chronic condition. These injuries are often attributed to overuse microtraumas.

Chronic muscle injuries are representative of a low – grade inflammatory process with a proliferation of fibroblasts and scarring. The acute injury that is improperly managed or that allows an athlete to return to activity before healing has completely occurred can cause chronic injury. The student should be especially knowledgeable about six chronic muscle conditions: myositis, tendinitis, tenosynovitis, bursitis, ectopic calcification, and muscle atrophy and contracture.

(1) **Myositis/fascttis** In general, the term myositis means inflammation of muscle tissue. More specifically, it can be considered as a flbrositis or connective tissue inflammation. Fascia that supports and separates muscle can also become chronically inflamed after injury. A typical example of this condition is plantar fascitis.

(2) **Tendinitis Tendinitis** has a gradual onset, diffuse tenderness because of repeated microtraumas, and degenerative changes. Obvious signs of tendinitis are swelling and pain that move with the tendon.

(3) **Tenosynovitis** Tenosynovitis is inflammation of the synovial sheath surrounding a tendon. In its acute state there is rapid onset, articular crepitus, and diffuse swelling. In chronic tenosynovitis the tendons become

locally thickened, with pain and articular crepitus present during movement.

(4) Bursitis The bursa is the fluid – filled sac found in places where friction might occur within body tissues. Bursae are predominantly located between bony prominences and muscles or tendons. Sudden irritation can cause acute bursitis, and overuse of muscles or tendons, as well as constant external compression or trauma, can result in chronic bursitis. The signs and symptoms of bursitis include swelling, pain, and some loss of function. Repeated trauma may lead to calcific deposits and degeneration of the internal lining of the bursa.

(5) Ectopic calcification Voluntary muscles can become chronically inflamed, resulting in myositis. An ectopic calcification known as myositis ossificans can occur in a muscle that directly overlies a bone. Two common sites for this condition are the quadriceps region of the thigh and the brachial muscle of the arm. In myositis ossificans osteoid material that resembles bone rapidly accumulates. If there is no repeated injury, the growth may subside completely in 9 to 12 months, or it may mature into a calcified area, at which time surgical removal can be accomplished with little fear of recurrence. Occasionally, tendinitis leads to deposits of minerals, primarily lime, and is known as caleific tendinitis.

(6) Atrophy and contracture Two complications of muscle and tendon conditions are atrophy and contracture. Muscle atrophy is the wasting away of muscle tissue. Its main cause in athletes is immobilization of a body part, inactivity, or loss of nerve stimulation. A second complication in sport injuries is muscle contracture, an abnormal shortening of muscle tissue in which there is a great deal of resistance to passive stretch. Commonly associated with muscle injury, a contracture is associated with a joint that has developed unyielding and resisting scar tissue.

Ⅴ. Synovial Joints

A joint in the human body is defined as the point where two bones join together. A joint must also transmit forces between participating bones.

A. Anatomical Characteristics

The joint consists of cartilage and fibrous connective tissue. Joints are classified as immovable (synarthrotic), slightly movable (amphiarthrotic), and freely movable (diarthrotic). Diarthrotic joints are also called synovial articulations. Because of their ability to move freely and thus become more susceptible to trauma, joints are of major concern to the coach, the athletic trainer, and the physician: Anatomical characteristics of the synovial articulations consist of four features: they have a capsule or ligaments; the capsule is lined with a synovial membrane; the opposing bone surfaces contain hyaline cartilage; and there is a joint space (joint cavity) containing a small amount of fluid (synovial fluid). In addition, there are nerves and blood supplied to the synovial articulation, and there are muscles that cross the joint or are intrinsic to it.

1. Joint Capsule

Bones of the diarthrotic joint are held together by a cuff of fibrous tissue known as the capsule, or capsular ligament. It consists of bundles of collagen and functions primarily to hold the bones together. It is extremely strong and can withstand crosssectional forces of 500 kg/cm^2. Parts of the capsule become slack or taut depending on the joint movements.

2. Ligaments

Ligaments are sheets or bundles of collagen fibers that form a connection between two bones. Ligaments fall into two categories: ones that are considered intrinsic and ones that are extrinsic to the joint. Intrinsic ligaments occur where the articular capsule has become thickened in some places. Extrinsic ligaments are separate from the capsular thickening.

A major factor in ligamentous injury is the viscoelastic tissue properties of ligaments and capsules. Viscoelasticity refers to extensibility when loaded that is time dependent. Constant compression or tension causes ligaments to deteriorate, whereas intermittent compression and tension increases strength, especially at the bony attachment. Chronic inflammation of ligamentous, capsular, and fascial tissue causes a shrinkage of collagen fibers; therefore repeated microtraumas over time make capsules and ligaments highly susceptible to major acute injuries.

Ligaments act as protective backups for the joint. Primary protection occurs from the dynamic aspect of muscles and their tendons. In a fast – loading situation, ligament failure ultimately will occur; however, the capsule and ligament provide maximum protection during rapid movements. Nevertheless, capsular and ligamentous tissues are highly sensitive to movement deprivation stress through joint immobilization. Capsular and ligamentous tissue respond to Roux's law of functional adaptation: an organ will adapt itself structurally to an alteration, quantitative or qualitative, of function?

3. Synovial Membrane and Synovial Fluid

Lining the synovial articular capsule is a synovial membrane made of connective tissue with flattened cells and villi (small projections) on its inner aspect. Fluid is secreted and absorbed by the synovial membrane. Synovial fluid has the consistency of egg white and acts as a joint lubricant. It has the ability to vary its viscosity. During slow movement, the fluid thickens; during fast movement it thins to a greater or lesser extent, both produced by the presence of hyaluronic acid.

4. Articular Cartilage

In general cartilage, as a connective tissue, provides firm and flexible support. It occurs throughout the body and consists of hyaline, fibrous, and elastic types. Cartilage is a semifirm type of connective tissue with a predominance of ground substance in the extracellular matrix. Within the ground substance are inset varving amounts of collagenous and elastic fibers. Cartilage has a bluish white or gray color and is semiopaque. It has no direct blood or nerve supply. Hyaline cartilage composes part of the nasal septum, the larynx, the trachea, the bronchi, and the articular ends of bones of the synovial joints. Fibrocartilage makes up the vertebral disks, symphysis pubis, and menisci of the knee joint. Elastic cartilage is found in the external ear and the eustachian tube.

As mentioned previously, the ends of the bones in a diarthrotic joint are covered by hyaline cartilage, which acts as a cushion for the bone ends. Its general appearance is smooth and pearly. Hyaline cartilage acts like a sponge in relation to synovial fluid. As movement occurs, it absorbs and squeezes out the fluid as pressures vary between the joint surfaces. Because of its great strength, the cartilage can be deformed without damage and can still return to its original shape. However, cartilaginous degeneration, producing microtrauma, may occur during the abnormal compressional forces that occur over a period of time. Hyaline cartilage has no direct blood supply,