Preventing Musculoskeletal Injury (MSI) for Musicians and Dancers

A Resource Guide

SHAPE
SAFETY & HEALTH IN ARTS
PRODUCTION & ENTERTAINMENT

Preventing Musculoskeletal Injury (MSI) for Musicians and Dancers

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About SHAPE

SHAPE (Safety and Health in Arts Production and Entertainment) is an industry association dedicated to promoting health and safety in film and television production, theatre, dance, music, and other performing arts industries in British Columbia. SHAPE provides information, education, and other services that help make arts production and entertainment workplaces healthier and safer.

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Contents

About this resource guide 5
Who should read this resource guide 6

Part 1: Background

What is musculoskeletal injury (MSI)? 8
Risk factors 11
General prevention and treatment 13
References 14

Part 2: Musicians and musculoskeletal injury (MSI)

Overview 16
Tendon and muscle disorders
(tendinitis, tenosynovitis, focal dystonia, muscle strain) 19
Nerve compression or entrapment
(carpal tunnel syndrome, cubital tunnel syndrome, thoracic outlet syndrome, sciatica) .. 22
Preventing musculoskeletal injury for musicians 24
Treating musculoskeletal injury for musicians 31
References 33

Part 3: Dancers and musculoskeletal injury (MSI)

Overview 36
Preventing musculoskeletal injury for dancers 40
Treating musculoskeletal injury for dancers 43
Nutrition 46
Bone injuries 48
References 50

Part 4: Musculoskeletal injuries (MSIs) prevalent in performers

Overview 56
Jaw and head injuries: Temporomandibular joint (TMJ) dysfunction 59
Shoulder injuries (rotator cuff injuries) 61
Shoulder injuries: Rotator cuff tears 62
Shoulder injuries: Shoulder impingement syndrome 64
Hand and arm injuries: Carpal tunnel syndrome 66
Hand and arm injuries: Cubital tunnel syndrome 69
Hand and arm injuries: Thoracic outlet syndrome 71
Hand and arm injuries: De Quervain's syndrome 73
Hand and arm injuries: Lateral epicondylitis (tennis elbow) 75
Hand and arm injuries: Medial epicondylitis (golfer's elbow) 77
Hand and arm injuries: Focal dystonia 79

Joint injuries: Arthritis 81
Hip injuries: Snapping hip syndrome (tight iliotibial band)..... 83
Knee injuries 86
Knee injuries: Patellofemoral pain..... 88
Knee injuries: Knee sprains and strains 90
Knee injuries: Meniscus tears 92
Back and neck injuries 94
Back and neck injuries: Spondylolysis..... 96
Back and neck injuries: Back and neck pain..... 98
Lower leg and ankle injuries 100
Lower leg and ankle injuries: Shin splints, stress fractures, and stress reactions 103
Lower leg and ankle injuries: Ankle sprains..... 106
Lower leg and ankle injuries: Posterior impingement syndrome (dancer's heel) 109
Lower leg and ankle injuries: Anterior impingement syndrome..... 111
Lower leg and ankle injuries: Achilles tendinitis..... 113
Lower leg and ankle injuries: Subtalar subluxation 115
Foot and toe injuries..... 117
Foot and toe injuries: Stress fractures of the second metatarsal..... 118
Foot and toe injuries: Fractures of the fifth metatarsal (dancer's fracture)..... 121
Foot and toe injuries: Cuboid subluxation 123
Foot and toe injuries: Flexor hallucis longus tendinitis 125
Foot and toe injuries: Blisters 128
Foot and toe injuries: Bunions 130
Foot and toe injuries: Toenail injuries..... 131

Index..... 132

About this resource guide

Performers such as musicians and dancers are at risk of occupational health problems that can significantly interfere with their ability to perform. If not recognized and properly treated, many of these health problems can limit, interrupt, or even end an individual's performing career.

This resource guide provides information and resources for the prevention of musculoskeletal injury (MSI) in performers. Other terms used to describe MSI include:

- overuse problems
- repetitive strain injury
- cumulative trauma disorder
- work-related musculoskeletal disorder
- activity-related soft tissue disorder

Generally, this guide will use the term *musculoskeletal injury* or *MSI* to describe an injury or disorder of the muscles, bones, joints, tendons, ligaments, nerves, blood vessels, or related soft tissues that may be caused or aggravated by activities related to performing, rehearsing, practising, or taking classes in music or dance.

Performers can and should prepare themselves for a long and healthy career by learning to recognize:

- early signs and symptoms of MSI
- occupational factors that cause or aggravate MSI
- practical strategies to reduce the risk and impact of MSI

This resource guide has four parts.

Part 1, Background, defines musculoskeletal injury and provides basic information on pain, risk factors, and general prevention and treatment. Parts 2 and 3 will be easier to understand if you read Part 1 first.

Part 2, Musicians and Musculoskeletal Injury (MSI), discusses common symptoms and types of injuries; tendon and muscle disorders; nerve compression or entrapment; and strategies for preventing and treating MSI.

Part 3, Dancers and Musculoskeletal Injury (MSI), discusses common symptoms and types of injuries; strategies for preventing and treating MSI; nutrition; and bone injuries.

Part 4, Musculoskeletal Injuries (MSIs) Prevalent in Performers, summarizes MSIs that occur in musicians and dancers. These MSI summaries provide a brief description of the injury as well as information on signs and symptoms; the causes of the injury; and treatment and prevention strategies. These summaries are not intended to replace the services of trained medical practitioners. Performers who recognize their own experience within an injury summary are strongly urged to seek a professional medical opinion.

Who should read this resource guide

If you participate in any aspect of the performing arts industry, this resource guide may help you prevent MSI in performers. A holistic approach to injury prevention includes consideration of personal, administrative, technical, and artistic issues, and recognizes that risk of injury can be significantly influenced by various factors (for example, parents, training at an early age, and facility and equipment design).

Figure 1 provides a non-exhaustive overview of participants in the performing arts industry who may have influence on the risk of MSI in performers. If your occupation is included or if your involvement in the performing arts industry has any influence on the experience of performers, this resource guide may be useful to you. You are encouraged to look for ways in which your involvement may prevent MSI in performers.

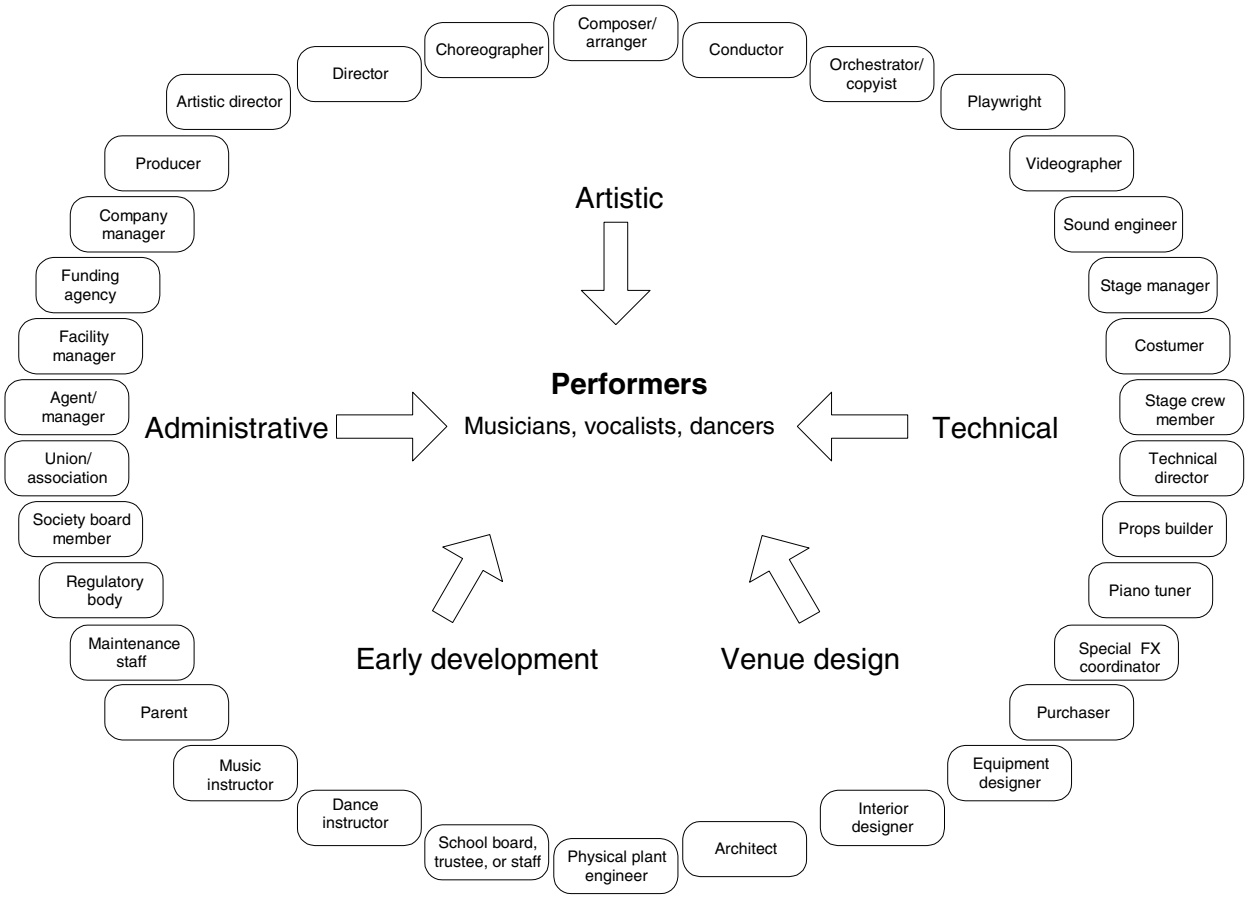

Figure 1
A non-exhaustive overview of participants in the performing arts industry who have varying degrees of influence on the risk of MSI in performers

Part 1
Background

What is musculoskeletal injury (MSI)?

Musculoskeletal injury (MSI) is any injury or disorder of the muscles, bones, joints, tendons, ligaments, nerves, blood vessels, or related soft tissues. This includes a strain, sprain, or inflammation that is caused or aggravated by activity.

Daily activities place demands on the body that may contribute to the development or occurrence of MSI. Most performers spend a large part of each day on practice, rehearsal, or performance. The physical, professional, and artistic demands of these activities can be stressful on the body and may eventually result in MSI-related signs or symptoms.

Signs and symptoms

Signs that may indicate MSI include:

- swelling
- redness
- difficulty moving a particular joint

Symptoms that may indicate MSI include:

- numbness
- tingling
- pain

These signs and symptoms may appear suddenly or they may develop gradually over a period of months or years. Signs and symptoms may or may not occur during the activity that is causing or aggravating the condition. Some conditions result in signs and symptoms that occur after the activity and may even occur during sleep.

Health professionals classify the severity of signs and symptoms using a graded scale that represents the progression of a typical overuse injury. This scale, adapted for performers, is illustrated in Figure 2, page 9. The severity of an injury and the need to establish a treatment plan increase as an individual progresses from Level I to Level V.

Health effects

Early signs or symptoms are indicators of various health effects that may develop if the signs or symptoms are allowed to progress. The specific health effects that are likely to develop depend on the specific activities. MSI-related health effects include:

- strains
- sprains
- disc herniation
- tendinitis
- tenosynovitis
- bursitis
- nerve compression

- nerve degeneration
- bone degeneration or malformation

Early recognition of signs and symptoms and appropriate responses are critical in minimizing the severity of health effects and maintaining an individual's ability to practise, rehearse, and perform.

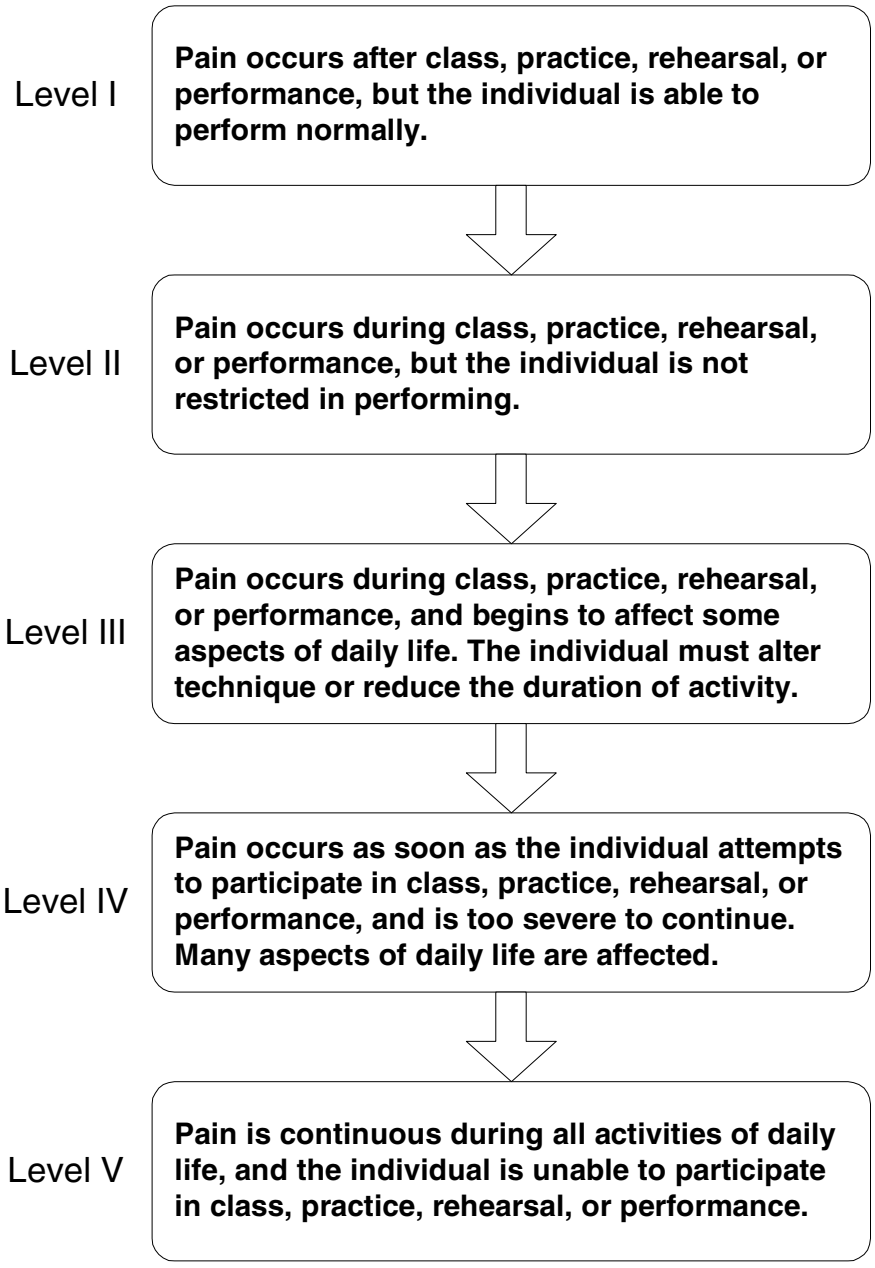

Figure 2
Progression of MSI signs and symptoms in performers. Where are you on this scale? If you are at Level I or II, modify your activities to prevent further progression of symptoms. If you are at Level III or higher, seek professional assistance.

Pain

Pain is a unique experience for each individual. The pain threshold of performers tends to be very high, partly because pain is a common experience in this physically demanding industry. Performers normalize pain and are less likely to fear it than the average person. Yet pain is a defence mechanism that is intended to protect and preserve our bodies. If you experience pain, it is important to pay attention to:

- when the pain occurs
- how long it lasts
- how it influences your ability to perform
- how it influences your other daily activities

Knowing where you are on the signs and symptoms scale (see Figure 2, page 9) may help you distinguish between pain that is due to intense or unaccustomed physical activity and pain that indicates a progressing injury.

Risk factors

Medical and scientific research has identified several risk factors that are widely believed to increase the likelihood of MSI (for more information, see "References," page 14). Understanding these risk factors and looking for practical ways to minimize their influences are important for maintaining your health and desired activity levels, as well as for preventing the frustrating and potentially career-ending effects of MSI.

Risk factors include environmental aspects, physical demands of activities, and personal characteristics. Figure 3 illustrates the primary risk factors associated with these three categories.

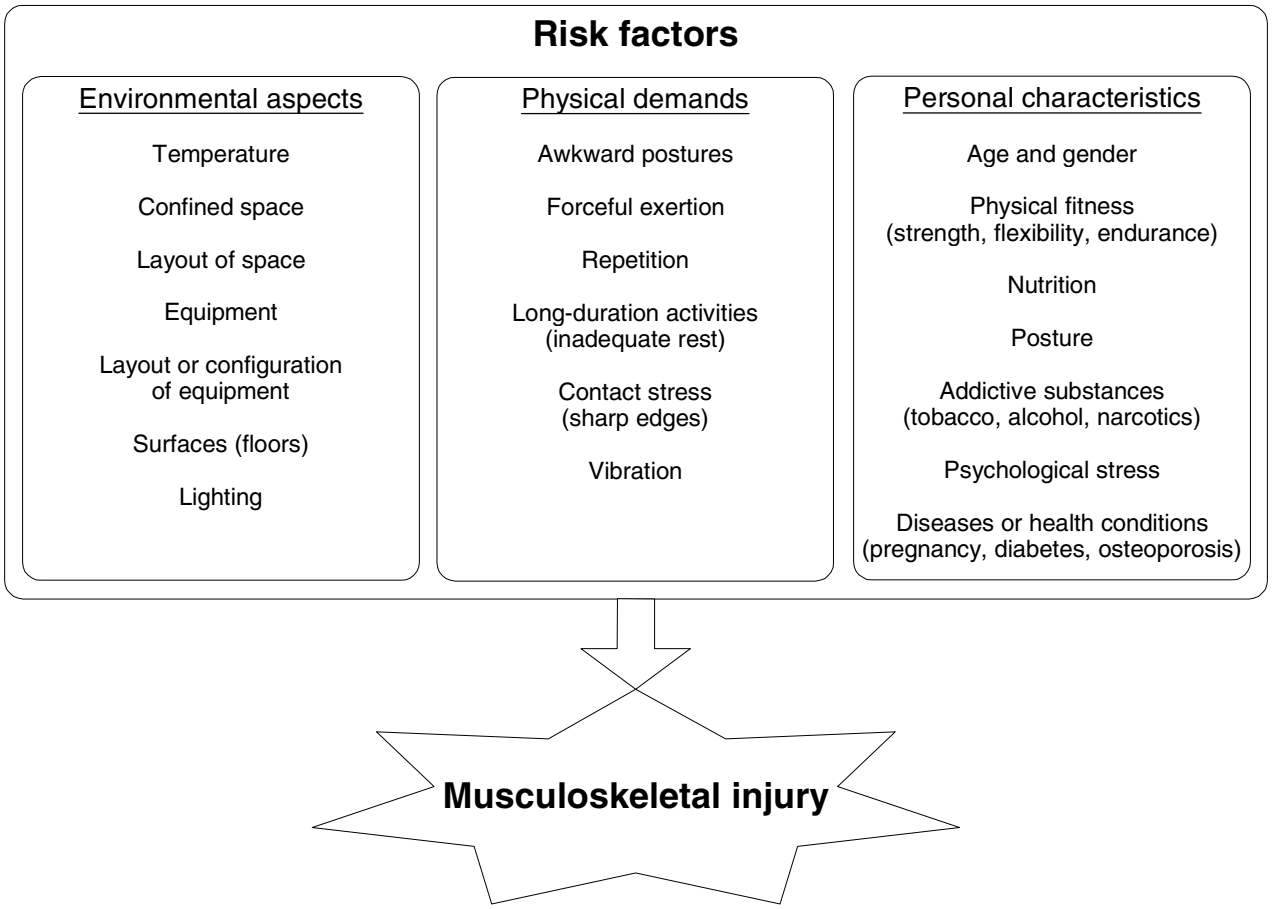

Figure 3
A non-exhaustive list of MSI risk factors

In general, the strongest relationship between risk factors and incidence of MSI is associated with extreme levels of any single risk factor or the occurrence of multiple risk factors simultaneously.

For performers, the greatest risk of MSI is associated with situations that involve:

- a change in technique or instrument
- intense preparation for performance
- preparation of a new and difficult piece
- prolonged performance without adequate rest

These situations are common for performers, but they could lead to a worst-case scenario. Over time, repetitive and sustained postures may result in stress to tendons, muscles, and nerves. Psychological stress and poor diet — which often accompany a challenging schedule, pressure to perfect, and performance anxiety — may also contribute to the negative effects of physical demands on performers.

General prevention and treatment

Prevention

MSI prevention is based on two levels of approach: (1) Control the risk factors and (2) Recognize and respond to early signs and symptoms.

Controlling risk factors

Controlling risk factors requires an awareness that they exist and the creative use of strategies to reduce their effects. In the performing arts, as in other occupations, control strategies are based on a combination of the following philosophies:

- Balance physical and psychological demands with the characteristics of the individual (know your personal limits).
- Maintain a high level of well-being, health, fitness, and nutrition.

Recognizing and responding to early signs and symptoms

Early recognition of signs and symptoms allows performers to:

- seek professional medical assistance
- get referrals to appropriate specialists
- take preventive action before pain starts to affect their daily lives (Figure 2, Levels I and II, page 9)

Unfortunately, it is more common for performers to work through pain until they can no longer perform. At later stages of injury (Levels III–V), the likelihood of full recovery diminishes, and the treatment process is more complex and disruptive to daily life.

Treatment

Medical management of signs and symptoms is best performed by medical practitioners who are sensitive to the professional and artistic demands placed upon performers. Musicians and dancers should seek the services of known medical professionals who have demonstrated an understanding of the performing arts.

Performers commonly combine complementary approaches with traditional medical management of MSI. There are many complementary approaches spanning a range of philosophies and practices, including:

- body-awareness training (for example, the Alexander Technique, Feldenkrais Method, Pilates Method, yoga, and Tai Chi)
- acupuncture
- massage therapy
- herbal medicine

For a list of health-care professionals who have experience treating MSI for musicians and dancers, contact SHAPE.

While anecdotal evidence supports the effectiveness of complementary approaches, it is recommended that they be implemented in conjunction with the approach of traditional western medicine.

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Part 2
Musicians and musculoskeletal injury (MSI)

Overview

Musicians are prone to musculoskeletal injury (MSI) that is caused or aggravated by playing their instruments. Playing a musical instrument may be second only to computer use in terms of population exposure to a risk factor for MSI (Morse et al. 2000).

Some studies have shown that approximately half of professional musicians and music students (including vocalists) experience significant symptoms (Chong et al. 1989; Fry 1986a; Norris 1993; Zaza 1998a). Although MSI is common across the entire industry, the risk of MSI is apparently greater for women than men and greater for string players and keyboardists than other musicians (Zaza and Farewell 1997). The difference in risk between genders may be due to anatomical and hormonal differences between women and men. The increased risk for string players and keyboardists is most likely due to the specific postural requirements of playing these instruments.

> "Music, by its very nature, consists of moving tones — in many cases, moving extremely rapidly and for prolonged periods. The repetitive physical motions and forces required to play such music may at times exceed the body's capabilities and thus become the source of physical problems."
>
> ~ W. J. Dawson, 1997

Symptoms

Common MSI symptoms for musicians include pain, weakness, stiffness (reduced range of motion), numbness, tingling, or loss of muscular control that interferes with the musician's ability to perform at the level they are accustomed to (Zaza, Charles, and Muszynski 1998; Kella 1997).

> "All patients complained of pain upon playing.... In half of these patients these symptoms resulted in loss of speed, volume or control. Rapid passages requiring arpeggios, octaves or trills were often affected."
>
> ~ J. Newmark and F. H. Hochberg, 1987

A number of musicians assume that their painful condition is normal and find ways to mask the effects of the developing injury (Fry 1986a; Sternbach 1993). This is partly due to a performance culture in which there is a long-standing philosophy that "the show must go on," and partly due to a common concern among professional musicians of being labelled as a musician with an injury (Sternbach 1993; Zaza, Charles, and Muszynski 1998). Unfortunately, many musicians, including those whose professional careers are well established, lack the financial resources necessary to subsidize preventive or early treatment.

There is also a predominant medical perspective that MSI is neither life-threatening nor medically serious, despite the musician's perspective that an MSI (and some recommended treatments) can be artistically and professionally limiting, or even career-ending, with devastating effects on the musician's physical, emotional, and financial well-being (Zaza, Charles, and Muszynski 1998). The music and medical communities require heightened awareness to significantly reduce the incidence of MSI in musicians.

Types of MSI

Common MSIs that musicians experience are related to:

- tendon inflammation (tendinitis or tenosynovitis)
- muscle cramping (focal dystonia)
- muscle strain
- compression or entrapment of nerves that affect the hands, arms, neck, back, or face

A general description of each of these types of MSI is provided in "Tendon and Muscle Disorders" (page 19) and "Nerve Compression or Entrapment" (page 22).

Each musical instrument is associated with a unique set of injuries that are related to the physical and postural demands of playing that instrument. Table 1, page 18, provides a summary of common MSIs associated with playing specific instruments. Understanding basic anatomy and the nature of common MSIs can greatly improve a musician's understanding of risk factors and preventive strategies. Part 4, Musculoskeletal Injuries (MSIs) Prevalent in Performers, provides summaries of many of the MSIs listed in Table 1, including information on the causes of the injury; signs and symptoms; and treatment and prevention strategies.

"Our data imply that particular repetitive movements associated with musical instruments predispose players to inflame characteristic areas of the upper limbs."

~ J. Newmark and F. H. Hochberg, 1987

Table 1
Musculoskeletal injuries associated with specific instruments

Violin/viola	**Guitar**
Neck pain	Triceps tendinitis (right)
Thoracic outlet syndrome (left)	Focal dystonia of index and middle fingers and thumb (right)
Carpal tunnel syndrome (left)	Thoracic outlet syndrome (left)
Cubital tunnel syndrome (left)	Carpal tunnel syndrome (left)
Flexor carpi ulnaris tendinitis (left)	Flexor carpi ulnaris tendinitis (left)
Rotator cuff tendinitis (right)	Strain of dorsal interosseous (left)
Extensor carpi radialis tendinitis (right)	
Temporomandibular joint dysfunction	
Cello/string bass	**Harp**
Neck pain	Neck pain
Ulnar nerve entrapment (left)	Flexor and extensor tenosynovitis of thumbs
Flexor carpi ulnaris tendinitis (left)	Extensor carpi radialis tendinitis (left)
Rotator cuff tendinitis (right)	Medial epicondylitis (left)
Extensor carpi radialis tendinitis (right)	Flexor hallucis longus tenosynovitis of big toe (right)
Vocals	**Saxophone**
Vocal cord strain	Back and neck pain
Facial and neck muscle strain	Extensor carpi radialis tendinitis (right and left)
Focal dystonia of vocal cord muscles	Temporomandibular joint dysfunction
Clarinet	**Bassoon**
Carpometacarpal joint strain (right)	Back and neck pain
Carpal tunnel syndrome	Temporomandibular joint dysfunction
De Quervain's syndrome (right)	Dental problems
Lateral epicondylitis (right and left)	Strain of teres major and pectoralis major (right)
Temporomandibular joint dysfunction	De Quervain's syndrome
Oboe	**Flute**
Extensor carpi radialis tendinitis (right)	Thoracic outlet syndrome (left and right)
Lateral epicondylitis (right)	Ulnar nerve entrapment (left)
Ulnar nerve entrapment (right)	Extensor carpi radialis tendinitis (left)
Posterior interosseous nerve entrapment (right)	Back and neck pain
Back and neck pain	De Quervain's syndrome (left and right)
De Quervain's syndrome	Focal dystonia of ring and little fingers (left)
Trombone	**Trumpet**
Focal dystonia of lip	Maxillofacial and lip trauma
Lateral epicondylitis (right)	Pharyngeal dilatation
Strain of orbicularis oris	
French horn	**Bagpipes**
Temporomandibular joint dysfunction	Focal dystonia of ring and middle fingers (right)
Strain of extensor carpi radialis (right)	
Strain of dorsal wrist ligament (right)	**Tuba**
Strain of orbicularis oris	Strain of orbicularis oris
Percussion	**Keyboards (piano/organ/accordion)**
Lateral and medial epicondylitis	Thoracic outlet syndrome
Flexor carpi ulnaris tendinitis	Medial and lateral epicondylitis
Extensor carpi radialis tendinitis	Tendinitis of wrist flexors and extensors
De Quervain's syndrome	Carpal tunnel syndrome
Carpal tunnel syndrome	De Quervain's syndrome
Achilles tendinitis	Dorsal wrist ganglion
	Focal dystonia of thumb, finger, hand, and foot muscles

Note: This table is based on reports by Chong et al. (1989), Fry (1986a and 1986b), and Norris (1993). This is not an exhaustive list of all MSIs or instruments. If you are aware of any other common MSIs, please contact SHAPE (see page 1 for contact information).

Tendon and muscle disorders (tendinitis, tenosynovitis, focal dystonia, muscle strain)

The human body moves and generates force based on tension produced by muscles and transferred to bones by tendons, which attach muscle to bone.

Tendinitis and tenosynovitis

Tendons are rope-like structures made of strong, smooth fibres that do not stretch. During movement, tendons normally slide within a lubricated tendon sheath. Irritation of the tendon (tendinitis) or sheath (tenosynovitis) results from excessive tension in the tendon or the friction of repeated movements. Tension and friction in tendons increase when awkward postures stretch or bend tendons around joints, contributing to the risk of MSIs such as tendinitis.

Excessive tension or impacts can eventually tear tendon fibres much like a rope can become frayed. This type of MSI is called a strain and usually results in the formation of scar tissue. Repeatedly strained tendons can become thickened, bumpy, and irregular. Prolonged irritation of the tendon sheath can cause the lining of the sheath to thicken and constrict, making it difficult for the tendon to slide in the sheath.

Focal dystonia

Focal dystonia is a malfunction of the muscle at a specific location, which may result in:

- cramping
- involuntary flexing or straightening of a joint
- a sense of fatigue
- loss of coordination

Focal dystonia may or may not be painful, but it will interfere with the musician's ability to play an instrument. Muscle cramping is not necessarily focal dystonia. While cramping or stiffness can occur as a result of the fatigue induced by a particularly long or difficult practice session, rehearsal, or performance, focal dystonia is a condition in which muscle dysfunction can occur in the absence of fatigue.

Focal dystonia typically affects the:

- hands and fingers of string and keyboard players
- feet of drummers
- vocal chords of vocalists
- embouchure of brass players

(Sternbach 1994)

The musician may experience referred symptoms in other parts of the body when cramping or spasm occurs in the neck or back muscles. For example, cramping in the neck muscles may result in pain behind the ears or above the eyes that resembles a headache. Several tendons and muscles are particularly at risk of injury for musicians.

Hand, wrist, and forearm

Keyboard and guitar players are susceptible to straining the small hand muscles that control lateral finger movement and finger spread (interosseous), as well as those that flex the finger at the large metacarpal joint (lumbricales). These strains are largely due to playing loud repeated octaves or chords that require difficult finger positioning (Chong et al. 1989).

Clarinet, oboe, flute, keyboard, and drum playing have been associated with De Quervain's syndrome (Zaza 1998a and 1998b; Chong et al. 1989). De Quervain's syndrome is characterized by pain in the tendons at the base of the thumb (extensor pollicis brevis and extensor pollicis longus) and on the thumb side of the forearm. It becomes painful to move the thumb away from the hand or to engage in activities that require a firm grip or twisting motion. In keyboard players, De Quervain's syndrome has been associated with performing a "thumb under" ascension of the keyboard (Chong et al. 1989). In clarinet and flute players, the thumb extensors are continuously involved in supporting the instrument. Drumming can involve extreme flexion and lateral motion of the wrist (ulnar and radial deviation) with rapid deceleration at the moment of impact, which repetitively stresses the extensor tendons.

> "With rates of playing reaching 30–40 notes per second, the intrinsic muscles of the hands become at risk for strain; indeed, this diagnosis is one of the most common performance-related problems seen in all instrumentalists."
>
> "Rapid finger movements also can lead to tendon difficulties."
>
> ~ W. J. Dawson, 1997

The muscles and tendons in the forearm that flex the wrist (move the palm of the hand toward the forearm) and extend the wrist (move the palm of the hand away from the forearm) are commonly irritated because of the demands of posture, force, and fine coordinated movement that playing some instruments requires of the hands and fingers. String players tend to injure the wrist flexors of the left wrist (flexor carpi ulnaris) and the extensors of the right wrist (extensor carpi radialis). This is due to the flexed wrist posture the musician maintains while applying pressure to strings with the left hand and the extension of the wrist while controlling the bow. The small rapid bow movements required for sustained tremolo place high demand on both the flexor and extensor muscles (Chong et al. 1989). Maintaining wrist flexion or extension while making rapid, forceful, or precise finger movements places a great deal of stress on the long tendons that cross the wrist. Certain wind instruments (oboe, French horn, and flute) require sustained wrist extension to hold the instrument while allowing the fingers to curl into position for fingering.

Elbow and shoulder

Elbow soreness can result where the forearm muscles attach to the bone on the elbow's outer edge (lateral epicondyle) or on its inner edge (medial epicondyle). These are the anchor points for tendons of several muscles, including flexor carpi ulnaris on the inner elbow and extensor carpi radialis on the outer elbow. Inflammation of these tendons is called epicondylitis and can result in pain at the elbow, forearm, or wrist.

Lateral epicondylitis (tennis elbow) is aggravated by activities that involve extending the wrist, straightening the fingers, or rotating the forearm so the palm faces up. Medial epicondylitis (golfer's elbow) is aggravated by activities that involve flexing the wrist, bending the fingers, or rotating the forearm so the palm faces down. Musicians are most

likely to develop epicondylitis when playing instruments that require complex postures with rotation of the forearm, bending of the wrist, and independent finger movement. Musicians who play keyboard, percussion, clarinet, harp, oboe, or trombone have been reported to be at risk of lateral or medial epicondylitis (Fry 1986b; Chong et al. 1989).

The shoulder tendons are at risk of injury for musicians who need to keep their arm in a raised position with the elbow pointing outward or forward. Irritation of the shoulder tendons is often referred to as rotator cuff tendinitis. The rotator cuff comprises the tendons of several muscles (teres major, infraspinatus, supraspinatus, and subscapularis), which help stabilize the arm at the shoulder joint and control rotation of the arm within the shoulder joint. Pain is usually experienced on the top or front part of the shoulder, or on the outer part of the upper arm, and may occur at night. Playing violin, viola, cello, string bass, or bassoon has been associated with rotator cuff tendinitis (Chong et al. 1989; Zaza 1998a and 1998b).

Back and neck

Low back pain is common among musicians, largely as a result of prolonged sitting in a restricted posture (Fry 1986a; Chong et al. 1989). The seated posture flattens the lumbar curve in the spine, increasing pressure in the intervertebral discs and placing the posterior ligaments and small muscles of the back into tension. Bulging or herniation of the intervertebral discs or local swelling because of strain of the small muscles and ligaments can result in muscle spasms and nerve compression.

Upper back and neck pain are more common in certain musicians because of specific playing postures required to support an instrument or the force required to play the instrument. Upper back and neck pain are usually related to postures of the head and upper arms, which are supported and stabilized by muscle activity in the upper back and neck. The static head position required to hold a violin or viola can lead to neck and face pain. Head posture adopted to play an instrument often involves turning the head to one side (for example, flute or harp), or tilting the head downward (for example, saxophone or keyboard). Larger, heavier instruments (for example, double bass or bassoon) that require strength to support or play are associated with back and neck pain. While this is likely due to the physical demands of playing these instruments, methods of transporting and carrying heavier instruments are also a consideration.

Head and face

Vocalists and horn players are susceptible to straining the muscle that controls the shape of the mouth and lips (orbicularis oris).

Wind musicians often suffer disorders of the temporomandibular joint (TMJ), which is where the jaw joins the skull in front of the ears. TMJ pain can seem to be a headache or can involve the face and neck, and is usually related to either excessive muscle tension (for example, teeth clenching) or to degradation of the joint itself. TMJ disorders develop for various reasons and are often related to psychological stress or teeth alignment. Instruments that require careful and sustained jaw positioning (violin, viola, saxophone, clarinet, and French horn) present the greatest risk of TMJ disorders.

Nerve compression or entrapment (carpal tunnel syndrome, cubital tunnel syndrome, thoracic outlet syndrome, sciatica)

Peripheral nerves travel from cranial nerves in the brain or spinal cord to the outer regions of the body. Motor nerves send signals to muscles. Sensory nerves transmit information such as pain, temperature, position, and pressure from receptors in the skin, muscles, and joints to the brain and spine. The proper functioning of both motor and sensory nerves is required for coordinated movement.

Nerve compression or entrapment results when there is pressure on or irritation of the nerve. This tends to happen at specific locations, where the nerve crosses a joint or where it travels through areas that are restricted in size by surrounding tissues. Aggravation of tendons or muscles that share space with nerves can result in local swelling that compresses the nerves. Several nerve compression disorders are common for musicians, including carpal tunnel syndrome, cubital tunnel syndrome, thoracic outlet syndrome, and sciatica.

Carpal tunnel syndrome

Carpal tunnel syndrome is compression of the median nerve at the wrist, resulting in numbness, tingling, or pain in the thumb, index, and middle fingers. The carpal tunnel is a narrow passage in the wrist that is formed by the bones on the back of the wrist (carpals) and a band of ligament on the inside of the wrist (flexor retinaculum). Several nerves, major blood vessels, and tendons run through the carpal tunnel to the hand. Swelling within the carpal tunnel can result from irritation of tendons, which causes pressure on the median nerve. This is thought to be related to activities that require repetitive or sustained wrist flexion, particularly with a lot of finger movement. The left hand of violinists, violists, and guitar players is commonly affected by carpal tunnel syndrome, particularly if playing in the 12^{th} or 13^{th} position for too long (Sternbach 1991).

Cubital tunnel syndrome

Cubital tunnel syndrome is compression or entrapment of the ulnar nerve at the inside groove of the elbow, resulting in numbness, tingling, pain, or loss of coordination in the fourth (ring) and fifth (little) fingers, and pain at the elbow. Postures that require flexion at the elbow and wrist with rotation of the palm upward (supination) — for example, the left hand while playing violin, viola, or guitar — present a risk of cubital tunnel syndrome (Chong et al. 1989).

Thoracic outlet syndrome

Thoracic outlet syndrome is compression of the brachial plexus (a group of nerves travelling toward the arm) between the first rib and collarbone, which can produce symptoms similar to carpal tunnel syndrome or cubital tunnel syndrome. Postures that result in the shoulders being rounded forward or elevated, sustained use of the pectoral muscles, and breath-holding or irregular breathing patterns all present a risk for thoracic

outlet syndrome. Violin and viola players are susceptible to thoracic outlet syndrome on the left side because of the posture required to secure the instrument between the chin and shoulder. Flute players are susceptible on both sides because of a static playing posture that involves flexing the shoulders forward, reaching the left arm across the midline of the body, and controlling the breathing. Posture while playing keyboard often involves rounded shoulders with the arms in a forward position, the head tilted forward, and irregular breathing patterns.

Sciatica

Sciatica involves pain in the legs and buttocks caused by irritation or compression of the sciatic nerve as it leaves the spine in the low back and travels down into the leg. Similar compression of nerves as they leave the spine can occur at any level, including the neck, with symptoms often reported in other regions of the body innervated by the compressed nerve. Musicians who are required to sit for prolonged periods, particularly if bent slightly forward or rotated to the side, are susceptible to low back pain and sciatica. The sciatic nerve can also be compressed in the back of the leg and irritated by prolonged sitting on a chair or bench that is too high or has a square edge on the front of the seat pan.

Preventing musculoskeletal injury for musicians

MSI prevention for musicians must be based on an understanding of the risk factors within the context of the musician's perspective, but it must also consider other participants in the performing arts industry (see Figure 1, page 6). Ideally, injury prevention strategies involve an active awareness of risk to the musician by all participants in the industry.

Occupational risk factors

Occupational risk factors for MSI include:

- awkward (non-neutral) postures
- repetitive motions
- force
- vibration
- long duration of exposure to risk factors

For musicians, risk factors that have the greatest demonstrated association with MSI are lack of warm-up and lack of adequate breaks during practice sessions (Zaza and Farewell 1997). Developing and adhering to a warm-up routine is important. Rest breaks should leave the musician feeling refreshed. Longer rest breaks may require another warm-up period to prepare the body to play the instrument again.

> "The upper extremity problems of hand, wrist, forearm, and elbow are frequently related not to the actual performance of the instrument, but to the process of reed preparation.... Some woodwind players are constantly working at a reed desk, with head forward, shoulders rounded, arms and hands engaged in repetitive motions and applying pressure, to maintain a continuous supply of high-quality reeds."
>
> ~ J. Kella, 1992

Prevention strategies

Musicians usually spend the most amount of time playing their instruments and have the most control over their situation during practice sessions, particularly during home practice. Rehearsals and performances are often governed by the demands of the conductor, bandleader, show schedule, venue, or designated duration of sets. Therefore, behavioural prevention strategies usually focus on practice habits. Many of these strategies can also be implemented, in part, during rehearsals and performances.

Prevention strategies must not compromise the instrument, the music, or the musician's health. The nature of music is such that repetitive and sustained awkward postures are often required to hold and play the instruments. However, musicians can have some influence over many risk factors, for example, by adjusting practice schedules, varying the difficulty of music, and using good playing technique.

Prevention strategies that may influence the primary risk factors for MSI include the following:

- Maintain personal health and well-being.
- Select appropriate practice locations.
- Develop good practice habits.
- Select appropriate instruments and furniture.

- Carry and set up equipment safely.
- Maintain body awareness.

The following prevention suggestions have some supporting evidence in the scientific literature, either for musicians or in occupations where there are similar types of injuries.

Maintain personal health and well-being

The first level of prevention is maintaining personal health and well-being in all aspects of daily living. Considering nutrition, hydration, physical activity, sleep quality, and stress management helps ensure that some of the intrinsic risk factors are managed. Managing these aspects of wellness helps ensure that the body is strong, fit, well nourished, and well rested. This helps prevent MSI and allows for more rapid recovery from physically demanding practices, rehearsals, or performances.

Smoking, alcohol consumption, coffee consumption, and the use of drugs can predispose an individual to MSI by negatively influencing physiological and psychological functioning (for example, reducing blood flow to the extremities, interfering with normal nerve function, or altering judgment and decision-making abilities). These are issues that compromise wellness in the absence of other physical or psychological stressors. In the physically and psychologically demanding environment of a musician, this reduces resilience and the ability to cope with other stressors.

Select appropriate practice locations

Environmental factors such as cold or poor lighting can increase risk of MSI. Cold environments reduce blood flow to the fingers and arms, interfere with adequate lubrication of tendons and joints, and can slow nerve conduction in the extremities. Lighting levels influence a musician's ability to read music, which may affect playing posture and can result in eye strain.

Selecting a practice environment that is properly heated and well lit is the ideal prevention strategy. Where this is not possible, wearing adequate clothing and warming the hands prior to playing is important for controlling the negative influence of cold on the functioning of the hands and fingers. Gloves or fingerless gloves may help keep the hands warm, but keeping the entire body warm is important for maintaining adequate blood flow to the extremities, which is considerably reduced when the body becomes cool. In a poorly lit environment, the use of portable task lamps or battery-powered clip lights to illuminate sheet music can help.

Develop good practice habits

Practice habits that contribute to the risk of MSI include:

- lack of warm-up
- inadequate rest
- overly strenuous repetition of demanding musical phrases
- sudden changes in practice routine

(Zaza and Farewell 1997; Paull and Harrison 1997; Kella 1997)

Warming up

A warm-up is intended to stimulate blood flow and physically warm the muscles and joints the musician will use while playing. A warm-up should involve gentle, smooth motions for several minutes. A musical warm-up at the beginning of a practice session, rehearsal, or performance should include long, slow notes to warm the muscles and encourage blood flow to the areas that will be demanding it during practice, rehearsal, or performance.

The use of stretching exercises to prevent MSI is controversial. Although widely considered beneficial, stretching and the use of whole-body exercise to warm up have not been demonstrated to produce benefits for musicians. Before undertaking a new stretching program, musicians should become familiar with good stretching technique. Musicians who experience pain or other symptoms should seek medical advice regarding appropriate exercises.

Stretching properly

Good stretching technique involves a proper warm-up and slow, controlled stretching of specific muscles. Warm-up should consist of two stages: joint rotation and aerobic warm-up.

1. Joint rotation. Slowly move each part of your body through its comfortable range of motion. (Remember, this is the warm-up, not the stretch. Don't push your range of motion.) This begins the process of lubricating the joints and preparing your body for activity.
2. Aerobic warm-up. Perform light aerobic activity for approximately five minutes to raise your body temperature and enhance blood flow to the muscles. The aerobic warm-up may involve a rapid walk, slow jog, or even skipping.

The key to safe stretching is a smooth, gentle, and steady elongation of the muscles (static stretching) without bouncing. Bouncing or ballistic stretching causes the muscles of the stretching limb to contract instead of elongate, which increases the potential for injury. Hold static stretches for 30–60 seconds.

Taking rest breaks

Practising, rehearsing, or performing for long periods or practising new material may expose a musician to excessive physical stress. Rest breaks help mitigate this stress.

Any type of physical training, including music rehearsal or practice, is based on the overload principle. To see an improvement in performance, the body must work harder than it is accustomed to working. This principle works well as long as the muscles get adequate rest. Without rest, muscles become fatigued and can no longer do the same amount of work. The physical stress of playing then shifts from the muscles to other soft tissue such as tendons and ligaments. Most soft tissue injuries occur when the muscles are fatigued.

With adequate rest between practice or rehearsal sessions and within performances, muscles become increasingly strong and able to do more work. Adequate rest breaks

allow musicians to feel refreshed and ready to continue performing near their physical limitations without progressively increasing their level of pain, discomfort, or fatigue.

Scheduling regular breaks into practice sessions provides a rest not only for load-bearing muscles and tendons, but also for the mind. This is expected to allow physical recovery of tissues that are under stress while playing and may also enhance learning. There is evidence that learning occurs more effectively if practice is performed in brief periods of time with short rest breaks, compared with long concentrated periods of practice (Zaza 1994).

The suggested ratio of practice to rest varies. Here are some suggestions:

- 5 minutes of rest for every 25 minutes of playing
- 10 minutes of rest for every 50 minutes of playing
- 10–15 minutes of rest for every 30 minutes of playing

(Zaza 1994; Kella 1997; Norris 1993)

More frequent rest breaks may be warranted if the musician is learning a particularly demanding repertoire. This may also involve spreading practice time throughout the day in order to allow adequate rest (Kella 1997). Professional organizations prescribe regular breaks during rehearsals and performances as well.

Avoiding repetition

Planning to work with a variety of music or exercises during a practice session can help prevent some of the repetition that may occur from practising a single phrase over and over again. Building in time to work with simpler pieces can provide a partial rest to minimize fatigue, particularly when learning physically difficult phrases.

It has been suggested that the use of imaging and visualization techniques can reduce the physical playing time required to master a piece of music (Lieberman 1989). Imagining that you are playing the music, note by note, movement by movement, can assist in the cognitive aspects of learning new music and enhance the speed at which motor learning takes place. This strategy reduces the reliance on physical practice time and may reduce the physical risk of injury.

Increasing duration and intensity

One of the most commonly reported risk factors is a sudden increase in the duration and intensity of practice sessions (Zaza and Farewell 1997; Kella 1997; Norris 1993; Chong et al. 1989). This typically occurs during preparation for a performance, during preparation of a new and difficult piece of music, or when returning from a prolonged break or holiday. Gradual increases to the duration and difficulty of practice are better than abrupt increases in practice intensity and duration (Zaza 1994). The gradual change in activity allows the body to adapt to the changing demand and can allow musicians to become aware of their limits if they pay close attention to signs and symptoms.

Select appropriate instruments and furniture

Selecting instruments

Changing instruments or playing a new instrument of the same type (including a better-quality instrument than the one previously played) presents a situation in which there is a sudden change in physical demands and an increase in the risk of MSI.

Playing poorly maintained or poorly designed instruments can require greater effort or force than playing similar, well-maintained instruments. For example, wind instruments with leaky valves or pads and string instruments with bridges that are too high will require greater effort to play well. Pianos with excessive dead space at the tops of the keys will require more force to obtain volume. Selecting quality instruments and maintaining their proper working condition will assist in preventing MSI (Norris 1993).

Selecting an instrument that fits the musician will help the musician adopt a reasonable playing posture without making concessions to adapt for excessive reaches or awkward hand and finger postures.

Selecting and adjusting furniture

Selecting or adjusting furniture — including chairs, music stands, or gadgets to support the instrument — can have a profound influence on playing posture.

Set chairs or stools at a height that allows the musician's feet to sit flat on the ground with the knees at a 90° angle. If the chair is an inappropriate height and is not adjustable, there are many possible solutions, including the following:

- If the chair is too tall, use a footrest (even something as simple as a phone book) to support the musician's feet.
- If the chair is too short, add a cushion to the seat, stack two chairs, or place wooden blocks under the chair feet.

(Paull and Harrison 1997)

Adjust music stands so the top of the sheet music is at or just below eye level. If the music stand must be substantially lower than eye level, the musician should make an effort to look at the sheet music by lowering the eyes rather than tilting the head. Place the music stand directly in front of the musician to minimize neck rotation.

Various gadgets are available to help achieve the posture or force required to play different instruments. A high chin rest can assist in positioning violins or violas without tilting the head excessively or elevating the shoulder. Harnesses can help support the weight of heavier instruments such as drums or tubas.

Carry and set up equipment safely

Musicians often have a significant amount of equipment to carry and set up before a practice session, rehearsal, or performance. This activity presents a risk of injury to the upper extremities and back and can contribute to fatigue or aggravation of existing conditions. Several strategies can be implemented to reduce the risk associated with carrying and setting up equipment.

Lifting safely

As with all lifting tasks, pay attention to safe lifting technique and plan your lift from start to finish. Avoid high-risk behaviours such as twisting your back or rapid lifting.

When planning a lift, ensure that you:

- know how heavy the load is
- have a stable base with your feet shoulder width apart
- are positioned to face the item you are lifting
- have a solid grip on the item
- have a clear route to your destination

Take the time to do the job right. Lifting injuries tend to happen more often when there is pressure to get the job done quickly.

Using appropriate containers

When transporting your equipment, select containers that are not excessively heavy and that have well-constructed, padded handles and wheels (as appropriate). Try to avoid large, heavy loads in containers that will need to be lifted. It is better to make two trips with a smaller load than one trip with a heavy load. When moving heavy equipment, ensure that you have enough people to assist. Ask for assistance. Where possible, use a lifting assist such as a dolly or hand truck, or package equipment in wheeled containers. Allow enough time for set-up to prevent rushing around while carrying equipment and to allow for adequate rest and recovery before playing your instrument.

If you have an existing injury in your upper extremities or back, look for ways to avoid carrying equipment altogether. Ask other band members, stage hands, or crew members who are not injured to carry your equipment or perform aspects of set-up that may aggravate your injury. Trading duties may allow you to help during set-up while minimizing the effect on your injury. If you must carry equipment, allow extra time for set-up so you can pace your activity and have time to recover from the work of set-up before playing your instrument.

Maintain body awareness

Body posture while playing influences the risk of MSI. Poor body mechanics result in awkward postures during both static and dynamic aspects of playing, increasing stress on tissues. Body posture includes not only the back and neck, but also the positioning of the shoulders, arms, hands, and legs, as well as the force that is applied to play the instrument.

Excessive force while playing can contribute to the stress on tissues. Some musicians have a tendency to use greater force than is necessary when playing forte or when the

instrument is poorly fit to them. Overplaying is common for string players (left hand), drummers, and horn players (Norris 1993).

Practising body awareness or movement disciplines

Practising one of several body awareness or movement disciplines can help create the awareness that is required to ensure good posture while playing. Training in alignment and awareness disciplines such as the Alexander Technique, Feldenkrais Method, Pilates Method, yoga, or Tai Chi in addition to playing an instrument increases awareness of playing posture and tends to enhance physical fitness. In any of these approaches, the goal is to gain a better sense of posture, movement, and status of the body. This allows the musician to make appropriate choices regarding playing posture, is expected to improve fluidity of movement, and assists the musician in learning to understand the difference between normal fatigue-related discomfort and pain that indicates excessive tissue stress or injury.

Many musicians have learned to play with pain and view this as a normal experience. Learning to recognize the signs and symptoms that indicate the development of MSI at an early stage is absolutely critical if steps are to be taken to prevent it from progressing. Recognition of familiar aches and pains allows the musician to combat these early signs with simple self-help techniques. Knowing when and where to go for medical help if these symptoms do not subside can prevent an ache from becoming a disruptive or even career-ending disease.

Treating musculoskeletal injury for musicians

Musicians' injuries can be managed at two levels. The first level is recognition of early signs and symptoms, and administration of simple self-help techniques. Ideally, musicians should learn to identify early signs and symptoms and practise self-help techniques at an early age. The second level is recognizing signs and symptoms that are persistent or unusual and seeking professional medical assistance (Kella 1997).

Warning signs and symptoms

Learn to recognize MSI signs and symptoms. Early warning signs and symptoms include:

- discomfort, pain, tingling, or numbness while playing
- weakness in the hands or difficulty with fine control of the fingers
- stiffness or limited range of motion
- postural changes (for example, shoulders elevated or rounded forward)
- local swelling or redness

If you notice discomfort or pain while playing your instrument, take a break until the symptom subsides. Avoid playing through the pain. In most cases it will only get worse if you continue to play.

RICE treatment protocol (rest, ice, compression, and elevation)

The RICE treatment protocol (rest, ice, compression, and elevation) is applied during the immediate stages of injury to help reduce the amount of damage to the body. This protocol will help manage the injury; however, guidance from a health-care professional should be sought to manage persistent or worsening symptoms.

The immediate benefits of following the RICE protocol are that it:

- decreases swelling
- decreases discomfort
- decreases muscle spasm
- prevents further injury

Rest

The concept of rest in this treatment protocol is a relative term. The objective of rest is to stop the exposure of the injured area to activities that aggravate the injury.

Ice

Applying ice or cold packs helps reduce swelling and manage pain by decreasing blood flow to the injured area and numbing pain sensation. Apply ice to the injured area for 15–20 minutes. Never place ice directly on the skin as this can result in frostbite. Place crushed or cubed ice in a wetted towel and then place the towel on the affected area. If ice is not available, a pack of frozen vegetables works just as well. Alternative methods of icing (creams, balms, or rubs) are not recommended because they only cool the first

layers of skin and not deeper into the injured area. Never use ice to numb an area so a musician can keep performing through pain. This is dangerous because it masks the symptoms and has the potential to make the injury worse.

Compression

Apply external compression to the injured area by wrapping the injury in a tensor bandage. Apply the wrapping in a criss-cross method — get directions for appropriate wrapping techniques from a health-care professional. Compression reduces the swelling of the injured body part by forcing fluid away from the injured tissue. Compression and ice often can be used together by wrapping the ice in the tensor bandage.

Elevation

Elevation allows gravity to help move the fluid away from the injured site. Elevate the injured area above the level of the heart.

Preventive measures

If you experience early signs and symptoms of MSI, try the following preventive measures:

- Identify aspects of your set-up, practice habits, or playing posture that may be contributing to the sign or symptom. Take appropriate actions to improve any shortcomings you may notice.
- Increase the amount of rest and decrease the duration of continuous playing time until you can play without symptoms. This may mean allocating more practice hours in your day to obtain the same amount of playing time.
- Be extra-conscious of performing a gradual, smooth warm-up at the beginning of your practice, rehearsal, or performance sessions.
- Be aware of which passages contribute to the signs and symptoms, and reduce your intensity and level of repetition while practising those passages. Perform long, slow notes or simpler passages immediately following the complex passages to allow some additional recovery time within the practice session. Alternate physical practice with mental practice (visualization or imagery) to balance the physical demand with adequate rest, while maintaining a focus on mastery of the passage.

When to seek medical assistance

If symptoms continue to occur each time you play, continue to get worse, or are unusual for you, seek medical assistance. If symptoms continue to persist after you have stopped practising, or if they appear at times other than when you are playing your instrument (for example, during sleep), seek immediate help from a health-care professional who is experienced in treating musicians' injuries.

For a list of health-care professionals who have experience treating MSI for musicians, contact SHAPE.

Refer to Figure 2, Progression of MSI Signs and Symptoms in Performers, page 9. You may want to seek assistance at any level along this scale. However, it is recommended that you seek immediate help from a health-care professional if you reach Level III or beyond.

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Part 3
Dancers and musculoskeletal injury (MSI)

Overview

Musculoskeletal injury (MSI) is the most frequently reported medical problem among classical and modern dancers. The majority (60–80%) of dancers have reported at least one injury that has affected their dancing or kept them from dancing (Bowling 1989; Hamilton et al. 1992; Milan 1994; Guierre 2000), and approximately half of dancers report at least one chronic injury (Bowling 1989).

Note: This part includes lists of selected references at the end of each section as well as a full reference list at the end of the part (page 50).

Long-term and chronic injuries

In 1989, Bowling surveyed the injury incidence in 141 professional ballet and modern dancers in the United Kingdom, including representation from the Royal Ballet, London Contemporary Dance Theatre, Sadler's Wells Royal Ballet, Diversions Dance Company, English Dance Theatre, and many smaller dance companies. The majority of dancers surveyed had experienced multiple injuries and injuries that were either recurring or not resolving (chronic).

Many dancers report long-term and chronic injuries because minor injuries go unreported and untreated for long periods. By the time these dancers finally report an injury or seek treatment, the damage has intensified to a level that requires major rehabilitation. Many dancers report self-treating injuries rather than seeking systematic professional medical treatment. Dancers self-treat and delay medical intervention for various reasons. They are often required to juggle a demanding schedule and lack the financial resources necessary to subsidize preventive or early treatments. In a 1992 study, Hamilton et al. found that the personality traits that characterize people with a high pain threshold also distinguish most of the injured dancers. As a result of a high pain tolerance, a dancer may delay medical intervention (Hamilton et al. 1992; Tajet-Foxell and Rose 1995).

Delayed-onset muscle soreness versus injury

Through their careers, dancers learn to recognize the difference between the delayed-onset muscle soreness that normally accompanies a physically demanding workout and the pain or symptoms that indicate injury. *Delayed-onset muscle soreness* is muscle stiffness that may develop 24 to 36 hours after intense or unaccustomed physical activity. Delayed-onset muscle soreness is a normal part of a physically challenging training program. It does not usually limit further activity and subsides within a few days. Muscle, tendon, or ligament injuries typically have a more rapid and localized onset of pain and require much longer (weeks or months) for full recovery. Because dancers commonly experience delayed-onset muscle soreness, there is a danger that they may not recognize pain caused by injury as such. Therefore, dancers are at risk of further aggravating injuries by continuing to train or rehearse in the same way.

Factors contributing to injury

The high incidence of injury in dancers has been attributed to:

- excessive dance training at an early age (before puberty)

- extensive and intense rehearsal
- the physical characteristics of footwear
- dancing on pointe
- the dietary habits common to dancers

(Reid 1988)

The effects of excessive and intense rehearsal are compounded by:

- overtired or overworked dancers
- inadequate warm-up
- unstable or unsuitable flooring
- cold environments

(Bowling 1989)

Faulty technique has been implicated as a major problem and contributor to injury (Maran 1997; Guierre 2000). Injuries because of faulty technique tend to recur even when rest and rehabilitation are successful in treatment of the initial injury. Each time a dancer resumes dancing with incorrect technique, the dancer may be reinjured. This scenario illustrates the importance of long-term dance training that includes a focus on correcting faulty technique.

The combination of high physical, mental, and environmental demands is thought to contribute to the high incidence of injury in dance (Smith, Ptacek, and Patterson 2000). The mental demands of dance can manifest as both physical stress (for example, muscle tightness or hyperventilation) and mental anxiety. Both of these factors are known contributors to injury (Smith, Ptacek, and Patterson 2000; Hamilton et al. 1992). Treating stress disorders in dancers has been shown to reduce the incidence of injury (Maran 1997). The dancer's stress level may also be influenced by interpersonal conflicts among individuals in the dance environment.

Rest and proprioception

Rest after injury, particularly lower limb injury, plays an important role in maintaining or restoring proprioception. *Proprioception* relies on sense organs in the joints to provide awareness of the joint's position, which is critical for posture, balance, and coordinated movements. Proprioception is important for dancers who are trying to coordinate difficult choreography and to balance in difficult positions. Postural stability requires adequate proprioception from the ankle joint. Proprioception is decreased for several weeks in dancers who have sprained their ankle, but will gradually improve as the injury heals. Dancers with ankle injuries have decreased postural stability and are more likely to suffer reinjury if they return to dancing before regaining full proprioception (Leanderson et al. 1996).

Types of MSI

The most common dance MSIs are strains, sprains, and bone disorders affecting the back or lower extremities (Bowling 1989; Kadel, Teitz, and Kronmal 1992; Khan et al. 1995). The majority of dance injuries are to the hip, knee, ankle, and foot. The lower limb is particularly vulnerable to injury for dancers because of the stress and strain that dance requires of this area (Milan 1994; Khan et al. 1995). The high incidence of lower

extremity injury has been attributed to forcing turnout and dancing on pointe in classical ballet dancers (Khan et al. 1995).

Approximately two-thirds of dance injuries are overuse and misuse injuries to the soft tissue (Bowling 1989; Milan 1994). Although soft tissue injuries are generally associated with full recovery within six to eight weeks, this is not typically the case for dancers, whose injuries often become chronic (47–60% of injuries) (Bowling 1989; Milan 1994). Chronic injuries are most likely to affect the back, neck, and lower extremities of dancers (see Table 2).

Table 2
Body parts affected by chronic injuries in dancers

Body part injured	Percentage of chronically injured dancers
Back or neck	29
Ankle	20
Knee	17
Thigh or leg	16
Hip, groin, or rib	6
Foot or toes	6
Upper extremities	6

(Adapted from Bowling 1989)

The majority of soft tissue dance injuries occur at performances or rehearsals (see Table 3). This suggests that the environmental, psychological, and physical factors affecting the dancer during performance or rehearsal increase the risk and incidence of injury. Dancers are more likely to push their physical limits during performance or rehearsal. Dancers may also experience high levels of physical and mental anxiety that result in tight muscles. Inadequate warm-up contributes to an increased risk of injury. Environmental factors that may affect dancers are the types of floors and temperatures in theatres.

Table 3
Location of injury occurrence

Location	Percentage of dancer injuries
Performance	32
Rehearsal	28
Class	16
Slow onset — multiple locations	7
Unknown	17

(Adapted from Bowling 1989)

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Preventing musculoskeletal injury for dancers

When preventing and treating dance MSIs, it is important to understand the mechanism of injury, the multifactorial causes of injury, and the professional and artistic demands on dancers. This section provides general suggestions and considerations to help prevent MSIs in dancers.

Dance on sprung floors

According to Newton's third law, for every action there is an equal and opposite reaction. When jumping and completing high-impact manoeuvres, a dancer exerts a force on the floor and the floor exerts an equal force on the dancer. These forces have a large impact on the dancer's feet and joints. A sprung floor absorbs some of the force, decreasing the acute impact on the body.

Dance in warmer studios

Cold environments are associated with decreased blood flow to the extremities. When blood flow is decreased, the affected body parts are more prone to injury.

Warm up before dancing

Warming up accomplishes three important changes in the body that help reduce the risk of injury:

1. Exercise increases the temperature of the muscle and connective tissue. This is associated with a decreased risk of soft tissue injury.
2. Exercise provides the stimulus and time needed for the cardiovascular system to adjust blood flow from the body's core to the active muscles, where the need for oxygen increases in response to the exercise.
3. Exercise stimulates joint lubrication and prepares the joints for full range of movement.

An adequate warm-up should accomplish each of these three goals.

Remain aware of dancers' limitations

When teachers and choreographers are aware of dancers' physical and mental limitations and requirements, dancers are not likely to feel pressure (whether real or interpreted) to push themselves beyond their capabilities. Dancers who are fatigued and pushing themselves beyond their physical capacity are more likely to adopt sloppy technique or make unsafe movements, increasing their risk of injury.

Rest between workouts

Any type of fitness training, including dancing, is based on the overload principle. To see an improvement in fitness, the body must work harder than it is accustomed to working. This principle works well as long as the muscles get adequate rest between workouts. Without rest, muscles become fatigued and can no longer do the same amount of work. The stress of the work (i.e., dance) then shifts from the muscles to other soft tissue such as tendons and ligaments. Most soft tissue injuries occur when the muscles are fatigued.

With adequate rest between workouts, muscles become increasingly strong and able to sustain more force, and thus do more work. Adequate rest breaks between workouts allow dancers to feel refreshed and ready to continue working near their physical limitations without progressively increasing their level of pain, discomfort, or fatigue. Without adequate rest between workouts, cumulative fatigue reduces muscle strength and endurance, and the level of pain or discomfort associated with activity progresses.

Maintain communication

Communication between dancers and artistic directors, teachers, and choreographers is important to maintain dancers' health. Brief conversations in class or rehearsal can help monitor dancers' physical and mental status. Early identification of problems can help reduce the likelihood of injury. Open communication provides both an opportunity and permission to identify signs and symptoms of developing soft tissue injuries before they become problematic. In addition, showing a genuine interest in dancers' well-being can have a positive effect on their level of stress and state of mind. A dancer's status can provide valuable information regarding the balance between the intensity of the workout and the adequacy of rest and recovery.

Rest when injured

Immediate management of acute MSIs is important. Care administered within the first 72 hours of an acute injury is critical to the injury's outcome. The RICE treatment protocol (rest, ice, compression, and elevation) is an effective measure in dealing with an acute soft tissue injury (see page 44). Knowing the difference between delayed-onset muscle soreness and pain due to injury is important for determining when to rest an injury and when to continue physical activity.

Delayed-onset muscle soreness peaks 24 to 36 hours after intense or unaccustomed activity. It is a normal response to such activity and subsides within a few days. Most dancers will recognize this soreness as muscle stiffness that is common during training. No restriction of activity is required for recovery from delayed-onset muscle soreness, and the individual may benefit from active use of the sore muscles.

Pain due to more serious soft tissue injury usually has a more rapid or acute onset and more localized symptoms, and is recognized as having different characteristics from the usual muscle soreness. Most soft tissue injuries require rest in the form of modified activity to allow the damaged tissue to heal. Modified activity may range from reduced intensity of activities that stress the damaged tissue to complete removal of all activity that affects the injured region. Guidance is best provided on a case-by-case basis by a medical professional who is familiar with sports or occupational injuries and the dance industry.

Get proper nutrition

Maintaining the body in a strong, resilient state requires enough balanced nourishment to support the caloric and metabolic demands of high-level physical activity and to develop a strong structural foundation in the musculoskeletal system. Bone density and muscle mass depend on an adequate supply of nutrients to support constant tissue remodelling. For more information, see "Nutrition," page 46.

Avoid strain when carrying equipment

For most dancers, carrying equipment, clothing, costumes, and other items is a reality that can place a significant amount of stress on the neck, shoulders, arms, and hands. Minimize the effects of carrying by selecting appropriate containers for your gear. Ideally, containers should be lightweight, with padded handles or shoulder straps. Avoid carrying gear in bags with narrow straps or handles because these increase the effects of contact stress. Where possible, use wheeled carts or bags (such as overnight travel suitcases) with handles that allow you to pull them while in a full standing posture.

Treating musculoskeletal injury for dancers

Dancers' injuries can be managed at two levels. The first level is recognition of early signs and symptoms, and administration of simple self-help techniques. Ideally, dancers should learn to identify early signs and symptoms and use self-help techniques at an early age. The second level is recognizing signs and symptoms that are persistent or unusual and seeking professional medical assistance.

The RICE treatment protocol (rest, ice, compression, and elevation) helps control the initial stages of an injury during the first few days. Injury that persists or becomes worse and begins to influence the dancer's ability to continue dancing is initially addressed by conservative treatment methods. Conservative treatment methods are non-surgical interventions that may include the use of:

- medication
- activity modification
- physical therapies
- splints
- orthotics
- taping
- ultrasound
- acupuncture

When conservative treatment methods are ineffective or the initial injury is particularly severe, more aggressive (surgical) approaches may be warranted.

Warning signs and symptoms

Learn to recognize MSI signs and symptoms. Early warning signs and symptoms include:

- discomfort, pain, tingling, or numbness while dancing
- weakness or difficulty with fine control of movement
- stiffness or limited range of motion
- postural changes (for example, shoulders elevated or rounded forward)
- local swelling or redness

If you notice discomfort or pain while dancing and circumstances allow it, take a break until the symptom subsides.

Preventive measures

If you experience early signs and symptoms of MSI, try the following preventive measures:

- Identify aspects of your training habits or dance technique that may be contributing to the sign or symptom. Take appropriate actions to improve any shortcomings you may notice.

- Increase the amount of rest and decrease the duration of continuous dance time until you can dance without symptoms. This may mean allocating more rehearsal hours in the day to obtain the same amount of dance time.
- Be extra-conscious of performing a thorough warm-up at the beginning of your rehearsal or performance sessions.
- Be aware of which movements contribute to the signs and symptoms, and reduce your intensity and level of repetition while rehearsing those movements. Alternate physical rehearsal with mental rehearsal (visualization or imagery) to balance the physical demand with adequate rest, while maintaining a focus on performance.

RICE treatment protocol (rest, ice, compression, and elevation)

The RICE treatment protocol (rest, ice, compression, and elevation) is applied during the immediate stages of injury to help reduce the amount of damage to the body. This protocol will help manage the injury; however, guidance from a health-care professional should be sought to manage persistent or worsening symptoms.

The immediate benefits of following the RICE protocol are that it:

- decreases swelling
- decreases discomfort
- decreases muscle spasm
- prevents further injury

Rest

The concept of rest in this treatment protocol is a relative term. The objective of rest is to stop the exposure of the injured area to activities that aggravate the injury. The dancer can continue with a normal workout routine, but should avoid the actions that result in discomfort or stress to the injured tissue.

Ice

Applying ice or cold packs helps reduce swelling and manage pain by decreasing blood flow to the injured area and numbing pain sensation. Apply ice to the injured area for 15–20 minutes. Never place ice directly on the skin as this can result in frostbite. Place crushed or cubed ice in a wetted towel and then place the towel on the affected area. If ice is not available, a pack of frozen vegetables works just as well. Alternative methods of icing (creams, balms, or rubs) are not recommended because they only cool the first layers of skin and not deeper into the injured area. Never use ice to numb an area so a dancer can keep performing through pain. This is dangerous because it masks the symptoms and has the potential to make the injury worse.

Compression

Apply external compression to the injured area by wrapping the injury in a tensor bandage. Apply the wrapping in a criss-cross method — get directions for appropriate wrapping techniques from a health-care professional. Compression reduces the swelling of the injured body part by forcing fluid away from the injured tissue. Compression and ice often can be used together by wrapping the ice in the tensor bandage.

Elevation

Elevation allows gravity to help move the fluid away from the injured site. Elevate the injured area above the level of the heart.

When to seek medical assistance

If symptoms continue to occur each time you dance, continue to get worse, or are unusual for you, seek medical assistance. If symptoms continue to persist after you have stopped dancing or if they appear at times other than when you are dancing (for example, during sleep), seek immediate help from a health-care professional who is experienced in treating dancers' injuries.

Refer to Figure 2, Progression of MSI Signs and Symptoms in Performers, page 9. You may want to seek assistance at any level along this scale. However, it is recommended that you seek immediate help from a health-care professional if you reach Level III or beyond.

For a list of health-care professionals who have experience treating MSI for dancers, contact SHAPE.

Conservative medical treatments

Conservative medical treatments are non-surgical methods of addressing a condition. The majority of dancers' injuries will respond well to an aggressive but conservative medical treatment program that is based on a team approach to case management. Several treatment modalities must be coordinated to deal with the injury thoroughly and to prevent recurrence, including:

- accurate diagnosis
- correction of dance technique (if necessary)
- manual therapies to promote joint and soft tissue healing
- nutrition advice
- a strength and fitness program (such as the Pilates Method) to maintain fitness levels and rehabilitate injured tissues while the dancer is unable to dance

(Khan et al. 1995)

Involving sports-medicine specialists in the treatment program has been shown to result in a high success rate (Bowling 1989).

Dance injuries that do not respond to conservative treatment and require surgical intervention are likely to benefit from dance-specific rehabilitation that includes a focus on maintaining and re-establishing joint mobility, flexibility, and strength.

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Nutrition

Nutrition influences the body's ability to respond to the stress of physical activity, injuries, and micro-traumas. Dancers who do not have adequate nutritional intake have a higher incidence of injury (Maran 1997).

Maintaining adequate hydration is also vital to avoiding injury. Dehydration occurs when the amount of water in the body decreases below normal levels. When the body is dehydrated, the level of electrolytes (sugars and salts) becomes unbalanced, and the risk of MSI and heat injury increases.

Eating disorders

Dancers as a group have been identified with a high incidence of eating disorders (Disordered Eating and Eating Disorders Web site, November 2, 2000). Eating disorders affect males and females. In this resource guide, the term *eating disorder* refers to maintenance of a diet lower than 70% of the recommended daily allowance (RDA) and to the disorders anorexia nervosa and bulimia nervosa.

Eating disorders are psychological disorders that have serious physical complications. *Anorexia nervosa* is characterized by abnormally low body weight. Anorexics achieve their low body weight by severely restricting the intake of food and possibly purging even small amounts of food. *Bulimia nervosa* is characterized by the ingestion of large quantities of food in short periods (binges), followed by attempts to purge the food. Purging is accomplished by vomiting, using laxatives, or engaging in intense physical exercise.

Eating disorders have been implicated in the high percentage of dancers who suffer from injury, osteoporosis, and fertility problems (Maran 1997). Dancers who are suffering from an eating disorder should seek professional help as soon as possible.

Body mass index (BMI)

The effects of poor nutrition have been shown to significantly increase the risk of injury in dancers (Benson et al. 1989). Dancers with a lower than normal body mass index (BMI) are more likely to become injured. BMI represents the relationship between weight and height (weight in kilograms divided by height in metres squared). BMI is a loose predictor of nutritional status. An acceptable BMI ranges between 20 and 25, with 18 to 20 defined as mild starvation, and below 16 indicating severe starvation. In 1989, Benson et al. showed that dancers with BMIs below 19 spent more days off with injury than dancers with BMIs above 19.

Menstrual dysfunction

Low BMI and eating disorders are also implicated in menstrual dysfunction. Menstrual dysfunction is another risk factor for MSI (Benson et al. 1989). *Menstrual dysfunction* refers to either delayed *menarche* (initiation of menstruation at puberty) or *amenorrhea* (cessation of menstruation). Dancers with lower than normal BMIs are more likely to suffer from delayed menarche or amenorrhea.

In a study involving 350 dancers at a national dance company school, dancers were shown to have a significantly later age of menarche than a matched group of non-dancers (Brooks-Gunn and Warren 1988). Leanness was the best predictor of menarcheal age in dancers, with the leanest dancers experiencing delayed menarche. Amenorrhea in dancers is caused by over-exercise and leanness, particularly low nutritional intake and low BMI.

Both delayed menarche and amenorrhea have severe implications for bone and joint health (see "Bone Injuries," page 48).

Web sites for eating disorders

The following is a brief list of Web sites that provide more information on eating disorders for dancers:

- *The Eating Disorders Site* www.closetoyou.org/eatingdisorders/
- *Edancing* www.danceart.com/edancing/
- *National Eating Disorders Association* www.nationaleatingdisorders.org
- *Web MD* http://my.webmd.com/content/dmk/dmk_article_40031

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Disordered eating and eating disorders. <www.shsu.edu/~counsel/ed.html> (November 2, 2000).

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Bone injuries

Bone mass in adults is a predictor of bone strength and is expressed as bone mineral density (BMD). As bone mass decreases, the risk of suffering a stress fracture or stress reaction increases. Bone injuries tend to occur in people who have lower than normal BMD or who put high levels of physical stress on particular aspects of the bone. Dancers may be particularly prone to bone injuries because there is a tendency for dancers, on average, to have lower BMDs than non-dancers (Foldes et al. 1997) and because the physical demands of dancing can generate high stress levels in the bone. In addition to bone injuries during a dance career, the low BMD in dancers during their younger years increases the probability of osteoporosis at a later age and into retirement.

Bone mass and BMD are affected by several factors, including:

- gender
- race
- hormones
- nutritional status
- physical activity

Three of these factors are particularly important to dancers: hormones, nutritional status, and physical activity.

Hormones

Estrogen is an important BMD determinant. Women who have delayed menarche (initiation of menstrual cycles) or who are amenorrheic (not menstruating) have a low estrogen level, which reduces BMD and bone strength.

Nutritional status

Nutritional status is important in achieving two components of BMD. Inadequate nutrition is associated with:

- delayed menarche and amenorrhea (thus resulting in decreased estrogen)
- a low dietary intake of calcium (a vital nutrient for bone health)

Physical activity

Physical activity is important in developing strong bones and maximizing BMD. The benefits of the activity are most pronounced in areas where the skeletal system is under mechanical load (i.e., load-bearing joints).

Compared to non-dancers, a high percentage of female ballet dancers are amenorrheic and/or have decreased nutritional status, which has resulted in low BMD (Wolman et al. 1990). The majority of dancers who report bone injuries are more than 25% below their ideal weight (Frusztajer et al. 1990). Fortunately, with healthy nutritional and hormonal status the physical activity of dance can also result in strengthening some bones, such as the head of the femur (in the hip).

Additional information

For more information, refer to the following sections:

- "Lower Leg and Ankle Injuries: Shin Splints, Stress Fractures, and Stress Reactions," page 103
- "Nutrition," page 46

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Part 4
Musculoskeletal injuries (MSIs) prevalent in performers

Overview

This part summarizes musculoskeletal injuries (MSIs) that musicians and dancers commonly experience. These MSI summaries provide a brief description of the injury as well as information on signs and symptoms; the causes of the injury; and suggested treatment and prevention strategies.

Note: This part includes reference lists at the end of each injury summary.

These MSI summaries are not intended to replace the services of trained medical practitioners. These summaries are meant to assist performers in recognizing signs and symptoms, opportunities for prevention, and when to seek medical assistance. This is not an exhaustive list of all the injuries that you may encounter. Patient guides for these and other injuries may be available through your physician or clinic.

This part contains summaries for the following MSIs:

Jaw and head injuries
- Temporomandibular joint (TMJ) dysfunction

Shoulder injuries
- Rotator cuff tears
- Shoulder impingement syndrome

Hand and arm injuries
- Carpal tunnel syndrome
- Cubital tunnel syndrome
- Thoracic outlet syndrome
- De Quervain's syndrome
- Lateral epicondylitis (tennis elbow)
- Medial epicondylitis (golfer's elbow)
- Focal dystonia

Joint injuries
- Arthritis

Hip injuries
- Snapping hip syndrome (tight iliotibial band)

Knee injuries
- Patellofemoral pain
- Knee sprains and strains
- Meniscus tears

Back and neck injuries
- Spondylolysis
- Back and neck pain

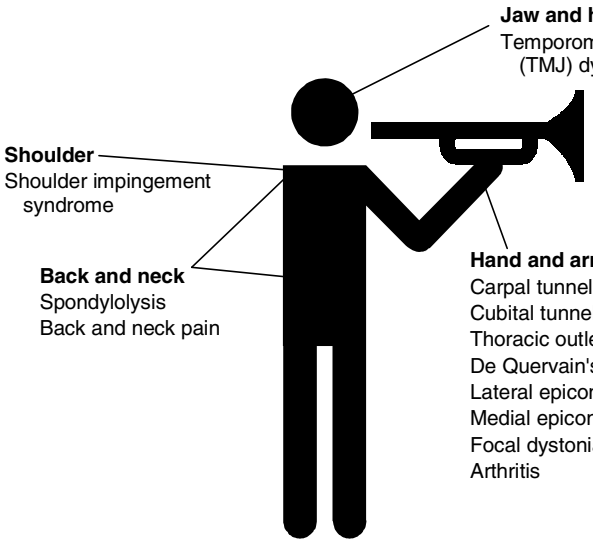
Lower leg and ankle injuries

- Shin splints, stress fractures, and stress reactions
- Ankle sprains
- Posterior impingement syndrome (dancer's heel)
- Anterior impingement syndrome
- Achilles tendinitis
- Subtalar subluxation

Foot and toe injuries

- Stress fractures of the second metatarsal
- Fractures of the fifth metatarsal (dancer's fracture)
- Cuboid subluxation
- Flexor hallucis longus tendinitis
- Blisters
- Bunions
- Toenail injuries

Injuries common to musicians



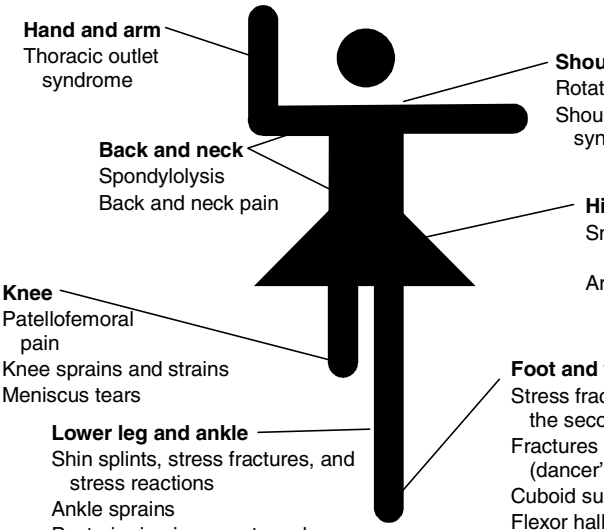
Jaw and head
Temporomandibular joint (TMJ) dysfunction

Shoulder
Shoulder impingement syndrome

Back and neck
Spondylolysis
Back and neck pain

Hand and arm
Carpal tunnel syndrome
Cubital tunnel syndrome
Thoracic outlet syndrome
De Quervain's syndrome
Lateral epicondylitis (tennis elbow)
Medial epicondylitis (golfer's elbow)
Focal dystonia
Arthritis

Injuries common to dancers



Hand and arm
Thoracic outlet syndrome

Shoulder
Rotator cuff tears
Shoulder impingement syndrome

Back and neck
Spondylolysis
Back and neck pain

Hip
Snapping hip syndrome (tight iliotibial band)
Arthritis

Knee
Patellofemoral pain
Knee sprains and strains
Meniscus tears

Lower leg and ankle
Shin splints, stress fractures, and stress reactions
Ankle sprains
Posterior impingement syndrome (dancer's heel)
Anterior impingement syndrome
Achilles tendinitis
Subtalar subluxation

Foot and toes
Stress fractures of the second metatarsal
Fractures of the fifth metatarsal (dancer's fracture)
Cuboid subluxation
Flexor hallucis longus tendinitis
Blisters
Bunions
Toenail injuries

Jaw and head injuries: Temporomandibular joint (TMJ) dysfunction

What is it?

The temporomandibular joint (TMJ) connects the jaw bone (mandible) to the skull immediately in front of the ear (temporal bone). The TMJ is able to move because of muscles that surround it and control its movement and position. This joint is responsible for movements related to talking, yawning, side-to-side jaw motion, and chewing.

When the mouth is open, the jaw condyles (rounded ends of the jaw) glide along the temporal bone in a socket. When the mouth is closed, the condyles glide back into their original position. As with other joints, the TMJ is lined with a meniscus (a soft disc), which absorbs shock.

Signs and symptoms

Symptoms of TMJ dysfunction include a feeling of generalized muscle pain and weakness, head pain, and difficulty opening and closing the jaw. Grinding or clenching the teeth is also common. This is the result of fatigue of the jaw, neck, and facial muscles. Discomfort or fatigue may also be felt in the upper back and shoulders, as these muscles are usually contracted in an attempt to "aid" the facial muscles.

What causes it?

TMJ dysfunction is often associated with the jaw clenching and tooth grinding that accompanies psychological stress in many people. Performance anxiety may contribute to jaw tension and the development of TMJ dysfunction.

Musicians susceptible to TMJ dysfunction include violin, viola, saxophone, clarinet, bassoon, and French horn players, as well as vocalists. Repetition is the main cause of TMJ dysfunction in musicians. Over time, the meniscus in the jaw joint becomes increasingly compressed and torn. This results in the jaw condyles wearing down. The grinding and resulting pressure on the ligament surrounding the joint can cause some of the symptoms. The body attempts to realign the joint using the muscles in the face, jaw, and neck. These muscles often become fatigued and additional muscles in the shoulders and back attempt to help the fatigued muscles. These shoulder and back muscles, however, soon become fatigued themselves.

Treatment

As with many injuries, the most important step in treatment is a correct diagnosis. Many of the signs and symptoms of TMJ dysfunction overlap with those of other disorders. For a proper diagnosis, a health-care provider may require X-rays or MRI in combination with dental records. Because of the complicated nature of the diagnosis, seek the opinion of at least two health-care professionals.

There are many different therapies for treating TMJ dysfunction. Because of the complex nature of the injury, approaches have not been standardized. Some modes of treatment may include:

- strengthening exercises
- pain medication
- heat or ice application
- splint therapy

Prevention

In response to stress, many people clench their jaw or tighten their facial muscles, both of which are causes of TMJ dysfunction. Therefore, stress management and relaxation techniques are important aspects of prevention.

Additional information

For more information, refer to the following sections:

- "Risk Factors," page 11
- "General Prevention and Treatment," page 13

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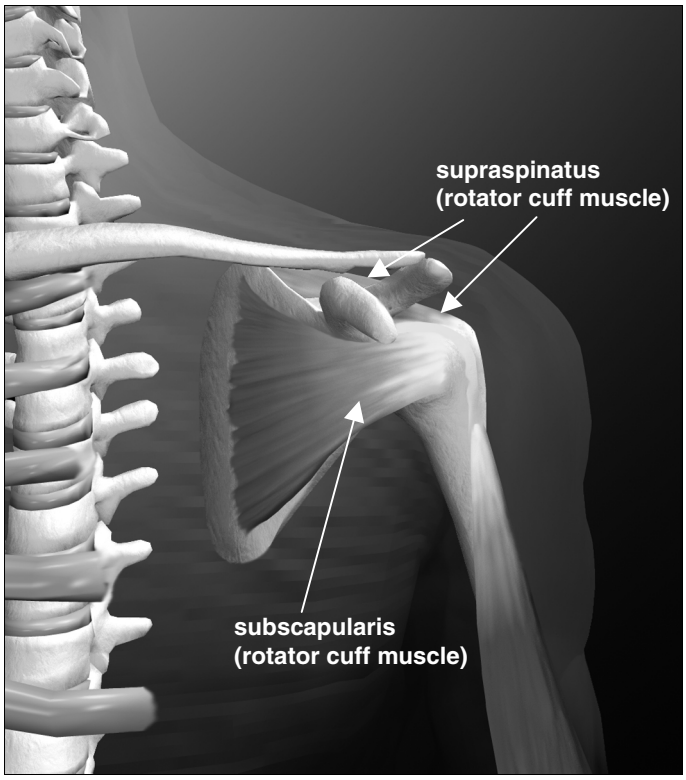
Shoulder injuries (rotator cuff injuries)

Rotator cuff is a term used to represent the shoulder girdle, which is composed of four muscles that help move the arm and stabilize the shoulder joint.

Typically, rotator cuff injuries are slow to heal because the anatomy of the shoulder is such that the blood supply to the rotator cuff muscles is poor. In general, poor blood supply is associated with a decreased ability for muscles and tendons to recover from daily wear and tear. The two most common types of rotator cuff injuries are tears and impingements.



The left shoulder seen from the front, showing two of the four muscles that make up the rotator cuff.

Shoulder injuries: Rotator cuff tears

What is it?

The rotator cuff muscles are attached to the bone in the arm by tendons. *Rotator cuff tears* occur when one or more of these rotator cuff tendons are torn partly or completely. These tendons can be torn by excessive force such as falling with an extended arm (Hoppenfield 1976). Tears often occur in people who have been suffering from shoulder problems for some time and whose weakened rotator cuff muscles and tendons are more prone to tearing (Medical Multimedia Group 2001).

Signs and symptoms

Pain and weakness are associated with tears of the rotator cuff tendons. The symptoms may vary depending on the severity of the tear. Complete tears are often associated with extreme weakness and an inability to move the shoulder properly. With partial tears, the shoulder may still move properly, but vague pain and weakness will persist, and an acute or stabbing pain may be felt when the shoulder is moved.

What causes it?

Tears occur with excessive force to the rotator cuff tendons. For example, a fall on an outstretched arm may cause enough force to tear the tendon, particularly if the tendon is already weakened or injured.

Treatment

As with most soft tissue injuries, the initial treatment for a rotator cuff tear is a combination of rest and ice. A medical professional may also prescribe anti-inflammatory medication to help alleviate pain. Stop all activity in the affected area until a medical professional diagnoses the injury and prescribes a treatment plan. It is not appropriate to self-treat a rotator cuff tear, as this may lead to increasing the severity of the injury. With a tear, it is important to start injury management immediately because the rotator cuff is such a slow-healing area. Minor tears can be managed without surgery, but it is not possible to treat complete tears non-surgically.

Once the pain subsides to a tolerable level, physical therapies are important for healing the rotator cuff and restoring normal function. Physical therapies are often combined with medications to manage pain and inflammation.

Recovering from a rotator cuff tear often takes several months, depending on the severity of the injury. When recuperating from this type of injury, the patient needs to find a balance between keeping the area moving and allowing the shoulder to rest (Robinson and Horrigan 1993).

Prevention

The key to preventing a rotator cuff tear is to maintain a healthy rotator cuff. Rotator cuff tears usually occur in people who have pre-existing injuries or a weak rotator cuff (Medical Multimedia Group 2001). Manage any discomfort or weakness in the rotator cuff immediately. If there are signs and symptoms of a weakened rotator cuff (i.e., pain or discomfort in the shoulder), avoid forceful activities such as lifting or throwing a dance partner until a proper diagnosis is obtained.

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Shoulder injuries: Shoulder impingement syndrome

What is it?

Impingement refers to pinching. In the shoulder, raising the arm can pinch some of the rotator cuff tendons and the bursa that lubricates the shoulder joint. When the arm is raised above shoulder level repetitively or for an extended period, the tendons and bursa may become irritated and inflamed. This swelling contributes to an increasing level of impingement.

Signs and symptoms

In the early stages of shoulder impingement syndrome, the symptoms are a general ache and sensitivity in the shoulder area, particularly when the arm is raised. As the impingement progresses, the pain becomes more acute and may be experienced when the arm is extended backward (Hoppenfeld 1976). If the shoulder becomes weak or movement is affected, the tendons may tear (see "Rotator Cuff Tears," page 62).

What causes it?

Shoulder impingement syndrome occurs when there is repetitive or sustained activity above shoulder level, particularly if the muscles are weak or fatigued. This activity irritates the rotator cuff tendons and the bursa because of the shape of the shoulder joint and the anatomical location of these tissues. This leads to inflammation and soreness at the shoulder joint.

Treatment

Minor shoulder impingement syndrome can easily progress to a more serious injury that will require months of rest and rehabilitation. The initial symptoms of pain and tenderness must be recognized and treated with rest and ice. Rest includes stabilizing the shoulder (for example, with a sling) for extended periods, but must be balanced with daily exercises to avoid "frozen shoulder" (an injury sustained by lack of shoulder movement). The amount of rest will depend on the severity of the injury and should be determined in conjunction with a physician or physiotherapist.

Once the pain subsides, physical therapies are important to strengthen the muscles of the rotator cuff, while being cautious not to aggravate or reinjure the area. Strengthening these muscles can decrease the amount of impingement experienced when the arm is raised overhead (Medical Multimedia Group 2001).

Prevention

The key to preventing shoulder impingement syndrome is to maintain a healthy rotator cuff. Strengthening the rotator cuff muscles will improve the stability of the shoulder and reduce the risk of an injury (Robinson and Horrigan 1993). Strengthening exercises will also help minimize impingement when the arm is raised above the head. Minimizing the

duration or repetition of activities that require the arms to be raised above shoulder level will also help.

References

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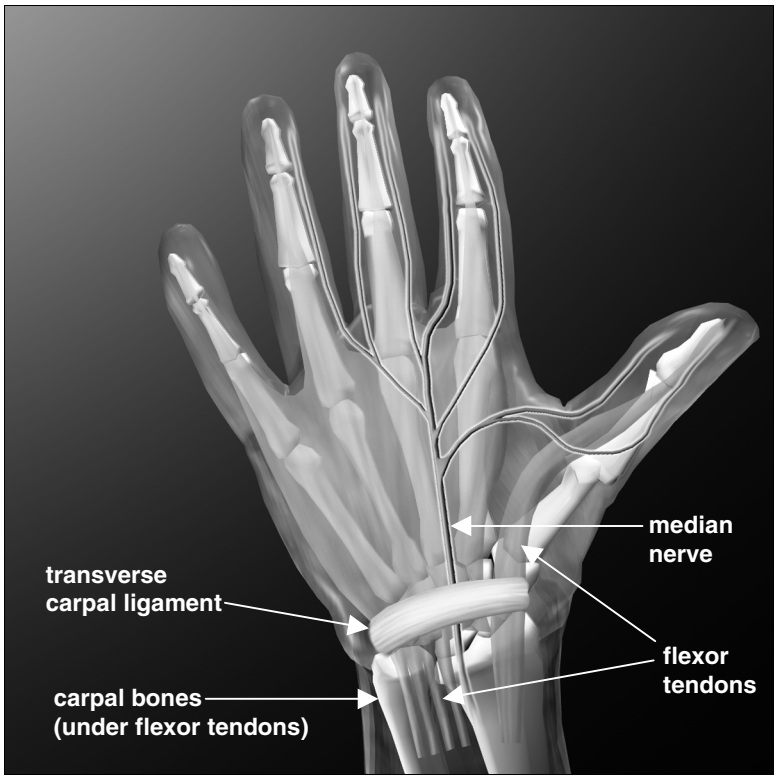
Robinson, J., and J. Horrigan. 1993. *7 minute rotator cuff solution.* San Mateo, Calif.: Appleton and Lange.

Hand and arm injuries: Carpal tunnel syndrome

What is it?

The carpal tunnel is the space at the base of the wrist formed by eight carpal bones on the back of the wrist and a ligament (transverse carpal ligament) along the palm side. The carpal tunnel is a narrow opening through which the flexor tendons and median nerve travel.

The flexor tendons travel from the muscles in the forearm to the hand and are responsible for finger and hand motion. The median nerve is responsible for sensation to the thumb, index finger, middle finger, and half of the ring finger. The median nerve also supplies sensation to the thumb muscles (thenar muscles). These muscles are of particular importance in pinching or gripping actions.



The right hand, palm up, showing the flexor tendons and median nerve passing through the carpal tunnel formed by the carpal bones and transverse carpal ligament.

Carpal tunnel syndrome is a condition in which the median nerve is compressed within the carpal tunnel and unable to function properly. Pressure on the nerve results in signs and symptoms that will progress if not adequately treated.

Signs and symptoms

The signs and symptoms of carpal tunnel syndrome are progressive in nature and may include:

- numbness and tingling in the hand or fingers
- night pain, which may wake the individual
- decreased feeling of touch in the thumb, index finger, and middle finger
- reduced dexterity of the hand or fingers
- a feeling of swollen fingers, even in the absence of visual signs of swelling
- reduced grip strength
- noticeable reduction in the size of the hand muscles, especially by the thumb (thenar muscles)

What causes it?

A number of factors may contribute to the development of carpal tunnel syndrome. Highly repetitive hand or finger actions are a common cause. If the flexor tendons become inflamed, the swelling applies pressure to the median nerve within the carpal tunnel, compromising the nerve's ability to function. A combination of awkward postures, forceful exertion, and high repetition will increase the risk of developing tendinitis, thus increasing the risk of carpal tunnel syndrome.

Carpal tunnel syndrome has been associated with playing violin, viola, guitar, percussion, piano, and clarinet.

Carpal tunnel syndrome may also be related to systemic or hormonal factors. For example, it is more common in pregnant women.

Treatment

Treatment for carpal tunnel syndrome ranges from non-surgical approaches to surgical protocols, with varying degrees of success in each type of treatment. A full recovery is more likely and more rapid if symptoms are reported in the early stages and the appropriate treatment regime is implemented. Avoid self-diagnosis, as carpal tunnel syndrome has symptoms in common with other disorders, and accurate diagnosis is critical in determining the best treatment. Seek professional medical advice.

Treatment of carpal tunnel syndrome should include the identification and minimization of aggravating activities. This may involve:

- a change of technique or hand posture
- shorter playing sessions
- more frequent breaks to allow for rest and recovery

Prevention

It is important for musicians to learn about proper body positioning while playing their instruments. Frequent breaks and stretching can break the repetitive cycle of playing and allow an opportunity for rest and recovery. Stretch the hands, neck, and shoulders intermittently during warm-ups, during practice sessions, and after completing sessions.

Additional information

For more information, refer to the following sections:

- "Risk Factors," page 11
- "General Prevention and Treatment," page 13

References

Floyd, R., and C. Thompson. 1994. *Manual of structural kinesiology*. Toronto: Mosby-Year Book Inc.

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Hand and arm injuries: Cubital tunnel syndrome

What is it?

The cubital tunnel is located on the inside (medial aspect) of the elbow, an area most people commonly associate with the "funny bone."

The sides of the cubital tunnel are formed by the flexor carpi ulnaris and flexor digitorum profundus muscles, the humerus bone (in the upper arm), and a ligament that crosses over the top. The ulnar nerve travels through the cubital tunnel as it passes from the upper arm into the forearm.

Each of the muscles performs different motions and the manner in which the motions are performed can result in the development of cubital tunnel syndrome. *Cubital tunnel syndrome* involves an irritation of the ulnar nerve in the elbow. Some people experience the same sensation as when they bang their funny bones.

Signs and symptoms

The primary symptom of cubital tunnel syndrome is a feeling of discomfort in the elbow area along the inside of the arm. Progression of symptoms may include discomfort in the hand as well as numbness or tingling in the little finger, ring finger, or along the back or side of the hand. If the problem is not addressed, symptoms may progress to include loss of grip strength and noticeable reduction in the size of the muscles near the little finger (hypothenar muscles).

What causes it?

The flexor carpi ulnaris muscle bends the wrist downward and sideways toward the little finger. The flexor digitorum profundus muscle moves the fingertips downward.

Highly repetitive actions that result in compression of the nerve near the elbow contribute to the development of cubital tunnel syndrome. These actions may include bending the wrist or fingers inward or sideways toward the little finger. The associated muscle contractions result in narrowing of the cubital tunnel. Other actions that may compress the nerve near the elbow include forceful straightening of or prolonged leaning on the elbow.

Highly repetitive wrist and finger motions can lead to overuse of the wrist and finger muscles. As with any overuse injury, the muscles fatigue and can become inflamed and suffer tissue micro-tears. With cubital tunnel syndrome, these micro-tears occur where the muscles attach to the bone in the elbow region. Inflammation results, applying pressure to the ulnar nerve.

Musicians who play violin or viola are particularly susceptible to cubital tunnel syndrome in their left arms.

Treatment

Initial treatment of cubital tunnel syndrome should include the identification and minimization of aggravating activities. This may involve:

- a change of technique or hand posture
- shorter playing sessions
- more frequent breaks to allow for rest and recovery

Compensatory techniques are a temporary measure that may be necessary to complete a performance. Longer-term preventive solutions may require re-education, including improved technique. Applying ice to the elbow may also be effective in controlling symptoms; apply ice frequently to reduce inflammation. If tight forearm muscles are contributing to the symptoms, gentle stretching may be beneficial. Consult a health-care professional to determine appropriate stretches.

If the initial efforts indicated above do not resolve symptoms, the success of the recovery depends on how quickly the individual seeks appropriate medical attention. Nerve disorders are serious, and nerve compromise over a long period can lead to permanent damage. Early identification of the problem and effective treatment increase the chance of a full recovery.

Prevention

The key to preventing cubital tunnel syndrome is to balance the stress on the ulnar nerve with rest and recovery. Perform gentle stretching during breaks (a technique called *active recovery*), every hour of practice or more, if possible. Prevention also requires the development of postural technique that minimizes stress on the ulnar nerve.

Additional information

For more information, refer to the following sections:

- "Risk Factors," page 11
- "General Prevention and Treatment," page 13

References

Floyd, R., and C. Thompson. 1994. *Manual of structural kinesiology.* Toronto: Mosby-Year Book Inc.

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Hand and arm injuries: Thoracic outlet syndrome

What is it?

The thoracic outlet is the narrow space that runs between the collarbone, the first rib, and one of the neck muscles (scalene muscles). Through this tunnel run veins, arteries, and nerves (median and ulnar nerves) that originate in the neck and travel down the arm. *Thoracic outlet syndrome* is a condition in which the nerves and blood vessels travelling through the thoracic outlet are compressed.

Signs and symptoms

Thoracic outlet syndrome has a number of symptoms that may be progressive in nature, including:

- numbness and tingling in the arm or hand
- swelling or lack of blood circulation to the hand, leaving it feeling cold
- pain or discomfort in the hand or arm
- weakness or fatigue of the hand or arm muscles

Diagnosis of thoracic outlet syndrome is difficult because it shares symptoms with other conditions. Thoracic outlet syndrome symptoms can mimic conditions such as a herniated disc in the neck, carpal tunnel syndrome, cubital tunnel syndrome, or bursitis of the shoulder.

What causes it?

Various factors may contribute to the development of thoracic outlet syndrome. Repetitive activities involving a head-forward posture or drooped shoulders may lead to compression of the nerve or vascular tissues. Partnering dance movements may stress the shoulder and result in compression of nerve or blood vessels. Carrying heavy loads, instrument cases, and dance bags may also lead to tissue compression. This can stress the shoulder-girdle structures (the clavicle, ligaments, and muscles). The most common cause of thoracic outlet syndrome is compression of nerves or blood vessels in the armpit. Thoracic outlet syndrome may also develop following neck or shoulder trauma.

Violin, viola, guitar, flute, and keyboard players have reported thoracic outlet syndrome.

Treatment

The key to effective treatment is a proper diagnosis. **Do not self-diagnose.** Thoracic outlet syndrome shares similar symptoms with other conditions, which can make it difficult to diagnose. Seek the help of a qualified health-care professional, as the appropriate treatment depends on the severity of the symptoms.

Prevention

The key to preventing thoracic outlet syndrome is to minimize stress on the neck and shoulders. Avoid awkward postures and minimize time spent using the neck and shoulder muscles in a static or continuous manner. Active recovery (stretching during rest breaks) may further reduce the risk of developing symptoms. To help minimize the recovery time should a traumatic injury occur, determine and maintain neck and shoulder posture that does not cause injury, as well as muscle strength and flexibility in these areas.

Additional information

For more information, refer to the following sections:

- "Risk Factors," page 11
- "General Prevention and Treatment," page 13

References

Floyd, R., and C. Thompson. 1994. *Manual of structural kinesiology.* Toronto: Mosby-Year Book Inc.

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Hand and arm injuries: De Quervain's syndrome

What is it?

De Quervain's syndrome is an inflammation of thumb tendons resulting in discomfort along the thumb and on the thumb side of the wrist, particularly along the two tendons that form a pit (the "snuff box") on the thumb side of the wrist when the thumb is fully extended.

Signs and symptoms

A common symptom of De Quervain's syndrome is discomfort along the back of the thumb. Some people may experience swelling and discomfort at the base of the thumb at the wrist. This discomfort will increase with thumb or wrist motion. Moving the thumb may become difficult and painful, particularly when pinching or grasping objects.

The condition can occur gradually or suddenly. In either case, the pain may travel up into the forearm.

What causes it?

Overuse of the thumb tendons is a common cause of De Quervain's syndrome. Overuse occurs with highly repetitive activities involving gripping or pinching forces of the thumb and wrist. Actions with greater forces will increase the risk of symptoms developing.

De Quervain's syndrome is also associated with rheumatoid arthritis.

Musicians at risk of developing De Quervain's syndrome include clarinet, flute, percussion, and keyboard players.

Treatment

Initial treatment of De Quervain's syndrome should include the identification and minimization of aggravating activities. This may involve:

- a change of technique or hand posture
- shorter playing sessions
- more frequent breaks to allow for rest and recovery

Applying ice to the base of the thumb may also be effective in controlling symptoms; apply ice frequently to reduce inflammation.

Consult a health-care professional to identify the appropriate treatment regime. Earlier intervention will lead to a more successful recovery and minimize the need for invasive treatments such as surgery.

Prevention

The keys to preventing De Quervain's syndrome are to minimize exposure to awkward thumb and wrist postures, and, whenever possible, to use a power grip that utilizes the whole hand rather than a pinch grip that utilizes just the fingers. Rest breaks are effective in providing recovery during tasks that involve awkward hand postures or forceful pinch grips.

Additional information

For more information, refer to the following sections:

- "Risk Factors," page 11
- "General Prevention and Treatment," page 13

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Hand and arm injuries: Lateral epicondylitis (tennis elbow)

What is it?

The lateral epicondyle is the area on the outside of the elbow where the wrist extensor muscles attach to the bone. This muscle group performs motions such as bending the wrist backward (extension), turning the hand palm-side-up, and lifting an object while keeping the elbow straight.

Lateral epicondylitis, commonly known as *tennis elbow,* is an inflammation of one or more of the tissues around the lateral epicondyle. In most cases, the extensor tendon is inflamed.

Signs and symptoms

Signs and symptoms include tenderness, pain, and swelling at the lateral epicondyle. Bending the wrist upward or gripping will aggravate symptoms.

What causes it?

Overuse of the hand and wrist extensor muscles is the most common cause of lateral epicondylitis, particularly when extending the fingers while the wrist is extended. Strained or overused muscles become inflamed and produce symptoms. Lateral epicondylitis can worsen if it is not addressed quickly and effectively.

Musicians at risk of lateral epicondylitis include clarinet, oboe, trombone, percussion, and keyboard players.

Treatment

Many tendinitis injuries have the same treatment protocol. Key components are applying ice to the affected area and stretching gently. For appropriate icing protocols and stretches, consult a health-care professional as soon as you feel symptoms. The sooner an injury is identified, the quicker the recovery and greater the chance of a full recovery.

Prevention

The keys to prevention are body awareness and stretching. Knowing the mechanics of the injury allows musicians to examine their technique and make minor posture changes while still maintaining the same performance results. Awareness of the body's position in relation to the instrument is key.

Frequent stretch breaks (every 45–60 minutes) help provide working muscles with an active recovery. Stretching helps relax tight muscles and improve flexibility and circulation. All of these are key in the prevention of injuries.

Additional information

For more information, refer to the following sections:

- "Risk Factors," page 11
- "General Prevention and Treatment," page 13

References

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Hand and arm injuries: Medial epicondylitis (golfer's elbow)

What is it?

Medial epicondylitis, often referred to as *golfer's elbow*, affects the inside bone region of the elbow (medial epicondyle), where the forearm flexor muscles are attached by a tendon. The forearm flexor muscles perform motions such as bending the wrist downward (flexion) and gripping objects.

Signs and symptoms

Signs and symptoms include tenderness, pain, and swelling at the medial epicondyle. Bending the wrist downward or gripping will aggravate symptoms.

What causes it?

The most common cause of medial epicondylitis is overuse of the forearm flexor muscles, particularly where strong gripping and wrist flexion are required, or where there is repetitive finger flexion while the wrist is flexed. Strained or overused forearm flexor muscles become inflamed. Overuse results in muscle micro-tears close to the origin point at the elbow. These micro-tears are small tears in individual muscle fibres that may not impair muscle function in the short term. However, scar tissue develops at the micro-tear sites as they heal. With the repeated generation of new micro-tears and the progressive increase in the amount of scar tissue in the muscle, the elasticity of the muscle becomes compromised and increases the strain on the tendons that anchor the muscle to the elbow.

Harp players are susceptible to medial epicondylitis in the left arm. Percussion and keyboard players are susceptible in both arms.

Treatment

Many tendinitis injuries have the same treatment protocol. Key components are applying ice to the affected area and stretching gently. For appropriate icing protocols and stretches, consult a health-care professional as soon as you feel symptoms. The sooner an injury is identified, the quicker the recovery and healing process.

Prevention

The keys to prevention are body awareness and stretching. Knowing the mechanics of the injury allows musicians to examine their technique to see whether or not it can be changed slightly while still maintaining the same performance results. Awareness of the body's position in relation to the instrument is key.

Frequent stretch breaks (every 45–60 minutes) help provide working muscles with an active recovery. Stretching helps relax tight muscles and improve flexibility and circulation. All of these are key in the prevention of injuries.

Additional information

For more information, refer to the following sections:

- "Risk Factors," page 11
- "General Prevention and Treatment," page 13

References

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Hand and arm injuries: Focal dystonia

What is it?

Focal dystonia is a syndrome that results in loss of motor control and prolonged, severe muscle cramping. It tends to affect musicians when they attempt to execute specific, highly repetitive, skilled movements on their instruments. Focal dystonia has been known to affect the hands and fingers of piano and guitar players, the embouchure of horn players, and the vocal cord muscles of vocalists. Focal dystonia is often referred to as *occupational cramp* or *musician's cramp.*

Signs and symptoms

Focal dystonia is characterized by loss of motor control in the hands or fingers, along with prolonged, intense contractions of the muscles that control the hands and fingers. Focal dystonia may or may not be accompanied by pain or discomfort similar to that experienced during normal muscle cramping. Focal dystonia is distinguished from normal muscle cramping in that:

- muscle fatigue is not a requirement for cramping to occur
- the dystonic response is task-specific

In fact, with focal dystonia cramping may be induced in response to beginning to play, or even thinking about playing, a specific piece of music.

What causes it?

The underlying cause of focal dystonia is unknown. However, there appears to be altered functioning of the central nervous system in musicians who experience it. This involves altered control signals from the motor cortex and altered sensory pathways at different levels of the nervous system while attempting to perform certain activities. Focal dystonia can be extremely task-specific. For example, a pianist who experiences finger dystonia while playing trills on a piano may not be able to reproduce the condition by attempting the same finger motions on a computer keyboard.

Treatment

Seek professional assistance if muscle cramping becomes frequent or is clearly associated with a specific activity or piece of music. If allowed to progress, focal dystonia can be a career-ending disorder. Treatment usually involves eliminating the specific activity that results in the cramping while using physical therapies to retrain sensory and motor control of the hand or fingers. Neuromuscular retraining has also been attempted using movement-awareness techniques such as the Feldenkrais Method and the Alexander Technique. Pharmacological interventions, including botulinum-toxin injections in the affected muscles, may be used to control focal dystonia. Physical fitness of the affected muscles is also encouraged.

Prevention

Pay attention to early indications of muscle cramping or fatigue while playing repetitive or complex music or drills. Standard preventive approaches include maintaining good physical fitness and balancing strenuous activity or demanding playing with rest.

Additional information

For more information, refer to the following sections:

- "Risk Factors," page 11
- "General Prevention and Treatment," page 13

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Joint injuries: Arthritis

Dancers have been reported to be more susceptible to joint injuries than non-dancers (van Dijk et al. 1995; Andersson et al. 1989). The most common of these joint injuries is arthritis. Long-term dancing has been shown to increase the risk of arthritis in all joints (van Dijk et al. 1995).

What is it?

Arthritis describes any inflammation of a joint or damage to the cartilage. Osteoarthritis, the most common type of arthritis, is characterized by degradation of the cartilage.

Signs and symptoms

Arthritis is characterized by pain in the joint and may be accompanied by swelling. Consult a physician as soon as possible if you suspect arthritis.

What causes it?

Osteoarthritis is thought to be caused by general wear and tear to the joint. Osteoarthritis can be categorized as primary, meaning that there is no known cause, or secondary, meaning it originates from an injury or developmental abnormality. Osteoarthritis often affects ballet dancers' hips, ankles, and feet, as these are the joints that sustain the most stress (Andersson et al. 1989; van Dijk et al. 1995; Smith, Ptacek, and Patterson 2000).

Treatment

The sooner arthritis treatment is initiated, the more successful the outcome in likely to be. Consult a physician as soon as you suspect arthritis or have unexplained joint pain.

Prevention

The key to preventing arthritis is to maintain healthy joints and nutrition throughout life. Get adequate rest between workouts and ensure that joint injuries such as sprains are properly treated.

Additional information

For more information, refer to the following sections:

- "Risk Factors," page 11
- "General Prevention and Treatment," page 13
- "Preventing Musculoskeletal Injury for Dancers," page 40
- "RICE Treatment Protocol (Rest, Ice, Compression, and Elevation)," page 44

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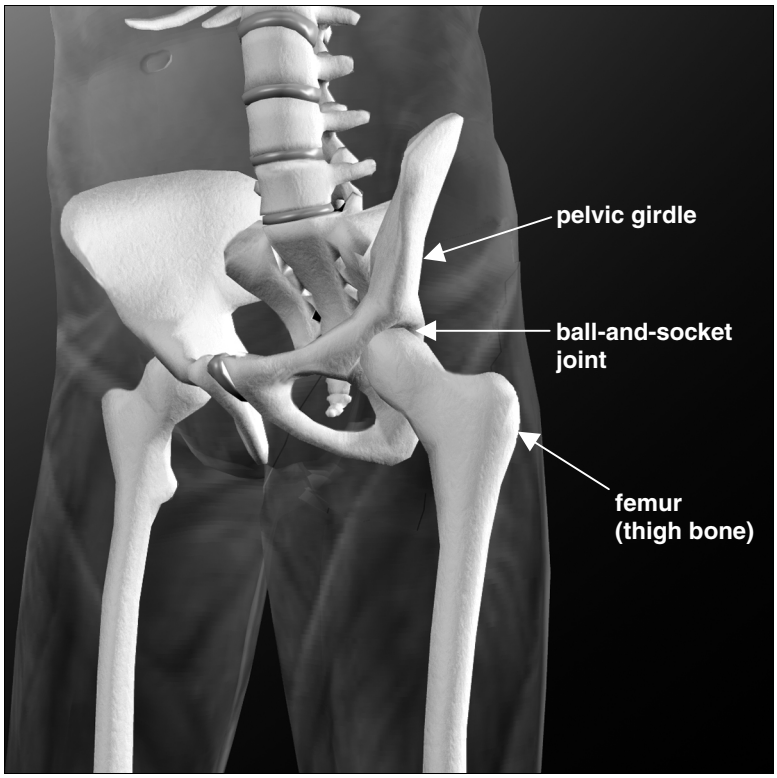
Hip injuries: Snapping hip syndrome (tight iliotibial band)

The hip is a ball-and-socket joint composed of the head of the thigh bone (femur) and a cavity in the hip bone (acetabulum). A layer of smooth cartilage covers both the head of the femur (ball) and the acetabulum (socket). The cartilage cushions the joint and allows the bones to move on each other with very little friction. An intricate structure of ligaments supports these bones.



The lower torso and upper legs, showing the ball-and-socket joint where the femoral head meets the acetabulum.

The ball-and-socket joint permits a wide range of motion in three planes:

- extension and flexion (moving the hip forward and backward)
- abduction and adduction (moving the hip side to side)
- internal and external rotation (moving the hip in a semicircle)

(Whiting and Zermick 1998)

Ten per cent of all ballet injuries involve the hip. This high percentage is due to the need of ballet dancers to perfect turnout, which is essential to good ballet technique. The most common hip injury is snapping hip syndrome, found in approximately 44% of reported cases of hip problems (Reid 1988).

What is it?

Snapping hip syndrome involves the iliotibial band, a long band of muscle-tendon that runs from the buttocks along the outside of the thigh and attaches outside the knee. Discomfort is noticeable when the iliotibial band rubs against a bone at the hip or the hip bursae (fluid-filled sacs).

Signs and symptoms

Discomfort and inflammation are noticeable at the knee or hip areas. The iliotibial band brushing over the bursae may cause a snapping sound during some movements such as walking (Reid et al. 1987).

What causes it?

Dancers may develop snapping hip syndrome as a result of a tight iliotibial band or tight buttocks muscles, which can often pull the iliotibial band too tight. This muscle tightness in the buttocks is a result of an imbalance in hip flexibility. In a 1987 study, Reid et al. found that dancers' abductors and external rotators were more flexible than their adductors. This imbalance is a result of many dancers' movements and techniques emphasizing turnout or the excessive use of the hip abductors and external rotators. A study by Kushner et al. in 1990 found that dancers frequently have less internal rotation and adduction of the hip than the normal athletic population. Further, ballet dancers commonly place their feet in a position where "rolling in," a position where the dancer rolls the foot over onto the inside of the ankle, can occur. This technique places undue stress on the iliotibial band as well.

Treatment

There are several effective techniques for alleviating the pain of snapping hip syndrome, including:

- deep massage over the outside of the thigh and buttocks muscles
- stretching
- icing

Prevention

The key to preventing snapping hip syndrome is a balanced stretching routine. Stretch both the abductors and adductors evenly. The abductors are the hip muscles that move the leg away from the midline of the body. The adductors are the hip muscles that bring the leg back to the midline of the body. In their 1987 study, Reid et al. recommended that ballet dancers include a structured iliotibial-band stretch as part of their warm-up and stretching routines.

Additional information

For more information, refer to the following sections:

- "Risk Factors," page 11
- "General Prevention and Treatment," page 13

- "Preventing Musculoskeletal Injury for Dancers," page 40
- "RICE Treatment Protocol (Rest, Ice, Compression, and Elevation)," page 44

References

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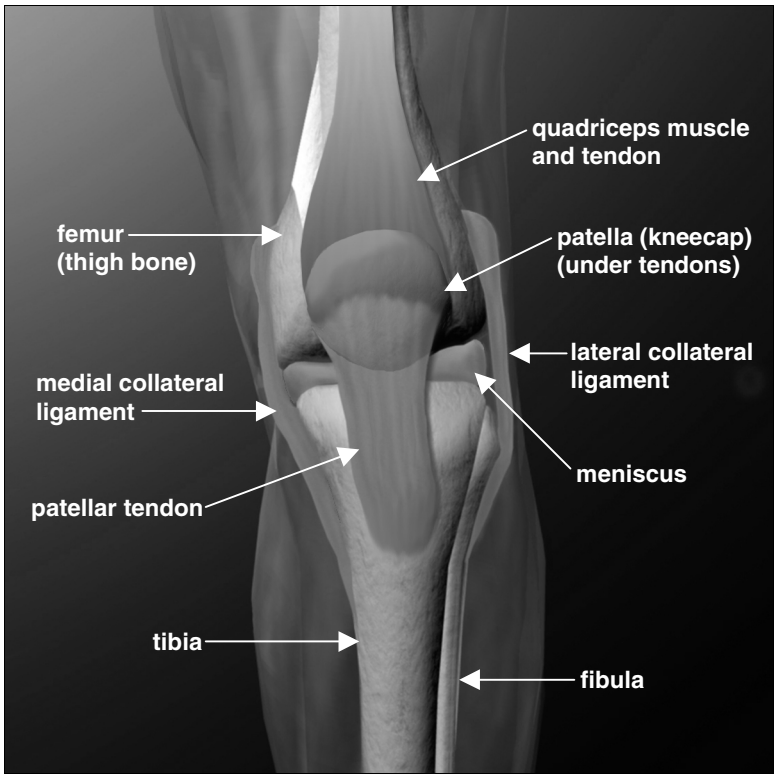
Knee injuries

Knee anatomy

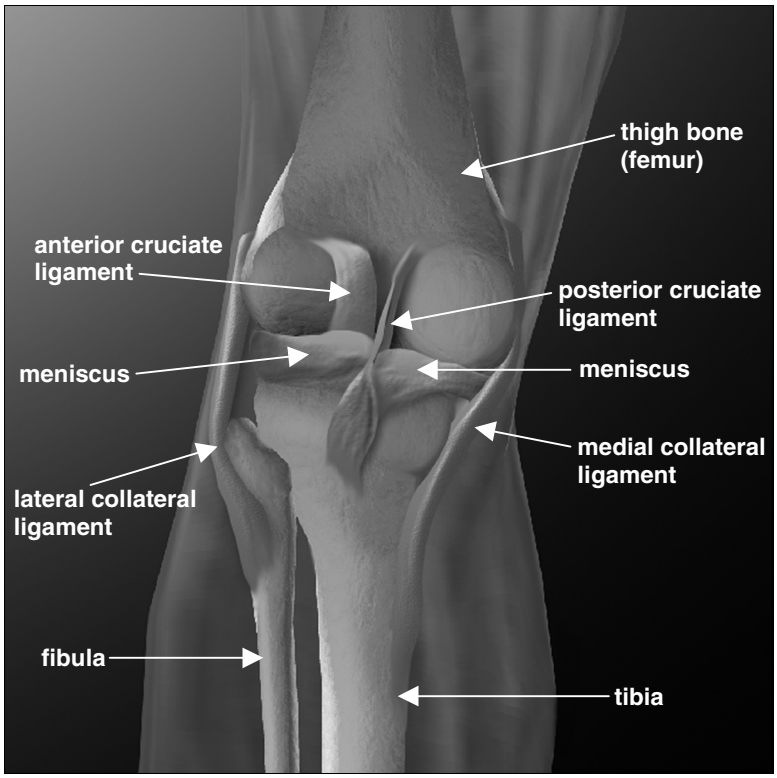
At the knee, the thigh bone (femur) meets the large lower leg bone (tibia) and the smaller lower leg bone (fibula). These bones are connected by ligaments (fibrous structures that connect bone to bone). Two ligaments are found on the sides of the knee: the medial collateral ligament on one side and the lateral collateral ligament on the other. In the middle of the knee, two more ligaments cross over to join the femur with the head of the tibia: the anterior cruciate ligament and the posterior cruciate ligament.

In between the femur and the tibia, articular cartilage and intra-articular fibrocartilaginous discs (menisci) help absorb shocks to the knee. Articular cartilage covers the ends of the bones to aid movement of the surfaces against each other. Articular cartilage is also found on the back of the kneecap (patella). The patellar tendon holds the kneecap in place and connects to the tibia and the quadriceps muscle group.



The left knee from the front, showing the ligaments and tendons that hold the joint together and provide stability.

The quadriceps muscles are the strong muscles in the front of the thigh. These muscles attach to the quadriceps tendon. When the quadriceps muscles contract, they straighten the knee joint (for example, rising from a squatting position). The hamstring muscles are the muscles in the back of the knee and thigh that bend the knee.



The left knee from the rear, with a clear view of the menisci, which help distribute weight from the femur to the tibia.

Knee injuries in dancers

Knee injuries account for 14–20% of all reported injuries among dancers (Koutedakis, Frischknecht, and Murthy 1997). More than half of these knee injuries are related to the patella (patellofemoral pain).

Male dancers have been reported to suffer more knee pain than female dancers. The reason for this trend may be the decreased flexibility males have in the hip external rotators (the muscles that swing the leg out and around). The result of this decreased flexibility is greater stress on the inside of the knee. Further, male dancers are known to perform large jumps more frequently, and complicated smaller jumps are combined with lifting their partners. All of these factors contribute to knee stress and the resulting pain. The key to preventing knee pain is to maintain healthy and strong leg muscles, including the muscles at the front and back of the leg.

References

Koutedakis, Y., R. Frischknecht, and M. Murthy. 1997. Knee flexion to extension peak torque ratios and low back injuries in highly active individuals. *International Journal of Sports Medicine* 18 (4): 290–295.

Knee injuries: Patellofemoral pain

What is it?

Patellofemoral pain is a common knee syndrome affecting the kneecap (patella) and surrounding area. Patellofemoral pain has various names, including:

- patellofemoral disorder
- runner's knee
- chondromalacia

The kneecap fits into grooves in the end of the femur called the femoral condyle. Repeated bending and straightening of the knee can irritate the inside surface of the kneecap and cause pain.

Signs and symptoms

The main symptom of patellofemoral pain is discomfort underneath the kneecap. This may be felt during walking, running, or sitting for long periods. Generally, the pain worsens while walking down stairs or downhill. Swelling may also be present in the knee at times, or snapping, popping, or grinding may be felt or heard.

What causes it?

In a 1995 study, Winslow and Yoder found a relationship between tight iliotibial bands and patellofemoral pain. The alignment of the hip to the knee and foot contributes to stress on the knee and iliotibial band. In ballet, two sets of hip muscles are extremely flexible (abductors and external rotators), contributing to an imbalance in muscle flexibility. This imbalance causes a tight iliotibial band, which results in the shin bone (tibia) becoming rotated, skewing the hip-knee-foot alignment. As a result, the patellar tendon is strained, causing uneven tracking of the patella. This uneven tracking results in the pain experienced underneath the kneecap.

Treatment

A combination of stretching and strengthening is required to ensure a proper recovery. Physical therapies are recommended to ensure that the appropriate exercises and stretches are prescribed for the severity of the injury. It is important to remember that the sooner the problem is identified, the sooner the dancer will be able to return to full form. If swelling is present at the time of injury, follow the RICE treatment protocol (rest, ice, compression, and elevation).

Prevention

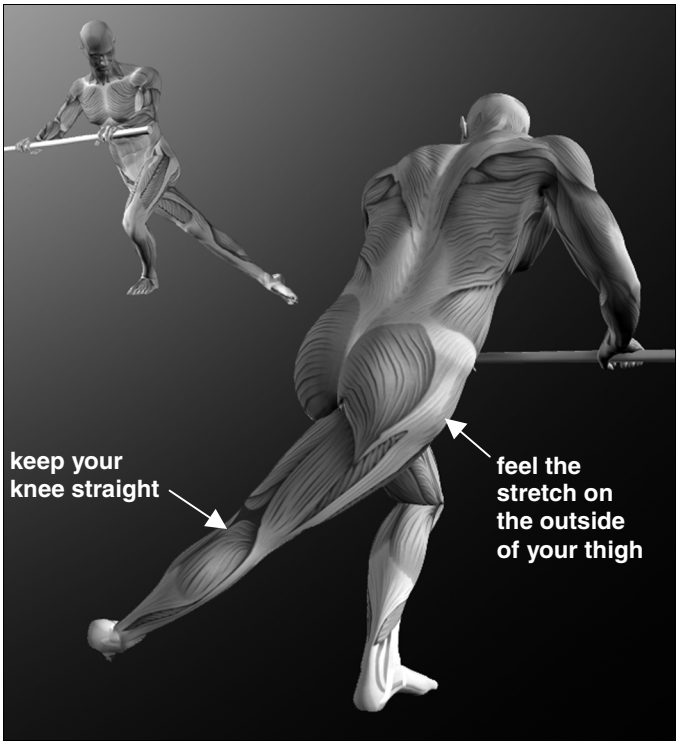
The best prevention for patellofemoral pain is to strengthen the thigh muscles, particularly the inside part of the muscle group. This is an important muscle group for dancers to strengthen, because dancers are known to have weaker inside-thigh muscles.

A balanced stretching routine is also key to ensure that the alignment of the hip-knee and ankle remains balanced.

Iliotibial band stretch

The following is an example of a stretch that can be performed for the iliotibial band:

1. Place your right leg behind your left leg.
2. Bend at the waist, leaning over a support such as a desk or counter.
3. As you bend your left knee, slide your right leg away from your body. Keep your right knee straight.
4. Bend your body toward your right leg. You should feel a stretch along the outside of your right thigh.



Additional information

For more information, refer to the following sections:

- "Risk Factors," page 11
- "General Prevention and Treatment," page 13
- "Preventing Musculoskeletal Injury for Dancers," page 40
- "RICE Treatment Protocol (Rest, Ice, Compression, and Elevation)," page 44

References

Koutedakis, Y., R. Frischknecht, and M. Murthy. 1997. Knee flexion to extension peak torque ratios and low back injuries in highly active individuals. *International Journal of Sports Medicine* 18 (4): 290–295.

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Winslow, J., and E. Yoder. 1995. Patellofemoral pain in female ballet dancers: Correlation with iliotibial band tightness and tibial external rotation. *Journal of Orthopoaedic and Sports Physical Therapy* 22:18–21.

Knee injuries: Knee sprains and strains

What is it?

A *knee sprain* is a common injury that occurs when one or more of the knee ligaments are stretched, torn, or completely ruptured. (Ligaments are strong non-elastic tissues that connect bone to bone.)

A *knee strain* occurs when knee tendons are overstretched or torn. (Tendons are elastic structures that connect muscle to bone.)

Signs and symptoms

Sprain or strain symptoms include:

- pain
- a popping sound or sensation at the knee
- swelling
- redness
- bruising
- limited or stiff range of movement

There may be a loss of strength or stability that results in the knee giving way when weight-bearing is attempted.

What causes it?

The knee is subject to large stresses and impact forces, which are particularly harmful if there is also rotation (twisting) or lateral (side-to-side) motion. Damage may occur as a result of forces created by the dancer (for example, a sudden sidestep or twist) or contact with another dancer (for example, a blow to the outside of the knee while the foot is planted on the ground).

Treatment

A knee sprain or strain may require surgery. Seek the guidance of a physician or specialist to ensure that the injury is diagnosed and treated correctly. The RICE treatment protocol (rest, ice, compression, and elevation) will help control inflammation and discomfort during the first two to three days. If weight-bearing causes noticeable discomfort, use crutches to help rest the injured area. The sooner the problem is identified, the sooner the dancer will be able to return to a normal routine.

Prevention

The most effective way to prevent knee injuries is to exercise and strengthen the muscles surrounding the knee (the quadriceps and hamstring muscles) to ensure joint stability and muscle balance. Always start any strengthening program gradually. At the first indication

of pain in the knee area, stop the exercise. Exercising too hard can seriously damage the knees.

References

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Reid, D. 1992. *Sports injury assessment and rehabilitation.* New York: Churchill Livingstone.

Villar, R. 1996. *Knee problems: A patient's guide to treatment and recovery.* Thorson's Health Series. London: Thorson Publishing.

Knee injuries: Meniscus tears

What is it?

A *meniscus* is a disc of cartilage that provides cushioning and lubrication between the bones at a joint, and assists in the distribution of forces between the bones on either side of the joint. At the knee, two half-moon-shaped discs of cartilage provide cushioning between the thigh bone (femur) and the large lower leg bone (tibia).

Signs and symptoms

Symptoms can vary depending on the size and location (medial or lateral) of the meniscus tear. Often, discomfort will be felt at the front or sides of the knee. Swelling and discomfort may occur after exercising. Motions that may aggravate the knee include squatting or bouncing up and down in a standing position.

The knee may also feel as if it is catching or locking and may not be able to straighten fully. Another common symptom is the knee giving way.

What causes it?

The meniscus may be injured when the knee is bent or twisted while bearing weight. Overuse can also cause a meniscus injury or degeneration. For example, repetitive squatting or kneeling can cause meniscus wear and make it more likely to tear. Meniscus tears often accompany knee ligament tears, most frequently the anterior cruciate ligament. Meniscus tears become more likely with age or compromised nutrition, as the cartilage becomes thinner and less resilient.

Treatment

If a meniscus tear is suspected, immediately stop exercise that affects the area, as exercise can cause permanent damage to the joint surface. Apply ice and compression to help manage swelling and discomfort until you are able to seek the guidance of a health-care professional. The most effective way to diagnose and treat a meniscus tear is arthroscopic surgery.

Arthroscopic surgery, usually day surgery, involves the placement of a small camera (about the size of a pencil) into the joint. This procedure allows not only accurate diagnosis of the injury, but also repair. Recovery time after the surgery varies with the individual and the severity of the injury. Some people can return to activity after a few days. As directed by a rehabilitation specialist, the return to activity usually begins with low-impact exercises such as swimming or biking.

Prevention

Strengthening the surrounding knee muscles (the quadriceps and hamstring muscles) helps take stress off the knee. Performing a proper warm-up and stretching before activity can also help prevent any type of knee injury, and help ensure both lubrication of the

joint and balanced muscle function during dance. Finally, orthotics or postural correction may be useful for some individuals to ensure that forces are properly distributed through the knee and that they do not generate undue stress at one location in the joint.

References

Garrett, J. 2000. *Knee pain: The self help guide*. San Francisco: New Harbinger Publishing.

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Back and neck injuries

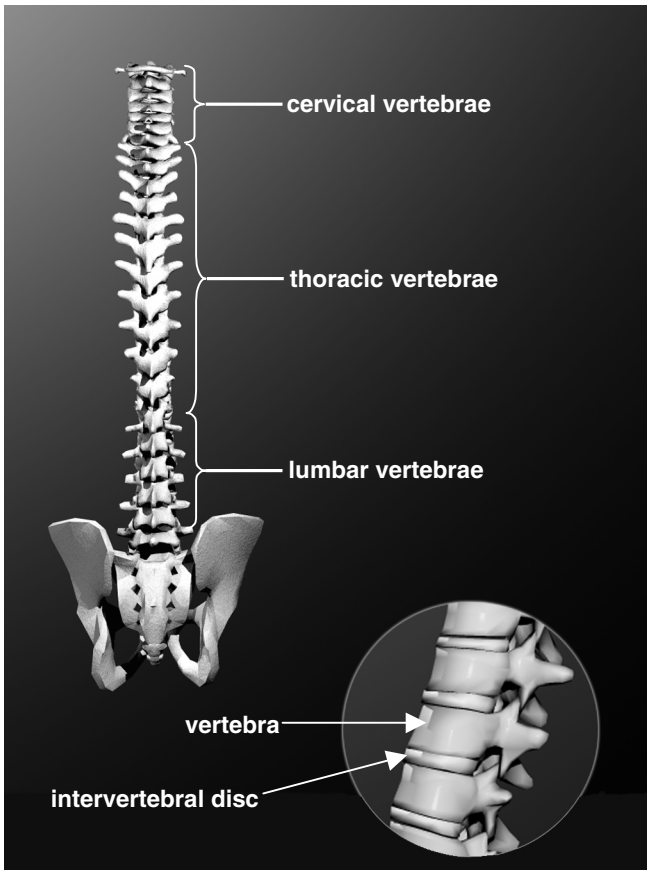
The back forms the structural core of the body, acting as an anchor point for muscles, tendons, and ligaments, as well as a pathway for nerves. The back is critical for the coordinated functioning and movement of the musculoskeletal system.

Spinal anatomy

The spine comprises a long column of vertebrae (small bones) stacked upon one another. Between each of these bones are small fluid-filled sacs called intervertebral discs. These discs are the spine's primary shock absorbers; it is important to ensure that they remain healthy. Each intervertebral disc consists of two parts: a hard, tough outer layer called the annulus, which surrounds a mushy, moist centre called the nucleus. The discs are primarily composed of water, and with age the water content decreases, reducing the disc's ability to provide protection.

The anatomy of the spine is usually described by dividing it into three major sections:

- The cervical (neck) section consists of seven cervical vertebrae.
- The thoracic (mid-back) section consists of twelve thoracic vertebrae.
- The lumbar spine (low back) section consists of five lumbar vertebrae. (Below the lumbar spine is a bone called the sacrum, which is part of the pelvis.)



The spine seen from the rear with a close-up side view of vertebrae and intervertebral discs.

The spine's natural curves are the result of the forces exerted by muscles, ligaments, and tendons that attach to the spinal vertebrae. Without these supporting structures, the spine would collapse. The supporting structures consist mainly of the abdominal (stomach) and back muscles. The abdominal muscles provide support by attaching to the ribs, pelvis, and, indirectly, the lumbar spine. The back muscles are arranged in three layers: deep, intermediate, and superficial. Each layer plays an important role in balancing the spine. Working together, these muscles achieve and maintain proper spinal alignment.

Back and neck injuries in performers

Back injuries may not be as common for dancers as other lower extremity injuries, but back injuries can be debilitating when they do occur. Dancers constantly strain the back muscles and bones because some dance movements require extreme postures and muscular effort. The back muscles are often strengthened unevenly, which can lead to misalignment or strains.

Musicians experience back and neck pain or injury because of the postural demands of playing their instruments and also because they must remain seated for prolonged periods in what are often poorly designed chairs. Back and neck posture are strongly influenced by the chosen instrument, which may require prolonged exposure to twisting or uneven muscle requirements between the right and left sides of the body. Stressing tissues on either side of the spine in ways that consistently differ between the right and left sides can lead to degenerative changes in the tissues and imbalances in the muscles.

Older dancers or musicians may develop osteoporosis. This condition involves a reduction in the density and strength of the back bones and is most commonly seen in female dancers. Both nutritional and hormonal status are important factors in preventing and controlling osteoporosis.

Another cause of low back pain is weak hamstring muscles (the muscle group at the back of the thigh). Dancers need strong quadriceps muscles (the muscles at the front of the thigh) to perform lifts and jumps, so they usually take time to strengthen the quadriceps accordingly. A common mistake among dancers is spending less time strengthening the hamstring muscle group, the muscles that oppose the quadriceps. Weak hamstrings can cause misalignment of the pelvis and low back.

Additional information

For more information, refer to the following sections:

- "Risk Factors," page 11
- "General Prevention and Treatment," page 13
- "Preventing Musculoskeletal Injury for Musicians," page 24
- "Preventing Musculoskeletal Injury for Dancers," page 40

Back and neck injuries: Spondylolysis

The most common back injury among dancers is spondylolysis.

What is it?

Spondylolysis is a stress fracture that occurs in one of the low back vertebrae, usually the fourth or fifth lumbar vertebra. The area of the vertebra called the pedicle is affected. The pedicle is the part of the bony ring that protects the spinal nerves and connects the vertebral body to the facet joints. With spondylolysis, the back part of the vertebra and the facet joints are only connected to the body by soft tissue (ligaments and muscles).

Signs and symptoms

In many people, spondylolysis is present without any obvious symptoms. The only symptom that the dancer will be able to feel is a pain that usually spreads across the low back and may feel like a muscle strain (Koutedakis, Frischknecht, and Murthy 1997). An X-ray is the only diagnostic tool that can be used to confirm spondylolysis.

What causes it?

A stress fracture can occur at the pedicle because of repetitive back extension and rotation movements that lead to an increase in shear forces in the lumbar spine. (Shear forces are the result of equal forces occurring in opposite directions.) Shear forces in the lumbar spine run side by side, pulling the tissue in between in each direction (Watkins 1999). As the shear forces increase, pressures on the facet joints increase. The shear forces are transmitted to the pedicle, which is unable to absorb repetitive shock, and a stress fracture results.

This commonly occurs among dancers who started dancing at a young age. Dance places a great deal of stress on the low back bones. The floors on which dancers perform are hard and do not absorb the forces that dancers exert on them (Bejjani 1987). Many dancers' shoes are not good shock absorbers. As a result, the low back absorbs the force and stress. This repetitive stress combines with the overstretching (extension) of the back that many dance movements require (Koutedakis, Frischknecht, and Murthy 1997). Overstretching of the back leads to an imbalance in the opposing muscle groups of the trunk and stomach. This imbalance prevents the low back from being loaded evenly. The net result on the back bones is cumulative, resulting in a stress fracture.

Treatment

Initial treatment for spondylolysis is always conservative (non-surgical). Consult a physical-therapies specialist for exercises designed to help stabilize the spine. The exercise regimen is a strengthening program concentrating on the back and abdominal muscles. As is the case with all injuries, early recognition of symptoms is key. The faster symptoms are recognized and treatment is sought, the quicker the body will heal.

Prevention

A balanced stretching program is key to maintaining a healthy spine. The back and abdominal muscles need to be strengthened in unison to ensure balance.

Dancers typically wear a slipper style of shoe that has little support or cushioning for absorbing shock. Dancers can help reduce the force exerted on their spines by wearing thicker-soled shoes or well-designed street shoes with low heels, arch supports, and cushioning. Further, dance studios can be designed (or redesigned) with sprung floors that absorb shock.

Additional information

For more information, refer to the following sections:

- "Risk Factors," page 11
- "General Prevention and Treatment," page 13
- "Preventing Musculoskeletal Injury for Dancers," page 40
- "RICE Treatment Protocol (Rest, Ice, Compression, and Elevation)," page 44
- "Lower Leg and Ankle Injuries: Shin Splints, Stress Fractures, and Stress Reactions," page 103

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Bejjani, F. J. 1987. Occupational biomechanics of athletes and dancers: A comparative approach. *Clinics in Podiatric Medicine and Surgery* 4 (3): 671–711.

Koutedakis, Y., R. Frischknecht, and M. Murthy. 1997. Knee flexion to extension peak torque ratios and low back injuries in highly active individuals. *International Journal of Sports Medicine* 18 (4): 290–295.

Watkins, J. 1999. *Structure and function of the musculoskeletal system*. Windsor, Ont.: Human Kinetics Publishing.

Back and neck injuries: Back and neck pain

Back or neck pain may occur for various reasons related to injury or irritation of the vertebrae, intervertebral discs, muscles, tendons, or ligaments. These injuries and irritations are common in the general population, but may also be related to the specific occupational activities of dancers and musicians.

What is it?

There are two categories of back and neck pain:

- mechanical pain
- nerve-related pain

Mechanical pain is due to localized inflammation that usually arises from injury or irritation of the back muscles, ligaments, facet joints, or intervertebral discs. Sprains and strains are mechanical pain injuries. Disc irritation is sometimes called discogenic pain.

Nerve-related pain is due to compression or irritation of nerve roots as they leave the spine's protection. Nerve-related pain may result from several sources of nerve-root compression, including the following:

- *Disc herniation* involves a bulge in the intervertebral disc that may place direct pressure on the nerve. In severe cases, the disc may rupture.
- *Segmental instability* or *vertebral subluxation* is a shifting in position of one vertebra relative to another, which results in pressure on the nerves above or below the vertebral level of the subluxation.
- *Spinal stenosis* is a narrowing of the canal through which the nerve passes. This narrowing may occur as a result of disc degeneration and the development of bone spurs.

Signs and symptoms

Back problems are typically characterized by localized tenderness and pain, but may also result in referred pain or numbness in the buttocks, groin, or legs. Similarly, neck problems may result in headaches or pain radiating into the shoulders or arms. Individuals may also experience muscle spasms or cramping as well as a reduced range of back or neck motion. In severe cases, loss of bowel and bladder control may occur, which requires immediate medical attention. Symptoms may include numbness, pain, or tingling in the extremities (legs or arms), with no pain in the back or neck. Careful attention to which activities increase or reduce pain and the exact location of symptoms can help clinicians determine the cause of the symptoms and the most appropriate course of treatment.

What causes it?

Various factors may cause back and neck pain, but back and neck pain are typically associated with overexertion or cumulative trauma involving repetitive or sustained awkward postures. General risk factors for back pain include:

- anatomical misalignment of the lower extremities
- imbalances in the leg muscles (the quadriceps and hamstrings)
- weakened abdominal muscles

Dancers are at risk of back pain as a result of faulty dance technique, repetitive awkward postures, and high forces required for throwing or catching partners.

Musicians are at risk of back pain for opposite reasons, since they are often required to sit for long periods. Some instruments require awkward neck, shoulder, and back postures that must be maintained throughout practice, rehearsal, or performance. Neck pain may be associated with postures that require support of the head while the neck is twisted, flexed, or extended, or with postures that require prolonged support of the arms above shoulder level. Psychological stress increases the likelihood of back and neck pain.

Treatment

Seek professional advice and treatment if symptoms involve numbness or pain in the extremities, loss of bowel or bladder control, or overly painful muscle spasms, or if symptoms persist or progressively worsen. Treatment typically involves physical therapies that vary according to the nature of the injury.

Movement awareness training (for example, the Alexander Technique, Feldenkrais Method, Pilates Method, yoga, or Tai Chi) and ongoing education regarding dance or instrument technique can help:

- alleviate postural imbalances
- identify problematic postures
- correct faulty technique that may contribute to aggravating back or neck injuries

Physical manipulation (chiropractic or physiotherapy) and massage therapy may assist with some conditions. Treatment of symptoms may involve the use of non-steroidal anti-inflammatory drugs, muscle relaxants, and modified activity. In severe cases such as a disc herniation, surgery may be advocated.

Prevention

A balanced exercise program is key to maintaining a healthy spine. The back, abdominal, leg, and arm muscles need to be strengthened in unison to ensure balance. Maintaining hamstring muscle flexibility has also been identified as important for low back health.

Dancers

Dancers typically wear a slipper style of shoe that has little support or cushioning for absorbing shock. Dancers can help reduce the force exerted on their spines by wearing thicker-soled shoes or well-designed street shoes with low heels, arch supports, and cushioning. Further, dance studios can be designed (or redesigned) with sprung floors

that absorb shock. Ongoing education regarding dance technique can help identify faulty biomechanical technique that may contribute to muscle imbalance and back pain.

Musicians

Musicians who must sit for prolonged periods during practice, rehearsal, or performance should take the time to establish and maintain a healthy seated posture. Support the feet and maintain a relatively straight back. Wedge cushions or lumbar support pads can help enhance the postural support provided by a chair.

Schedule regular, active breaks into practice, rehearsal, and performance to alleviate back and neck strain. Active breaks require the musician to stand up, walk, and possibly stretch.

Heavy lifting and carrying are well documented as presenting risk of back injury. Where required to lift or carry heavy instruments or equipment, reduce back strain by getting help from another person and using wheeled cases, trolleys, and dollies.

Additional information

For more information, refer to the following sections:

- "Risk Factors," page 11
- "General Prevention and Treatment," page 13
- "Preventing Musculoskeletal Injury for Dancers," page 40

References

Norris, R. 1993. *The musician's survival manual: A guide to preventing and treating injuries in instrumentalists.* St. Louis: MMB Music Inc.

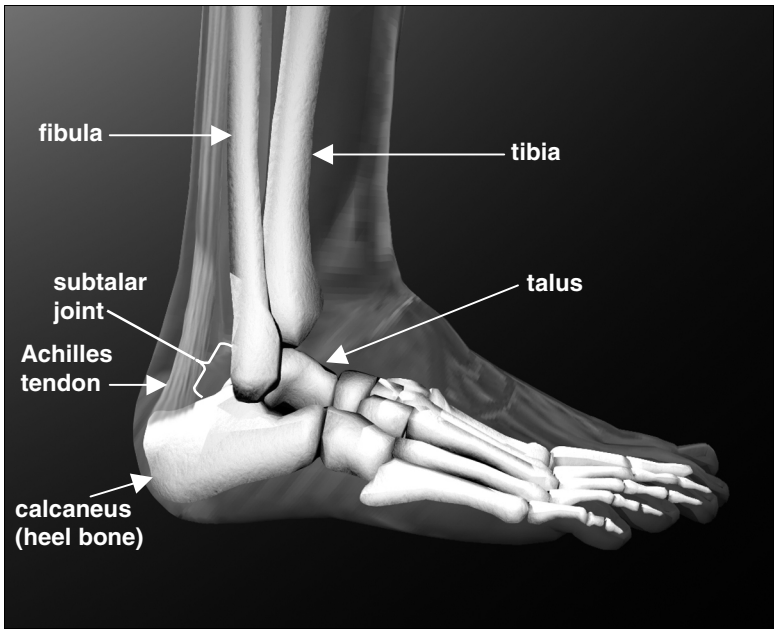
Lower leg and ankle injuries

Lower leg and ankle anatomy

The two lower leg bones, the tibia (the larger bone) and the fibula (the smaller bone), join the femur (thigh bone) at the knee.

At the lower end of the leg, what we normally think of as the ankle is made up of two joints: the ankle joint and the subtalar joint. The tibia and fibula join each other to form a deep socket that meets the talus (a foot bone). These three bones form a hinge joint — the ankle joint. The subtalar joint is formed by the talus and the calcaneus (heel bone). The ankle joint and subtalar joint allow the full range of motion in the foot. Many ligaments reinforce the ankle. (Ligaments are strong non-elastic tissues that connect bone to bone.)

The Achilles tendon is the most important tendon for walking, running, and jumping. (Tendons are elastic structures that connect muscle to bone). The Achilles tendon attaches the calf muscles to the calcaneus, allowing us to rise up on our toes (pointe or demi-pointe) — a common position for dancers. The tendon that runs toward the back of the ankle attaches one of the smaller calf muscles to the underside of the foot. This tendon helps support the arch and allows the foot to turn inward.



The right foot seen from the right side, showing the subtalar joint, formed by the talus and the calcaneus.

The common ankle movements are as follows:

- *Dorsiflexion* is movement of the top of the ankle and foot toward the front of the shin bone.
- *Plantar flexion* is movement of the ankle and foot away from the shin bone.
- *Eversion* is turning the ankle and foot outward, away from the midline of the body.
- *Inversion* is turning the ankle and foot inward, toward the midline of the body.

Ankle injuries in dancers

Because of the importance of the foot and ankle in dance, many studies have aimed to determine some common characteristics of dancers' ankle flexibility. In 1996, Wiesler et al. investigated flexibility patterns and how they related to reported injuries. They found the following:

- Modern dancers exhibited greater ankle inversion than ballet dancers.
- Right ankles were more flexible than left in females.
- Females had significantly greater dorsiflexion than plantar flexion.
- Dance that involved extreme and unpredictable movements was more likely to result in new injuries.
- Recurring or chronic injuries were common among dancers.

References

Wiesler, E., K. Hunter, D. Martin, W. Curl, and H. Hoen. 1996. Ankle flexibility and injury patterns in dancers. *American Journal of Sports Medicine* 24 (6): 754–757.

Lower leg and ankle injuries: Shin splints, stress fractures, and stress reactions

What is it?

Shin splints, stress fractures, and stress reactions are overuse injuries of the lower leg usually associated with forceful, repetitive activities such as running or jumping.

Shin splints involve pain at the front of the lower leg in the shin region. The pain is caused by an irritation of either the periosteum (the lining of the tibia, or shin bone) or the muscles and tendons in the area.

A *stress reaction* is defined by accelerated remodelling or resorption of bone.

A *stress fracture* is a small crack or cracks that occur as a result of repeated loading of the bone when muscles are fatigued. Fatigued muscles transfer more of the load to the bone.

Shin splints or stress reactions can progress to stress fractures if left untreated. Stress fractures can progress to complete bone fractures if left untreated.

Of 23 ballet dancers who were X-rayed, 19 showed signs of stress fractures or stress reactions; some dancers had both (Nussbaum, Treves, and Micheli 1988). The feet are the most common site of stress fractures in dancers, and the tibia is the most common place for stress reactions or shin splints.

Signs and symptoms

A common symptom of all three conditions is aching pain that may become more severe during activity. The pain tends to remain localized over the injury site and swelling often occurs directly over the site. Some stress fractures and stress reactions are asymptomatic. Only 10 of the 13 dancers with stress fractures and 6 of the 19 dancers with stress reactions reported symptoms (Nussbaum, Treves, and Micheli 1988).

The signs and symptoms for shin splints, stress fractures, and stress reactions are similar. It should be noted that tibia stress fractures are commonly misdiagnosed as shin splints (van Dijk et al. 1995). Seek medical advice to identify the cause of symptoms.

What causes it?

Intensive dance rehearsal and a high percentage of time dancing on pointe or demi-pointe increase the stress and pressure on the foot and tibia metatarsals, as well as the supporting muscles. As muscles become fatigued the dancer may have difficulty maintaining position, and the muscles transfer stress to other soft tissue and bone. When the bone is repeatedly stressed and has low bone mineral density levels, the trabeculae (lattice structural component of bone) receive micro-trauma, eventually resulting in stress fractures. Dancing on hard floors increases the risk of stress fractures and stress reactions.

Treatment

Treatment of shin splints may involve various techniques, which include:

- resting the area
- applying heat to enhance local circulation before activity
- applying ice and compression to control inflammation after activity
- physical therapies
- correcting any underlying postural distortions that may aggravate or contribute to the injury

With stress fractures, rest for the injured area is the only treatment that will allow the bone to heal. Applying ice may help reduce the pain and some of the swelling. A lack of pain does not mean that the bone has healed (many people do not report symptoms). Continue rehabilitation for at least eight weeks, regardless of symptoms.

When returning to activity, the dancer should not experience any pain. Restore full range of motion, strength, and balance before returning to a pre-injury workout schedule. If the dancer resumes activity too quickly, the stress fracture is more likely to progress to a complete bone fracture.

Prevention

Following these guidelines may help prevent shin splints, stress fractures, and stress reactions:

- Dancers should adopt new training schedules slowly. Changes in the amount and type of exercise are the most common causes of stress fractures.
- If dancers do excessive pointe or demi-pointe work one day, they should focus on other types of work during the next workout.
- Shoes should be well maintained (for more information, see “Foot and Toe Injuries,” page 117)
- A healthy diet including many calcium-rich foods helps build strong bones and promote healing to damaged areas.
- Early recognition of symptoms is important. Stop activity if pain or swelling occurs. If the pain persists after a few days rest, consult a sports-medicine physician.
- Sprung floors and other shock-absorbing materials should reduce the risk of stress fractures and stress reactions. Shock-absorbing insoles will also help reduce risk. Insoles may not be possible in dance shoes (particularly pointe shoes), but will help decrease the overall stress on bones if worn in street shoes.

Additional information

For more information, refer to the following sections:

- “Risk Factors,” page 11
- “General Prevention and Treatment,” page 13
- “Preventing Musculoskeletal Injury for Dancers,” page 40
- “RICE Treatment Protocol (Rest, Ice, Compression, and Elevation),” page 44

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Lower leg and ankle injuries: Ankle sprains

What is it?

Ankle sprains are the most common type of ankle injury for dancers. Ankle sprains involve the lateral (outside) structures of the ankle and occur when the ankle is inverted. The outside of the ankle comprises three ligaments:

- the anterior talofibular ligament
- the calcaneofibular ligament
- the posterior talofibular ligament

Ankle inversion injuries are common and usually affect the anterior talofibular ligament and the calcaneofibular ligament. The anterior talofibular ligament keeps the ankle from sliding forward. The calcaneofibular ligament keeps the ankle from rolling over on its side.

A sprain is the result of a ligament tear. The degree of tearing varies and can be divided into three grades for the ankle:

- Grade 1 is a stretching or partial tear of the anterior talofibular ligament.
- Grade 2 is a complete tear of the anterior talofibular ligament and some damage to the calcaneofibular ligament.
- Grade 3 is a complete tear of the anterior talofibular and calcaneofibular ligaments.

(Hardaker 1989)

Signs and symptoms

The dancer will experience swelling and pain in the area of the sprain. In many cases the swelling causes a loss of ankle movement. These symptoms may go away quickly, but the dancer may be left with a feeling of instability in the ankle region.

What causes it?

The injury mechanism is usually related to dancers landing jumps with their heels turned in (Quirk 1994). Dancers spend hours perfecting their jumps and technique, and three factors may contribute to an ankle sprain:

1. working close to the limits of strength
2. a slight loss of balance
3. a lapse in concentration

Treatment

As with any injury that involves inflammation, apply the RICE treatment protocol:

- Rest — Avoid using the ankle to prevent further damage.
- Ice — Apply ice or cold packs to the ankle for 15–20 minutes each hour to help reduce swelling.

- Compression — Wrap a tensor bandage around the ankle to help reduce swelling.
- Elevation — Elevate and support the ankle while resting to prevent blood from pooling and increasing swelling.

The severity of the ankle sprain will determine the required course of treatment:

- Grade 1 — Use taping or an air cast and maintain ice, compression, and elevation until the swelling has gone down. Three-point crutch walking may be necessary.
- Grade 2 — Significant swelling allows little treatment initially other than compression. With a decrease in swelling, tape the ankle or use an air cast.
- Grade 3 — Manage the injury using immobilization and surgical considerations.

(Hardaker 1989)

In all cases pursue physiotherapy to ensure that the dancer regains full range of motion and proprioception, as well as ankle stability.

Prevention

In many cases dancers suffer ankle sprains when they push themselves and their muscles to the limits. When this occurs, they may lose concentration or their muscles may not be able to maintain proper technique because of fatigue. The key to prevention is to rest the body adequately and take steps to prevent exhaustion, such as keeping hydrated. Use exercise to strengthen and balance supporting muscles.

Training with rocker boards and wobble boards

Rocker boards and wobble boards help improve balance, strength, and muscle memory and can be used to retrain injured muscles. A rocker board (illustrated at right) is a board with a pivot point in the centre, which allows the board to tilt on one axis. A wobble board is a flat disk resting on a half ball, which allows it to tilt on any axis.

Exercises involve balancing or moving in a controlled manner from side to side or front to back. As your balance and strength improve, you can progress to one-footed exercises, which are good for strengthening the ankles.

When rehabilitating an injury, start from a non-weight-bearing position (for example, sitting in a chair) before progressing to standing exercises.

Training with a rocker board can help improve balance, strength, and muscle memory.

Additional information

For more information, refer to the following sections:

- "Risk Factors," page 11
- "General Prevention and Treatment," page 13
- "Preventing Musculoskeletal Injury for Dancers," page 40
- "RICE Treatment Protocol (Rest, Ice, Compression, and Elevation)," page 44

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Wiesler, E., K. Hunter, D. Martin, W. Curl, and H. Hoen. 1996. Ankle flexibility and injury patterns in dancers. *American Journal of Sports Medicine* 24 (6): 754–757.

Lower leg and ankle injuries: Posterior impingement syndrome (dancer's heel)

What is it?

Posterior impingement syndrome, commonly known as *dancer's heel,* involves compression of soft tissues at the back of the ankle. A bony-formation bump behind the ankle causes the compression.

Signs and symptoms

The dancer feels discomfort at the back of the ankle when the toe is pointed. The pain is aggravated by relevé and relieved somewhat by the plantigrade stand (Hardaker 1989). Examination reveals tenderness behind the ankle joint. It is important to seek the advice of a doctor or physiotherapist to ensure that the problem is correctly identified and treated.

What causes it?

Dancer's heel is a common injury that is sometimes seen in sports but most commonly in ballet. Dancer's heel occurs when the dancer forces plantar flexion or pointing the toes downward. Standing frequently in the point or demi-pointe position contributes to the likelihood of this injury occurring (Quirk 1994).

Treatment

Initial treatment for dancer's heel is always non-surgical. Seek physiotherapy and follow the recommended exercises and prescriptions. In some cases health-care professionals may recommend steroid injections or anti-inflammatory medication.

If non-surgical treatment does not help alleviate the discomfort, surgical intervention will be required to remove the bump that is compressing the soft tissue. As a result, the dancer will be on crutches for 10–14 days and usually can resume dance class about 6 weeks after surgery (Quirk 1994).

Prevention

Following a rehabilitation plan outlined by a rehabilitation specialist can prevent reinjury. Do not return to activity before the injury is healed completely and follow directions carefully when returning.

Additional information

For more information, refer to the following sections:

- "Risk Factors," page 11
- "General Prevention and Treatment," page 13
- "Preventing Musculoskeletal Injury for Dancers," page 40
- "RICE Treatment Protocol (Rest, Ice, Compression, and Elevation)," page 44

References

Hardaker, W. 1989. Foot and ankle injuries in classical ballet dancers. *Orthopaedic Clinics of North America* 20 (4): 621–627.

Quirk, R. 1994. Common foot and ankle injuries in dance. *Orthopedic Clinics of North America* 25 (1): 123–132.

Lower leg and ankle injuries: Anterior impingement syndrome

What is it?

Anterior impingement syndrome is similar to posterior impingement syndrome, except it involves the top of the ankle where the shin bone meets the ankle (Hardaker 1989). A bump forms and compresses the soft tissue at the front of the ankle.

Signs and symptoms

The first sign is a loss of depth in the dancer's pliés. This is often accompanied by ankle pain that cannot be localized to one area (Hardaker 1989). Over time the dancer will be able to localize the pain to the top of the ankle, where swelling may be present. Upon further examination there will be tenderness in the area as well.

What causes it?

Demi-pliés can produce direct contact between the tibia and the talus. With repeated contact, a bony formation that compresses the soft tissue can occur (Hardaker 1989). Some people may be more susceptible than others, depending on their anatomy.

Treatment

Early recognition of symptoms is extremely important because **anterior impingement syndrome is not reversible.** To help improve symptoms, the dancer may want to:

- perform in street shoes
- use half-inch heel lifts
- take anti-inflammatory medication
- discontinue the forced plié

(Hardaker 1989)

Consult a doctor early in the treatment course to help keep symptoms to a minimum. With advanced cases, surgery is usually pursued. It is important to note that surgery inevitably leads to a recurrence of the bone formation in approximately three to four years (Hardaker 1989).

Prevention

The literature provides no useful prevention techniques. Early recognition of signs and symptoms may prevent more serious symptoms from developing.

Additional information

For more information, refer to the following sections:

- "Risk Factors," page 11
- "General Prevention and Treatment," page 13

- "Preventing Musculoskeletal Injury for Dancers," page 40
- "RICE Treatment Protocol (Rest, Ice, Compression, and Elevation)," page 44

References

Hardaker, W. 1989. Foot and ankle injuries in classical ballet dancers. *Orthopaedic Clinics of North America* 20 (4): 621–627.

Quirk, R. 1994. Common foot and ankle injuries in dance. *Orthopedic Clinics of North America* 25 (1): 123–132.

Lower leg and ankle injuries: Achilles tendinitis

What causes it?

Achilles tendinitis is inflammation of the large tendon at the back of the leg that attaches the calf muscles to the back of the heel bone. Under too much stress, the Achilles tendon tightens and is forced to work too hard. This causes it to become inflamed and, over time, can produce a covering of scar tissue, which is less flexible than the tendon. If stresses continue on the inflamed Achilles tendon, it can tear or rupture.

In ballet, Achilles tendinitis occurs most commonly when female dancers tie their ankle ribbons too tightly. The ribbon knot presses against the Achilles tendon, resulting in unnecessary tendon tightness (Quirk 1994). Other contributing factors may include:

- hard floors
- tight heel cords
- rolling in
- an inability to obtain full height in relevé

(Hardaker 1989)

Signs and symptoms

Pain is localized in the area surrounding the Achilles tendon (toward the back of the foot). The dancer may notice pain when performing pliés or landing jumps (Hardaker 1989). Upon closer examination, a thickening of the tendon and some irregularity in the tissues surrounding the tendon may be felt (Quirk 1994).

Treatment

Conservative treatment (physiotherapy) is usually effective enough to decrease the tendon inflammation. As with any injury that involves inflammation, apply the RICE treatment protocol:

- Rest — Avoid using the ankle to prevent further damage.
- Ice — Apply ice or cold packs to the ankle for 15–20 minutes each hour to help reduce swelling.
- Compression — Wrap a tensor bandage around the ankle to help reduce swelling.
- Elevation — Elevate and support the ankle while resting to prevent blood from pooling and increasing swelling.

Performing a structured stretching program in conjunction with strengthening exercise is an effective way to treat Achilles tendinitis. Start and follow such treatment under the direction of a rehabilitation professional.

Prevention

To decrease the likelihood of developing Achilles tendinitis, female ballet dancers should be conscious of how their shoes are tied, ensuring that the ribbons around the ankles are

not tied so tightly as to impinge the tendon. Further, maintaining a balanced stretching and strengthening program will help decrease the likelihood of other risk factors, such as rolling in on the ankle, from occurring.

Additional information

For more information, refer to the following sections:

- "Risk Factors," page 11
- "General Prevention and Treatment," page 13
- "Preventing Musculoskeletal Injury for Dancers," page 40
- "RICE Treatment Protocol (Rest, Ice, Compression, and Elevation)," page 44

References

Hardaker, W. 1989. Foot and ankle injuries in classical ballet dancers. *Orthopaedic Clinics of North America* 20 (4): 621–627.

Quirk, R. 1994. Common foot and ankle injuries in dance. *Orthopedic Clinics of North America* 25 (1): 123–132.

Lower leg and ankle injuries: Subtalar subluxation

What is it?

A *subluxation* is a minor dislocation. *Subtalar subluxation* occurs in the ankle, just below the talus (the bone that, with the shin bones, forms the ankle — see the illustration on page 101). The talus and the adjoining bones are slightly displaced from their normal position. The joint surfaces still touch, but not in normal relation to one other.

Signs and symptoms

The dancer will notice pain in the area of the heel and the mid-foot. In some cases, dancers describe a strange sensation of forward shifting of the painful foot (Menetry and Fritschy 1999). Immediately after a subtalar subluxation, dancing is no longer possible and walking may also be difficult. Sharp pain may accompany these signs.

What causes it?

In a 1999 study, Menetry and Fritschy found that all the subtalar subluxations in their study occurred after a grand plié on pointe or at the landing of a jump on demi-pointe. Further, all occurred without any of the mechanisms of an ankle sprain.

When the dancer performs the two movements described above, muscles in one direction are activated and, as the foot lands, an opposite set of muscles is activated to ensure that balance is maintained and the foot is stabilized. The result is a force that separates the bones.

Treatment

Seek treatment for a subtalar subluxation immediately after the sensation described above in “Signs and Symptoms” occurs. Treatment involves manipulation of the ankle to put it back into place (Menetry and Fritschy 1999). Only medical professionals should perform such manipulation, as the consequences of treatment by a non-professional can be detrimental to a dancer’s career. The dancer can usually resume dancing within a few weeks following taping and rehabilitation.

Prevention

In many cases subtalar subluxation, like many other injuries, occurs when dancers push themselves and their muscles to the limits. When this occurs, they may lose concentration or their muscles may not be able to maintain proper technique because of fatigue. The key to prevention is to rest the body adequately and take steps to prevent exhaustion, such as keeping hydrated. Further, a balanced stretching and strengthening program will help keep the ankle stable and flexible.

Additional information

For more information, refer to the following sections:

- "Risk Factors," page 11
- "General Prevention and Treatment," page 13
- "Preventing Musculoskeletal Injury for Dancers," page 40
- "RICE Treatment Protocol (Rest, Ice, Compression, and Elevation)," page 44

References

Menetry, J., and D. Fritschy. 1999. Subtalar subluxation in ballet dancers. *American Journal of Sports Medicine* 27 (2): 143–149.

Watkins, J. 1999. *Structure and function of the musculoskeletal system*. Windsor, Ont.: Human Kinetics Publishing.

Foot and toe injuries

The majority of dance injuries are foot injuries (Garrick and Requa 1993; Hamilton 1993; Harrington, Crichton, and Anderson 1993; Richardson and Graves 1992). Dance postures and the repetitive, acute stress on the foot account for the high incidence of injury (Schon 1993; Hamilton 1988; Hardaker 1989; Marshall 1988). Although they may seem localized, many foot injuries are often related to other factors (Schon 1993).

Injury factors

Factors that contribute to the high incidence of foot injuries in dancers include:

- repetitive impact on the dance floor
- narrow ballet slippers with poor support
- dancing on pointe or demi-pointe
- repetitive pliés
- weak posterior tibial tendons
- tight heel cords
- forced turnout
- second-toe lengths
- technique

(Hardaker 1989; Miller et al. 1990; Quirk 1994; Ogilvie-Harris, Carr, and Fleming 1995; Schon 1993)

Foot injury rehabilitation is particularly difficult for dancers because they cannot avoid most of the injury causes. Dancers must be aware of risks and try to control as many aspects as possible. When not dancing, dancers must properly care for their feet.

Footwear and metatarsal injuries

Several studies have implicated the ballet slipper (ballet shoe) as a source of injury (Miller et al. 1990; Marshall and Hamilton 1992; Tuckman et al. 1992; Bowling 1989). The footwear used for ballet dancing (and related forms of dance) leaves the foot unprotected. When the dancer jumps, the feet go through a rising motion from a flat foot to a fully flexed, or pointed, foot. This motion places all the stress or pressure of the body on the metatarsals. When the dancer lands, the toes land first, then the metatarsals, then the heel; again, a majority of pressure is transferred to the metatarsals (Miller et al. 1990). This large amount of pressure on the metatarsals is one reason that so many dancers suffer metatarsal injuries.

Dancers suffer two main metatarsal injuries: stress fractures of the second metatarsal and fractures of the fifth metatarsal (Miller et al. 1990; O'Malley, Hamilton, and Munyak 1996a; O'Malley et al. 1996b; Hardaker 1989; Quirk 1994; Harrington, Crichton, and Anderson 1993). Both are described in more detail in the following "Foot and Toe Injuries" sections, pages 118–122.

References

See the reference list on pages 119–120.

Foot and toe injuries: Stress fractures of the second metatarsal

Stress fractures are commonly reported in dancers, and the second metatarsal is the most common location (O'Malley, Hamilton, and Munyak 1996a; O'Malley et al. 1996b).

What is it?

Stress fractures are spontaneous fractures of normal bone that result from high stresses applied to the bone (DeLee 1993). These fractures frequently occur after rigorous, repetitive training. Stress fractures are described in more detail in "Lower Leg and Ankle Injuries: Shin Splints, Stress Fractures, and Stress Reactions," page 103.

Signs and symptoms

Aching pain that becomes more severe during activity is a common symptom. The pain tends to remain localized over the fracture site, and swelling often occurs directly over the site. Some stress fractures and stress reactions are asymptomatic.

What causes it?

Intensive dance rehearsal and a high percentage of time dancing on pointe or demi-pointe increase stress and pressure on the metatarsals (O'Malley et al. 1996b; DeLee 1993; Hamilton 1993). As muscles become fatigued the dancer may have difficulty maintaining position, and the muscles transfer stress to other soft tissue and bone. When bone is repeatedly stressed (for example, in jumping), it becomes prone to stress fractures.

Risks that have been shown to be significant for stress fractures of the second metatarsal are:

- amenorrhea
- anorexia nervosa
- pes cavus (cavus foot)
- anterior ankle impingement
- a shorter big toe

(O'Malley et al. 1996b; Tuckman et al. 1992; Ogilvie-Harris, Carr, and Fleming 1995)

When the big toe is shorter than the second toe, more pressure is placed on the second toe. The second toe is not as strong as the big toe, and a longer second toe contributes to the risk of a stress fracture of the second metatarsal (O'Malley et al. 1996b; Miller et al. 1990; Ogilvie-Harris, Carr, and Fleming 1995).

Treatment

Resting the injured area is the only treatment that will allow the bone to heal. Applying ice may also help reduce pain and some swelling. A lack of pain does not mean that the bone has healed (many people do not report symptoms). Continue rehabilitation for at least eight weeks.

When returning to activity, the dancer should not experience any pain. Restore full range of motion, strength, and balance before returning to a pre-injury workout schedule. If the dancer resumes activity too quickly, the stress fracture is more likely to progress to a complete bone fracture.

Prevention

Following these guidelines may help prevent stress fractures of the second metatarsal:

- Dancers should adopt new training schedules slowly. Changes in the amount and type of exercise are the most common causes of stress fractures.
- If dancers do excessive pointe or demi-pointe work one day, they should focus on other types of work during the next workout.
- Shoes should be well maintained (for more information, see "Foot and Toe Injuries," page 117).
- A healthy diet including many calcium-rich foods helps build strong bones and promote healing to damaged areas.
- Early recognition of symptoms is important. Stop activity if pain or swelling occurs. If the pain persists after a few days rest, consult a sports-medicine physician.
- Sprung floors and other shock-absorbing materials should reduce the risk of stress fractures and stress reactions. Shock-absorbing insoles will also help reduce risk. Insoles may not be possible in dance shoes (particularly pointe shoes), but will help decrease the overall stress on bones if worn in street shoes.

Additional information

For more information, refer to the following sections:

- "Risk Factors," page 11
- "General Prevention and Treatment," page 13
- "Preventing Musculoskeletal Injury for Dancers," page 40
- "RICE Treatment Protocol (Rest, Ice, Compression, and Elevation)," page 44

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Foot and toe injuries: Fractures of the fifth metatarsal (dancer's fracture)

A *fracture of the fifth metatarsal* (the little toe metatarsal) is commonly known as a *dancer's fracture* because of the high frequency of this injury in dancers (O'Malley, Hamilton, and Munyak 1996a; O'Malley et al. 1996b; Quirk 1994).

What is it?

Dancer's fracture is an acute injury in which, unlike a stress fracture, the bone breaks. A spiral break in the fifth metatarsal initiates at the lateral (outside) edge of the distal aspect (the end) of the bone. The fracture spirals around the bone, moving medially (toward the inside of the metatarsal) and proximally (toward the rest of the foot) (O'Malley, Hamilton, and Munyak 1996a). The end result is a complete fracture of the bone; the bone appears as if it has been cut on the diagonal.

Signs and symptoms

Dancer's fracture is associated with:

- acute inflammation
- pain
- swelling
- redness or bruising
- heat

Dancers usually know when they have sustained a fracture, and it has been shown that the majority of dancers report to a physician within 24 hours of injury (O'Malley, Hamilton, and Munyak 1996a).

What causes it?

Orthopaedic surgeons have completed the majority of research on dancer's fracture. Most of the surgeons agree that the fracture is caused by significant stress on the bone and pushing the dancer to anatomical or physical limits. Ankle instability is thought to be a major risk factor because the injury occurs when the ankle is inverted and the dancer is in a demi-pointe position (Hamilton et al. 1992; Harrington, Crichton, and Anderson 1993; O'Malley, Hamilton, and Munyak 1996a; O'Malley et al. 1996b). However, most research has focused on injury treatment rather than cause. The surgeons report that any significant displacement (i.e., the position of the broken bone) should be reduced (fixed) for the dancer (DeLee 1993; Heim and Pfeiffer 1988; Richardson and Graves 1992). Thus, when the bone is broken the dancer should avoid pointing the toe.

Treatment

Several experiments have investigated different methods of reducing dancer's fracture (Hamilton et al. 1992; Harrington, Crichton, and Anderson 1993; O'Malley, Hamilton, and Munyak 1996a; O'Malley et al. 1996b). All methods require the involvement of a

sports-medicine physician, an orthopaedic surgeon, or both. A health-care professional must assess each case to determine appropriate treatment.

Prevention

Because there is little research outlining the risk factors, it is difficult to know how to prevent dancer's fracture. Since ankle instability is thought to be one factor, dancers should strengthen their ankles (see "Training with Rocker Boards and Wobble Boards," page 107). Dancers who are fatigued should get adequate rest to avoid undue stress on the soft tissue and bone of the foot.

Additional information

For more information, refer to the following sections:

- "Risk Factors," page 11
- "General Prevention and Treatment," page 13
- "Preventing Musculoskeletal Injury for Dancers," page 40
- "RICE Treatment Protocol (Rest, Ice, Compression, and Elevation)," page 44

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Foot and toe injuries: Cuboid subluxation

What is it?

Cuboid subluxation is a dislocation of the calcaneocuboid portion of the mid-tarsal joint. In other words, the mid-foot bone moves out of proper alignment. Other terms used to describe cuboid subluxation are:

- cuboid fault syndrome
- dropped cuboid
- locked cuboid
- subluxed cuboid

(Wywiorski; Blakeslee and Morris 1987)

Signs and symptoms

Pain in the side of the mid-foot and weakness during the push-off of walking are common symptoms. The pain may radiate or travel to the bottom of the foot arch, or to the front portion of the ankle. Jumping movements are usually associated with severe acute pain until the bone is returned to its natural position. In extreme cases, the dancer or a health-care professional may be able to see a depression in the top of the foot and a lump in the bottom (Wywiorski).

What causes it?

When the dancer pronates (rolls inward) the foot, the risk of cuboid subluxation increases (Blakeslee and Morris 1987; Omey and Micheli 1999). In a 1992 study, Marshall and Hamilton reported that pronating the foot may be a risk factor, but it is not necessarily the only cause for dancers. Extreme stress or pulling in the muscles, particularly the peroneus longus muscle, pulls the outside of the cuboid bone to the top of the foot, forcing the inside portion of the bone to move out of alignment toward the bottom of the foot. In other words, the bone rotates in the foot. The muscle becomes very tight when the bone is subluxed and sometimes seizes (Newell and Woodie 1981; Marshall and Hamilton 1992; Wywiorski).

Male and female dancers tend to suffer cuboid subluxation from different causes (Marshall and Hamilton 1992; MacIntyre and Joy 2000). In males, the injury is usually acute and caused by frequent jumps in which the foot is continually stressed in a pronated position. In females, the injury is more often a chronic overuse injury, possibly caused by frequent relevés (Marshall and Hamilton 1992; Wywiorski; Blakeslee and Morris 1987). For both males and females, the foot hypermobility that dance requires is thought to be a major risk factor.

Treatment

There are three key areas in the treatment of cuboid subluxation:

- proper diagnosis
- proper reduction
- proper maintenance

(Marshall and Hamilton 1992; Blakeslee and Morris 1987; Wywiorski)

Many dancers have been reported to self-treat cuboid subluxation by jamming the bottom of the foot on a raised surface in an effort to realign the bone (Marshall and Hamilton 1992). While this method may work in the short term, it often results in a recurring injury. Dancers with this problem should consult a physician.

Prevention

Follow these guidelines to prevent the onset or return of cuboid subluxation:

- Dancers should not perform any rigorous activity, particularly jumping, for two days after the bone has been realigned.
- A professional who is familiar with the proper technique can strap a pad onto the bottom of the foot, inside the shoe, to provide additional support.

(Wywiorski; MacIntyre and Joy 2000; Marshall and Hamilton 1992; Blakeslee and Morris 1987; Omey and Micheli 1999)

Additional information

For more information, refer to the following sections:

- "Risk Factors," page 11
- "General Prevention and Treatment," page 13
- "Preventing Musculoskeletal Injury for Dancers," page 40
- "RICE Treatment Protocol (Rest, Ice, Compression, and Elevation)," page 44

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Foot and toe injuries: Flexor hallucis longus tendinitis

What is it?

The flexor hallucis longus muscle passes along the bottom of the foot and works to flex the big toe to a pointed position. Dancers frequently injure the tendon of this muscle (the tendon attaches the muscle to the bone). Dance is considered to be a predisposing factor for flexor hallucis longus tendinitis, as non-dancers are rarely affected (Sammarco and Cooper 1998; Hamilton 1982).

Signs and symptoms

Symptoms of flexor hallucis longus tendinitis include pain (generally worse on initiation of movement) and possibly localized swelling. Dancers often experience this pain when jumping or when in plié in the fifth position, tendu, or relevé (Sammarco and Cooper 1998). When the injured tendon is palpated there is localized tenderness.

What causes it?

The movement from a flat foot to the demi-pointe position, in which the dancer maintains the body weight high on the ball of the foot, appears to cause stretching and friction in the tendon and tendon sheath, causing tendinitis or tenosynovitis.

Treatment

A physician or specialist should coordinate treatment. If anatomical abnormalities or poor technique cause the injury, the health-care professional will have to develop a specialized treatment program for the dancer. Additionally, flexibility exercises that focus on the bottom of the foot have been shown to have some positive effect in dancers suffering from flexor hallucis longus tendinitis (Sammarco and Cooper 1998). In some cases, surgery to release the tendon is required.

In general, the RICE treatment protocol (rest, ice, compression, and elevation) can help minor tendinitis. This is because tendinitis is an inflammatory injury, and using such methods to decrease inflammation will decrease the severity of the injury.

Prevention

In general, tendinitis can be prevented by ensuring that muscles and tendons are always adequately warmed up before strenuous activity. Stretching the bottom of the foot and ensuring adequate rest between workouts may also help decrease injury risk.

Additional information

For more information, refer to the following sections:

- "Risk Factors," page 11
- "General Prevention and Treatment," page 13

- "Preventing Musculoskeletal Injury for Dancers," page 40
- "RICE Treatment Protocol (Rest, Ice, Compression, and Elevation)," page 44

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Foot and toe injuries: Blisters

Almost all dancers (and people in general) suffer from blisters at some point in their lives. Blisters can be particularly damaging for dancers because they have to spend a lot of time wearing the shoes or carrying out the actions that cause blisters. As a result, the blisters never have a chance to heal, and the affected area may become infected.

What is it?

A *blister* is an elevation, generally filled with a watery liquid, in the top layer of the skin.

Signs and symptoms

Most people know when they have blisters. Blisters are generally raised patches of skin that are painful when pressure or friction is applied. When a blister breaks open, liquid is often released and raw skin is exposed. When the raw skin is exposed, the blister becomes more painful and the risk of infection increases.

What causes it?

Blisters are caused by friction — the rubbing and heat between the skin and the ballet slipper. Blisters are localized to the high friction spot on the foot.

Treatment

Take care of blisters to ensure that they do not lead to infection. Most dancers probably have a regimen for dealing with blisters. If the regimen is successful, do not change it.

In general, keep blisters clean. Do not pop small blisters; protect them so they do not grow larger. A doughnut-shaped piece of moleskin around the blister may help remove the friction from the blister. If the moleskin causes other problems, stop using it.

Draining blisters

It is best to drain large blisters (i.e., blisters that are an inch in diameter or larger). To drain a blister, follow these guidelines:

1. Drain the blister carefully, using clean equipment (i.e., a needle sterilized in alcohol).
2. Clean the area and flatten the layer of skin.
3. Apply an antibiotic ointment (do not use alcohol or iodine) and a bandage.
4. Do not peel off the skin until it has hardened and the area underneath looks healed.
5. If the blister becomes infected, see a physician.

Prevention

Follow these guidelines to prevent blisters:

- Lubricate areas that commonly blister. Petroleum jelly or talcum powder can help reduce the friction that causes blisters.
- Wear properly fitting shoes (not too tight or too loose) on and off the dance floor.
- Toughen the skin. Do not remove calluses; they help prevent blisters. Anecdotal evidence suggests that soaking the feet in strongly brewed tea or applying a tincture of benzoin helps toughen the skin on the feet.

Foot and toe injuries: Bunions

What is it?

Bunions are common in dancers. A *bunion (hallux abducto valgus)* is an enlargement of the joint at the base of the big toe that develops when the big toe bends toward the second toe. This bend results in a bump that protrudes from the joint and a big toe that tends to point permanently toward the second toe. The altered mechanics of the joint can result in cartilage damage and considerable discomfort.

Signs and symptoms

Bunions are visible protrusions whose diagnosis is easily confirmed by X-ray. Symptoms include restricted range of motion for the big toe and pain that is usually aggravated by footwear. Dancing on pointe or any dance manoeuvres that stress the big-toe joint may aggravate the bunion and create discomfort.

What causes it?

Bunion formation may have a genetic component, but is typically related to mechanical stress at the big-toe joint. This stress may be caused by either direct trauma to the joint or repeated, sustained pressure on the joint, which may be caused by excessive pronation (poor foot posture) or restrictive footwear (footwear that is too narrow or too short).

Treatment

There is usually no way to completely eliminate bunions once they have developed. Apply heat before activity and ice after activity to minimize symptoms. Wear dance shoes and street shoes that fit properly — this is critical for symptom prevention and management. Avoid high-heeled shoes and ensure that shoes have adequate toe room. Cushioning the bunion with a doughnut-shaped bunion pad may reduce irritation. Using orthotics to minimize pronation may also help. Seek the advice of a medical professional if these conservative approaches do not help manage pain within two weeks, or if the big toe begins to overlap the second toe. Surgery can relieve symptoms, but typically is not as effective as a complete cure.

Prevention

Identifying and correcting faulty foot mechanics (pronation) using orthotics and physical therapies may help prevent or control bunion formation. It is critical to select shoes that fit properly and that do not place excessive pressure on the big toe or big-toe joint.

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Foot and toe injuries: Toenail injuries

Dancers are prone to toenail problems. This section is a general guide to the maintenance of healthy toenails.

Bruised toenails

Bruised toenails are caused by the toenail pushing back into its base. When toenails extend beyond the end of the foot and the dancer does pointe work, the pressure causes the toenail to push back on itself. This pressure causes the nail bed to become bruised and sore.

Take care to ensure that toenails are short; they should not extend beyond the end of the toe. Do not cut toenails too short, as this increases the risk of ingrown toenails and causes the skin on the end of the toe to peel.

Ingrown toenails

Ingrown toenails are a significant problem for dancers (Eisele 1994). Ingrown toenails are generally caused by crowding of the toes (particularly in pointe shoes), pressure on the toes, and poorly cut toenails (Eisele 1994; Quirk 1994).

To prevent ingrown toenails, ensure that there is adequate space for the toes in shoes, including ballet slippers. Cut nails straight across rather than curved at each end. If an ingrown toenail does occur, treat it right away.

Treat ingrown toenails by soaking the affected toe in warm salt water several times a day. A piece of cotton soaked in alcohol can be put under the ingrown corner during the soak. If the area becomes infected, consult a physician.

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Index

achilles tendinitis, 113
activity-related soft tissue disorder. *See* musculoskeletal injury
acupuncture, 13
Alexander Technique, 13, 30
amenorrhea, 46–47, 48, 118
ankle sprain, 106–107
anorexia nervosa, 46, 118
arthritis, 81

back injuries, 94–100
back pain, 18, 21, 23, 95, 98–100
blisters, 128
bone injuries, 48
  fracture of the fifth metatarsal, 121–122
  spondylolysis, 96–97
  stress fracture of the leg, 103–104
  stress fracture of the second metatarsal, 118–119
bulimia nervosa, 46
bunions, 130

carpal tunnel syndrome, 18, 22, 66–67
carrying equipment
  dancers, 42
  musicians, 28–29
chondromalacia. *See* patellofemoral pain
cubital tunnel syndrome, 18, 22, 69–70
cuboid subluxation (foot dislocation), 123–124
cumulative trauma disorder. *See* musculoskeletal injury

dancer's fracture, 121–122
dancer's heel, 109
dancers
  achilles tendinitis, 113
  amenorrhea, 46–47, 48, 118
  ankle sprain, 106–107
  anorexia nervosa, 46, 118
  arthritis, 81
  back injuries, 94–100
  blisters, 128
  bone injuries, 48
  bulimia nervosa, 46
  bunions, 130
  chronic injury, 36, 38
  cuboid subluxation (foot dislocation), 123–124
  eating disorders, 46–47
  flexor hallucis longus tendinitis (big toe), 126
  foot injuries, 117–131
  iliotibial band tightness, 83–84
  impingement syndrome (ankle), 109, 111
  impingement syndrome (shoulder), 64–65
  ingrown toenails, 131
  knee sprain or strain, 90–91
  little toe (fifth metatarsal) fracture, 121–122
  meniscus tears, 92–93
  nutrition, 41, 46–47, 48
  patellofemoral pain (knee pain), 87, 88–89
  preventing musculoskeletal injury, 40–42
  rest between workouts, 41
  rotator cuff (shoulder), 61, 62–63, 64
  shin splints, 103–104
  spondylolysis, 96–97
  stress, 37, 40
  stress fracture (foot), 118–119
  stress fracture (leg), 103–104
  stress fracture (vertebra), 96
  subtalar subluxation (ankle dislocation), 115
  temporomandibular joint dysfunction, 59–60
  thoracic outlet syndrome, 71–72
  treating musculoskeletal injury, 43–45
  warm-up, 40
delayed-onset muscle soreness, 36, 41
De Quervain's syndrome, 18, 73–74
disc herniation, 21

eating disorders, 46–47
epicondylitis, 18, 20–21
  lateral, 20–21, 75
  medial, 20–21, 77

Feldenkrais Method, 13, 30
focal dystonia, 17, 18, 19, 79–80
foot injuries, 117–131
frozen shoulder, 64

golfer's elbow. *See* medial epicondylitis

hallux abducto valgus, 130

iliotibial band tightness, 83
impingement syndrome
  ankle, 109, 111
  shoulder, 64–65
ingrown toenails, 131

jaw clenching. *See* temporomandibular joint dysfunction

knee pain. *See* patellofemoral pain
knee sprain or strain, 90–91

lateral epicondylitis, 20–21, 75

medial epicondylitis, 20–21, 77
meniscus tears, 92–93
menstrual dysfunction, 46–47
MSI. *See* musculoskeletal injury
muscle cramping. *See* focal dystonia
muscle stiffness. *See* delayed-onset muscle soreness
musculoskeletal injury, general
  dancers, 36–38
  definition, 5, 8
  health effects, 8, 9
  musicians, 16–18
  prevention, 13
  risk factors, 11–12
  signs and symptoms, 8, 9
  treatment, 13
musicians
  back pain, 21, 23, 95, 98–100
  body awareness, 29–30
  carpal tunnel syndrome, 22, 66–67
  carrying equipment, 28–29
  cubital tunnel syndrome, 22, 69–70
  focal dystonia, 19, 79–80
  impingement syndrome (shoulder), 64–65
  lateral epicondylitis, 20–21, 75
  medial epicondylitis, 20–21, 77
  neck pain, 21, 95, 98–100
  nerve compression or entrapment, 22–23
  practice habits, 25
  practice locations, 25
  preventing musculoskeletal injury, 24–25
  rotator cuff (shoulder), 21, 61, 62–63, 64
  sciatica, 22, 23
  taking rest breaks, 26–27
  temporomandibular joint dysfunction, 21, 59–60
  tendinitis (elbow and shoulder), 20–21
  tendinitis (hand, wrist, and forearm), 20
  tendon and muscle disorders, 19–21
  thoracic outlet syndrome, 22–23, 71–72
  treating musculoskeletal injury, 31–32
  warm-up, 26
musician's cramp. *See* focal dystonia

neck pain, 18, 21, 95, 98–100
nerve compression or entrapment, 18, 22–23
nutrition, 41, 46–47, 48

occupational cramp. *See* focal dystonia
osteoarthritis, 81
osteoporosis, 95

pain, 9, 10, 36
patellofemoral pain, 87, 88
Pilates Method, 13, 30
proprioception, 37

repetitive strain injury. *See* musculoskeletal injury
rest when injured, 41
RICE treatment protocol, 31–32, 41, 43–44, 106–107, 113
rotator cuff (shoulder), 21, 61, 62–63, 64
runner's knee. *See* patellofemoral pain

sciatica, 22, 23
shin splints, 103–104
signs and symptoms, 8, 9, 13, 16, 31, 32, 56
  See also specific injuries
snapping hip syndrome, 83–84
spondylolysis, 96–97
sprung floors, 40
stress, 37, 59
stress fracture
  foot, 118–119
  leg, 103–104
  vertebra, 96
subluxation
  cuboid (foot), 123–124
  subtalar (ankle), 115
symptoms. *See* signs and symptoms

Tai Chi, 13, 30
temporomandibular joint dysfunction, 21, 59–60
tendinitis, 8, 17, 18, 19, 21, 67, 113
  elbow and shoulder, 20–21
  extensor carpi radialis (forearm), 20
  flexor carpi ulnaris (forearm), 20
  flexor hallucis longus (big toe), 126
  hand, wrist, and forearm, 20
tenosynovitis, 8, 17, 18, 19
thoracic outlet syndrome, 18, 22–23, 71–72
TMJ. *See* temporomandibular joint dysfunction
toenails, 131

work-related musculoskeletal disorder. *See* musculoskeletal injury

yoga, 13, 30