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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