Assessment and Treatment Principles for the Upper Extremities of Instrumental Musicians

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CHAPTER 142

PERFORMANCE-RELATED ISSUES
NONMUSICAL ACTIVITIES AND FACTORS
CLEAR-CUT PATHOLOGIES AFFECTING MUSICIANS
HYPERMOBILITY
FOCAL HAND DYSTONIA
WORK-RELATED UPPER LIMB DISORDERS, “OVERUSE,” OR NONSPECIFIC ARM PAIN
NERVE ENTRAPMENT SYNDROMES

CRITICAL POINTS

- Performance-related issues are discussed, followed by assessment and treatment techniques for tendinopathies, hypermobility, and focal hand dystonia.
- Other conditions covered include nerve entrapment syndromes and ganglions.
- Ideas are presented regarding orthotic intervention, musical ergonomics, warm-up and cool-down exercises, and an example of a graded return-to-play program.
- Environmental factors and anatomic variations that can affect musicians are mentioned briefly.
- The four surgical principles that need to be considered when operating on musicians are listed as well as a discussion on using the musical instrument as a rehabilitative tool.

Musicians’ hands are vital to their musical performance. Musicians often have to perform to the limit of their abilities physically, emotionally, and spiritually. They utilize rapid, complex, coordinated movements. Sometimes they are required to play in less than ideal environments and usually they do not have a medical team to support them in the way sports medicine supports athletes. Musicians can be required to play long tours with poor facilities. Noise, drug and alcohol use, and pressures can be high. They frequently injure themselves or acquire injuries that can lead to difficulties or an inability to play their instrument.

Over the last 20 years musicians’ medicine has become increasingly popular, with at least six textbooks relating to this topic published in English. Professional groups and organizations have been established in numerous countries to research preventative measures and effective treatments that are tailored to musicians. Each country has specific circumstances (e.g., health-care system, available financial support, and perceived medical need) that influence the administrative structure of the performing arts organizations. Additionally, alongside national initiatives, there is a growth in international cooperation, assisted by the development of international conferences.

Specialist assessment and rehabilitation techniques are required when dealing with this patient group. An understanding of the instrument and the type of music played is imperative. An area of specialization that has come to the fore in musicians’ medicine is hand therapy.

The focus of performing arts medicine should be prevention. Wynn Parry has made a detailed analysis of the 1046 musicians he has personally seen at British Association of Performing Arts Medicine (BAPAM) clinics (Fig. 142-1). Clear-cut pathologies in which a specific diagnosis can be made were evident in 48% of this group. Of the structural disorders, four broad bands were evident: old injuries (22%), tenosynovitis (12%), hypermobility (9%), and focal hand dystonia (5%). In the remaining 52% few physical signs could
be found, and the symptoms were seen as being very vague, general, and due to performance-related issues such as incorrect practice or playing techniques.

Performance-Related Issues

Nontrauma-related conditions need careful analysis and consideration, and thus hand surgeons or therapists may be able to assist with providing an anatomic diagnosis for a painful condition in a musician’s hand or arm. Some conditions may result from:
- excessive training
- change in instrument
- quality of instrument

Excessive Training

Abrupt increase in practice or performance time is perhaps the most common risk factor. This can occur while attending a summer academy, preparing for a recital or competition, during holiday seasons when performers may be in increased demand, or when an amateur decides to intensify training. Newmark and Lederman carried out research on musicians at a conference. Only two players were professional musicians and 73% (79/109) did not usually practice routinely and had a rapid increase in playing time and so were predisposed to overuse injuries. Of those affected by the significant increase in practice time 61% (48/79) developed new playing-related complaints, whereas 34% (27/79) experienced problems even without a significant increase in playing time. The authors comment that musicians should view themselves as athletes, be more attentive to their physical limitations, condition their bodies accordingly, and work at preventing overuse injuries. They hope that teachers, performers, and physicians learn from the experiences of their respondents and implement a carefully planned increase to playing time.

“Correct” practice technique is imperative. Musicians frequently overpractice, which can have a negative effect on the individual’s whole body—particularly the hands and upper limbs. During long practice sessions, the instrumentalist may begin to use suboptimal body mechanics, which most frequently affect the hands and arms. Training errors often include failure to take at least a 5- or 10-minute break every hour of practice. Practice of physically difficult or awkward passages should be limited to short segments of 2 to 3 minutes each within a practice session.

A physical warm-up and cool-down before and after playing is desirable and seen as being essential. The neck, shoulders, and arms should be the focus areas. This might include slow rolling of the head and neck, shoulder shurgs, side bends, and torso twists. If the musician plays an instrument, such as the violin, viola, or flute, that requires constrained postures, these sessions are of particular importance. Much time is spent with patients discussing “graded-return-to-play” programs and practice techniques, which are discussed later in the chapter.

Change in Instrument

Changing from violin to viola (increasing the size of the instrument), electric bass to string bass (increasing the length of the fingerboard and required finger span), synthesizer to acoustic piano (increasing the force requirements for sound production), flute to piccolo (decreasing hand span and finger spacing), bassoon to contrabassoon (increasing the weight of the instrument and the hand span), or from a standard drum set to an “extended” set (increasing upper extremity reach requirements) represents the range of possible changes and how those changes can affect the upper extremities. These changes may predispose the musician to injury, especially if combined with an abrupt increase in playing time. The solution is to decrease the intensity of practice when such a change is made, and then to gradually build to the desired level of play. A change in teacher or style of music performed may result in a change in technique, which then requires a similar modification to the intensity of practice.

Quality of Instrument

Leaking keys or valves on a poorly maintained wind instrument can result in increased fingertip pressure required to produce a clean sound. Bridges on string instruments that are too high can increase the force needed to depress the strings. A piano in poor condition may require more force to achieve the desired dynamics and subtleties in sound, color, dynamic, and shade. Animal studies have shown that highly repetitive motor movements can contribute to degradation in the somatosensory cortex. However, Byl and associates comment that when the speed and force of the repetitive motor task is varied and interspersed with other regular activities, the degradation of hand cortical representation and loss of motor control can be minimized. Thus, it is important to maintain instruments in top playing condition, with the hope of decreasing excessive energy outlay for the desired level of performance. Musicians need to intersperse practice and playing with other activities in order to decrease the chances of developing medical conditions.

Nonmusical Activities and Factors

A musician may have excellent technique and practice habits, but may sustain upper extremity trauma from a variety of...
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Nonmusical activities. Musicians can suffer trauma while engaged in sporting or home hobby activities. These injuries need to be managed within the context of their instrument and the demands placed on their hands. Sports such as volleyball and martial arts are correlated with a particularly high incidence of hand injuries. Other hand-intensive activities that may cause problems include knitting, needlepoint, woodworking, fly tying and fishing, writing, and computer use.

Environmental Factors
Cold temperatures produce a number of adverse effects on musicians’ limbs. Cutaneous sensitivity decreases in the cold, which may lead to the use of excessive fingertip pressure, an increase in joint fluid viscosity, slowing of nerve conduction velocity, and diminished blood flow because of vasoconstriction. These effects may occur in spite of increased muscular demands. Players must guard against these effects by whatever means available, including wearing thermal underwear under their performance clothes, layering clothes, using fingerless gloves, or placing a heater in the practice studio.

Anatomic Variations
Anatomic variations range from the obvious to the subtle. Obvious ones, such as small stature or hand size, can be a problem when playing large or awkward instruments or certain pieces of music composed by persons with unusually large or flexible hands, such as Paganini or Rachmaninoff. An example of this can be seen in Figure 142-2.

A troublesome subtle variation is positive ulnar variance, which can cause an impingement syndrome when playing instruments requiring ulnar deviation—for example, certain fingers in the piano, harp, matched grip with the drums, the left hand in the trumpet, and at the end of the up-bow passage in stringed instruments. For musicians playing these instruments, accessory tendons in the first dorsal extensor compartment can predispose to de Quervain’s disease.

Tendinous interconnections between the flexor digitorum superficialis of the fourth and fifth fingers can lead to severe problems if they occur in the left hand of violinists or violists (Fig. 142-3). Cervical ribs may cause problems on the left side in string bass players or musicians who are required to flex or rotate their neck while playing instruments such as the viola, violin, or flute.

Clear-Cut Pathologies Affecting Musicians

Tendinopathies
Tendinopathies are a common degenerative rather than inflammatory condition. Histopathologic surgical specimens show a lack of inflammation. The term tendinopathy should be used rather than tendinitis, tendinosis, paratendinitis, or tenosynovitis, as this term refers to the primary symptomatic tendon disorder and has no implication of pathology. The cause of tendinopathy is unclear but three broad ideas cover possible methods of development:

• Mechanical—Perhaps the tendon has been overloaded, causing damage to the extracellular matrix, which in turn has caused a failed healing response in the tenocytes.
• Vascular—Tissue hypoxia may decrease the viability of tendon cells, and as the tendon reperfuses, oxygen free radicals are released, possibly leading to a pathologic tendon. Free radicals are associated with ageing, neurodegenerative diseases, chondral and meniscal lesions, and tendon degeneration in rats. If this hypothesis is valid then the possibility of treating tendinopathies with antioxidants is raised.
• Neural—There may be a neurogenic origin to diseased tissues as mast cell degranulation and release of substance P has been implicated and found in degenerative tendons.

Figure 142-2 A, Cornetto player displaying wrist and elbow positioning. This patient presented with ulnar nerve symptoms and intrinsic muscle strain in both hands, probably due to long-term positioning of both upper extremities in awkward positions because of the constraints of the instrument. B, Small hand size with limited finger span resulting in intrinsic muscle strain.

Figure 142-3 A, The wrist flexion and forearm hypersupination required to reach the higher positions on the viola. B, The size of the instrument relative to the individual can influence the ease of playing and the possibility of the musician being predisposed to developing medical symptoms.
Butler and Sandford outline the intrinsic and extrinsic factors that can lead to tendinopathies developing.

- **Intrinsic factors include:**
  - Age—mostly affects people older than 30 years of age
  - Nutrition—predominately affects people with poorer nutrition levels
  - Anatomic variations—affects people with extra long tendons or individuals who have two tendons in one tendon sheath
  - Joint laxity—hypermobile patients are more frequently affected
  - Gender—women are more often affected than men
  - Systemic disease—diabetic patients are more commonly affected

- **Extrinsic factors include:**
  - Occupation—if you work in confined spaces or perform repetitive movements
  - Sport/hobby—if forceful repetitive movements or sustained postures are required
  - Physical load—if heavy loads are required to be repeatedly moved
  - Equipment—if the equipment is not well maintained, of poor quality, or inappropriate to the individual
  - Rapid increase in work load—if the work load is intense, fast-paced, and pressurized
  - Environment—if the environment is too cold, too hot, cramped, or pressured

**De Quervain’s Disease**

De Quervain’s disease is a stenosing tenovaginitis of the abductor pollicis longus and extensor pollicis brevis. These two muscles commonly share a tendon sheath and, although the tendons are entirely normal and no inflammation is present, a cross section of the fibro-osseous channel shows diminishment of the channel and fibrotic thickening of the extensor retinaculum. Clinical examination shows swelling, thickening, and pain of the first dorsal compartment. There is pain on resisted thumb extension and abduction, and weak pinch grip. A Finkelstein test is positive. There are no reliability studies for this test, but it is commonly utilized in the clinical setting. Differential diagnosis for de Quervain’s disease includes first carpometacarpal joint osteoarthritis, scaphoid fracture, intersection syndrome, superficial radial nerve irritation (Wartenberg’s syndrome), and central referral.

Other tendinopathies include lateral and medial elbow pain, trigger finger, and carpal tunnel syndrome.

**Treatment Principles for Tendinopathies**

Patient education, ergonomic advice, activity modification, biomechanical considerations, electrotherapy, acupuncture, ice, strengthening, stretching, myofascial release, trigger point therapy, orthotic positioning, administration of non-steroidal anti-inflammatory drugs (NSAIDs), local steroid injections, and surgery are all possible treatments for the symptomatic patient.

**Patient Education**

The patient with a tendinopathy or muscular strain who rests just enough to keep playing, but manifests lingering symptoms, can develop a chronic condition that flares up repeatedly until adequate rehabilitation is received. Requirements for adequate rehabilitation include full range of motion (ROM), minimum pain on palpation of the muscle bellies or tendon origins and insertions, reasonable normative maximum grip strength, good endurance rates, and high levels of coordination. The musician must be aware that the length of the healing process is in months rather than weeks, and that the key to getting better and staying better is to modify the way the task is being performed as this may be predisposing to the condition.

**Activity Modification and Ergonomic and Biomechanical Considerations**

Some awkward postures are probably unavoidable, but some are related to poor instrumental ergonomics and technical difficulties. Marked wrist deviation and excessive fingertip loading can lead to increased tissue stresses and elevated pressures in the carpal tunnel. The use of excessive force, whether it be gripping drumsticks, pressing down on strings or keys, or clenching the violin between neck and shoulder, increases the risk of soft tissue injury. Carrying heavier instruments can strain the hands. Using wheels or backpack-style straps on cases can effectively reduce the carrying load placed on the limbs.

Many adaptive devices and cases have been specifically designed to decrease joint strain, distribute the load of the instrument, or protect the instrument and yet be lighter and more ergonomically sound. Some examples of such supports are shown in Figure 142-4.

**Computer Use**

Computer use is ubiquitous, often ergonomically unsound, and frequently intense, especially among students. The musician must be counseled to minimize computer use, especially during periods of intensified musical activity. Optimal ergonomic positioning while at the computer should be enforced for all patients, and keyboard short cuts should be used wherever possible in order to decrease the total number of keystrokes made during a session at the computer.

Here are some general concepts that are readily accepted when using a computer keyboard and mouse:

- Keep wrists neutral.
- Don’t rest wrists while typing.
- Move the whole arm while keying.
- Avoid stretching the fingers to reach keys that are far away.
- Keep fingers curved and relax the thumb.
- Use a light touch.
- Keep fingernails short.
- Avoid double clicking as much as possible when using a mouse.

**Myofascial Pain and Stretching**

Myofascial pain may be due to overactivity of motor end plates in muscles, which results in distinct referral patterns of pain. For example, a tender point or trigger point in the brachioradialis can refer to the elbow, thumb, and dorsum of the hand. Treatment can include trigger pointing, soft tissue massage, stretching, icing, acupuncture, home acupressure,
timpanists who stand to play. Larson and coworkers showed that musculoskeletal symptoms associated with practice and performance may be due to the lack of hypermobility of some joints involved in intensive repetitive movement. Subjects who played instruments requiring repetitive motion reported fewer symptoms in their joints if they were hypermobile.

Jull states that for many musicians hypermobility is an impediment. The weakness in muscle power and increased vulnerability of the associated joint can lead to an increased propensity for these musicians to develop injuries or chronic “overuse” syndromes. There is evidence to suggest that hypermobile joints have a decreased sensitivity to proprioception, so musicians may exert more force than necessary on keys or strings, thus increasing the possibility of chronic strain.

**Hypermobility**

Musicians seem to have a higher incidence of hypermobility than the population at large. Increased range can be very advantageous to musicians such as string players and pianists. Indeed some very virtuosic players such as Paganini and Liszt were hypermobile. Larson and colleagues studied 660 musicians and concluded that hypermobility in the fingers, thumb, and wrist may be an asset when playing repetitive motions on instruments such as the flute, violin, or piano. This author went on to say, however, that hypermobility may be a limitation when the joints are required to be stabilizers—for example knee joints for timpanists who stand to play. Larson and coworkers showed that musculoskeletal symptoms associated with practice and performance may be due to the lack of hypermobility of some joints involved in intensive repetitive movement. Subjects who played instruments requiring repetitive motion reported fewer symptoms in their joints if they were hypermobile.

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**Hypermobility and the Role of Hand Therapy**

Patients are routinely assessed for hypermobility in the initial examination, using the nine-point Beighton score and involving the following features:
Advice and adaptive task performance can prevent injuries from developing and ensure that the performer is more able to have a generally more fulfilling and less painful time especially when playing their instrument. Patients can benefit greatly from a rehabilitation program to improve muscle power. The stability-strengthening exercises encourage co-contraction of the muscles surrounding a joint. Isometric strengthening and proprioception exercises both on and away from the instrument can assist in achieving this goal (Fig. 142-7).

Therapeutic putty exercises can be very useful in increasing intrinsic muscle strength and proprioceptive awareness. Orthotic positioning options are discussed later in the chapter.

When exercising away from the instrument, initial stability exercises include isometric muscle contraction in a pain-free range while wearing a support. Later in the rehabilitation phase, exercises can be progressed to include concentric and eccentric strengthening. Isometric strengthening exercises on the instrument can be a useful tool—for example exercises in the neutral joint position while holding the bow, string instrument, or clarinet. Proprioception exercises and retraining such as tapping exercises and weight-bearing exercises in a neutral position should be performed first with the eyes open and then with the eyes closed. After months of performing strengthening exercises, symptoms can improve, and it is not uncommon to detect an improvement in ligament tautness with joint translation testing. It is encouraging
enough muscle strength has been gained or orthotic use continued until a neutral joint position can be maintained.

**Stability Exercises for the hand and wrist**

These exercises do not involve any movement but are static and resisted. Support the length of your forearm on a table. You should feel resistance rather than pain, and only use 30%–50% of your maximal effort. Hold each position for 5–10 seconds, increase as tolerated up to 30 seconds.

**Forward bending**

With the palm of your hand facing down and your hand forming a light fist, push your forearm into the table and feel the resistance right up into your upper arm.

Repeat ___ times ___ per day

**Backward bending**

With your affected wrist in a neutral plane and whilst forming a light fist, place your unaffected hand over the back of the wrist and resist the backwards movement.

Repeat ___ times ___ per day

**Side to side**

Rest your hand and forearm with the little finger in contact with the table. Make a light fist and push the side of your forearm into the table.

Repeat ___ times ___ per day

**Rest your hand and forearm with the palm facing the table and make a light fist. Resist movement toward the thumb with the palm of the other hand.**

Repeat ___ times ___ per day

**Turning**

Rest your hand and forearm with the little finger in contact with the table, resist against your affected side using your other hand. Place your unaffected hand over the base of your wrist. Imagine you are turning your palm down toward the table and resist this movement without moving the wrist.

Repeat ___ times ___ per day

**Focal Hand Dystonia**

Dystonia is a syndrome characterized by involuntary prolonged muscle contractions that can lead to sustained twisting postures. Three criteria are used in classifying this syndrome: age of onset, cause, and distribution of symptoms. Onset before 28 years of age is classified as early, and after this age is classified as late-onset dystonia. Cause can be divided into primary/idiopathic (no obvious affects on the brain) or secondary/symptomatic (often the basal ganglia are affected, resulting in more generalized symptoms). Distribution of symptom manifestation can be

- **General**—symptoms manifest in all extremities including the trunk.

Figure 142-7 Patient handout showing stability exercises for the wrist and forearm.
Figure 142-8 Task-specific action-induced focal hand dystonia has different forms, including musician’s dystonia that can affect the hand and embouchure (A) and writer’s cramp (B).

Figure 142-9 Focal hand dystonia in musicians showing lack of motor coordination or loss of voluntary control in a cellist’s (A) and pianist’s (B) right small and ring fingers.

- **Hemi**—symptoms are focused on one side of the body.
- **Segmental**—a segment of the body is affected.
- **Focal**—a single body part is affected.

Any part of the body can be affected by focal dystonia, including the neck, eyelids, vocal cords, or hand.49,50

This following section focuses on focal hand dystonia, a late-onset, primary dystonia that is often task-specific and includes musician’s and writer’s cramp (Fig. 142-8).

**Focal Hand Dystonia in Musicians**

FHD in musicians is a painless primary dystonia that tends to be task-specific, focal, and of late onset. Symptoms can include lack of coordination, cramping, and tremor51 and tend to be specific to each individual and related to the instrument played rather than hand dominance (Fig. 142-9).

Patients can respond to sensory tricks and, if they do, this is usually a good indicator of how successful hand therapy will be. *Sensory tricks* can be used to “fool” the brain and give a “nonsense” feedback loop that breaks the fixed link in the sensory motor loop for a short period.49,52,53 Often the novelty is only effective for a short time until the brain recalibrates to an automatic pattern, which is the dystonic one. Coban, Blu-Tack, latex gloves, and orthoses can all be used as sensory tricks (Fig. 142-10).

The estimated prevalence of FHD among professional musicians is about 2% to 10%,54-56 which is higher than that of writer’s cramp (0.1%) in the general population.57 FHD is overwhelmingly more common in classical rather than pop, rock, or jazz musicians. The high percentage of FHD in this population reflects the specific demands of continuous repetition made by classical music.

**Treatments**

At present there is no cure for dystonia, and many of the treatments available have significant limitations. Current treatments include oral medication such as trihexyphenidyl, botulinum toxin injections, surgery, rehabilitative therapies, and supportive approaches. Butler and Rosenkranz9,58 published two papers that clearly outline many of the treatments that have been researched and undergone clinical trials.

The rehabilitative approaches include:

- **Sensory reeducation**—focuses on sensory discrimination.
- **Sensory–motor retuning (SMR)**—combines both the sensory and motor aspects of FHD.
- **Multidisciplinary approach**—includes hand therapy and combines the sensory and motor aspects of FHD.
- **Limb immobilization**—interrupts motor performance and decreases afferents from the limb.
- **Supportive approaches**—can include assistive devices, instrument modification, Alexander technique, and psychotherapy. There is a strong clinical impression within a very experienced group of treating practitioners that some personality abnormalities and a strong psychological trait is correlated with patients who develop FHD.

The mechanisms by which FHD develops in musicians need to be identified. Treatment must assist in reestablishing sensory–motor control. A comprehensive therapy program with an aggressive sensory reeducation element can improve sensory processing and motor control of the hand. SMR is of value for treating FHD in pianists and guitarists. Scientific research investigating preventative measures and appropriate
treatments for FHD is essential. Collaboration and a multidisciplinary team approach to prevention, treatment, and research are imperative and will be of benefit to all. A fuller overview of current treatment principles can be found in Butler and Rosenkranz.59

Work-Related Upper Limb Disorders, “Overuse,” or Nonspecific Arm Pain

The term overuse injury has been defined as a condition that occurs when any biologic tissue is stressed beyond its physical or physiologic limits. The common presenting complaints are pain and stiffness but may include swelling and diminished coordination and function. Some histologic studies have revealed pathologic but nonspecific changes.60 There is no clear evidence that musicians suffer true overuse with tissue damage, as seen in athletes, and the experimental evidence used to argue this point in musicians is not strong.61

The clinician needs to be careful to assess the patient thoroughly with respect to diagnosis and then to review for nonspecific arm pains. The diagnosis of nonspecific arm pain should not be seen as a blanket term for patients for whom no specific diagnosis can be made.

Classification and Grading

Work-related upper limb disorders (WRULDs), overuse, or nonspecific arm pain injuries can be classified as acute or chronic. An acute injury follows a specific incident, such as overpracticing a difficult passage. The musician may experience pain or stiffness during practice or the following day. A chronic injury usually has a more insidious onset. The limb becomes progressively more painful and dysfunctional over time.

Fry62 has developed a five-category grading system:
Grade 1. Pain at one site only while playing
Grade 2. Pain at multiple sites
Grade 3. Pain that persists well beyond the time that the musician stops playing
Grade 4. All of the above plus activities of daily living (ADL) begin to cause pain
Grade 5. All of the above plus all daily activities that engage the affected body part cause pain

Most injuries fall into categories 1 to 3.63 The earlier the symptoms are recognized and treated, the sooner the recovery is likely to occur and the more complete it is likely to be. Unfortunately, the prevalence of injury can be quite high, especially among professional orchestra members. A survey of more than 2000 orchestra members revealed 76% of those surveyed had significant physical problems.64 Subtle loss of motor control or technique may be one of the earliest signs of overuse.65

Treatments for Nonspecific Arm Pain

The cornerstone of treatment is pain avoidance, also known as relative rest.66 Other treatment modalities will usually be inadequate unless relative rest is strictly observed. It is
important to emphasize to the musician that they must not avoid playing altogether, but equally that they must not play for long periods of time. The patient must become highly aware of pain-producing activities, be they musical, nonvocational, or ADL. The patient must learn to avoid, or at least modify, those activities to minimize the number of daily painful “twinges.”

Hand therapists can assist in giving advice about joint protection and energy conservation techniques. These principles are similar to those used for patients with rheumatoid arthritis (Box 142-1).

Principles of joint protection and energy conservation can be employed to preserve the patient's joints and reduce pain levels. It is a “style of life” that once learned becomes second nature. It is not designed to make life complicated, but rather to encourage independence. These principles are also very important to implement if the patient is hypermobile.

All previous treatment methods mentioned in this chapter apply to musicians who experience nonspecific arm pain. The playing position, the interface or relationship between the instrument and the musician's body and vice versa, and general levels of fatigue all need to be assessed and relevant modifications made, as these all affect symptoms and healing.

Nerve Entrapment Syndromes

Digital Compression Neuropathies

Digital compression neuropathies occur when the digital nerves are compressed between the hard instrument and the phalanx. Many different instrumentalists can present with these symptoms:

- percussionists, especially players of double-mallet instruments, such as the xylophone, vibraphone, and marimbas
- the index fingers of those using traditional drumsticks
- the left index finger of flutists
- the right index finger of violin, viola, and cello players, from pronation forces against the bow stick
- the right thumb tip in cellists where it presses against the “frog”
- Coban wrapped around the bow, stick, or the finger works especially well to protect the digital nerve. The use of a foam pad or Lycra or silicon sleeve such as Silipos can also assist with proprioceptive retraining on the instrument (Fig. 142-12).

It may be necessary, depending on the severity of the condition, to reduce playing time. Misdiagnosis is common, and clinicians can often be misled by the presence of index finger paresthesias into considering carpal tunnel syndrome. Electrodiagnostic testing can be useful to clarify the diagnosis, especially with “double-crush” syndromes, in which the patient may have multiple sites of entrapment,7 such as the cervical, brachial, or carpal regions. This highlights the importance of observing the musician playing the instrument. Where practical and possible, musicians are always assessed with their instrument, and frequently treatment sessions involve the use of the instrument as a rehabilitative tool.

Carpal Tunnel Syndrome

Carpal tunnel syndrome (CTS) can be classified as bona fide and non-bona fide. Winspur68 wrote about three classification subgroups for musicians suffering from CTS.

- Classic idiopathic CTS, or bona fide CTS—caused by increased pressure within the carpal tunnel.
- Wrist flexor tenosynovitis with carpal tunnel-like symptoms.69 These symptoms usually emerge following intense practice or prolonged performance. The symptoms are not present when the musician has a break from playing, is on holiday, or limits playing. Examination shows boggy swelling at the wrist, and the flexor tendons are commonly swollen, nodular, and tender. Nerve conduction studies (NCS) are normal, and Phalen's test produces discomfort but no paraesthesia. Treatment for flexor tenosynovitis of the wrist is conservative and NSAIDs with or without an injection of nonabsorbable steroid into the carpal canal can be of great value. If NCS are abnormal, then surgery may be indicated, but it should be considered as a last resort.70
- Acute positional CTS symptoms70,71 can be due to positioning the wrist in flexion while playing, and thus symptoms may only occur during the act of making music. In Figure 142-13 you can see the amount of wrist flexion used by this guitarist to gain access to the lower strings; sustaining this position can lead to carpal tunnel-like symptoms and can in turn cause trauma to the median nerve if the playing position and schedule is not modified adequately.

Diabetes, thyroid disease, peripheral neuropathy, and fluid retention associated with pregnancy can be predisposing factors. CTS symptoms may also be due to cervical symptoms, and thus upper limb tension testing may be necessary and appropriate to differentiate the source of the compression.

Wrist orthoses can be useful for decreasing pressure on the nerve and retraining wrist positioning while playing. The orthosis should hold the wrist in a neutral position of 0 to 5 degrees extension. Most commercial orthoses hyperextend the wrist considerably more than this, thus possibly raising the pressure in the carpal tunnel. The palmar aluminum strips can easily be flattened out to achieve a neutral position. The orthoses should be worn at night for those who complain of nocturnal or early morning paresthesias. If positional paresthesias occur during the day, the orthoses may be worn then as well but should be removed hourly for gentle, active ROM exercises to prevent stiffness. Depending on the severity of the symptoms it may be necessary to use a full-length resting orthosis, since wrist orthoses leave the fingers free to pinch and grip and this can lead to raised carpal tunnel pressures.

Musical technique should be evaluated to minimize extremes of wrist position. Biofeedback may be used for neuromuscular reeducation to reduce grip force and fingertip loading. Orthoses can be useful for retraining wrist position. For example guitarists can benefit from using a wrist orthosis while playing to retrain a more neutral wrist position and facilitate use of larger joints like the elbow or shoulder (Fig. 142-14).
**Box 142-1 Patient Handout on Joint Protection and Energy Conservation Techniques**

**MAIN METHODS OF JOINT PROTECTION**
1. Use joints in a good position.
2. Avoid activities that do not allow for a change in position.
4. Avoid tight grips or gripping for long periods, especially small and narrow objects.
5. Avoid actions that may lead to joint deformity.
6. Use one large joint or many joints.

**USE JOINTS IN A GOOD POSITION**
Joints work best in certain positions. When they are used in the wrong position, such as twisting, extra force is placed through the joint and the muscles are unable to work as well, eventually causing pain and deformity.

**AVOID ACTIVITIES THAT DON’T LET YOU CHANGE THE POSITION OF YOUR HAND**
When you are in a position for a long time your muscles get stiff and pull the joint into a bad position. The muscles also get tired quickly and so the force is taken up by the joint and not the muscles, thereby leading to pain and damage.

**RESPECT PAIN**
The nature of arthritis means that you may always have pain. If pain continues for hours after an activity has stopped, this means that the activity was too much and should have been changed or stopped sooner. Your therapist will talk to you about the many ways of dealing with pain, such as the use of orthoses, saving energy, learning relaxation methods, planning the day ahead or using equipment or gadgets to help you with certain activities.

**AVOID TIGHT GRIPS OR GRIPPING FOR LONG PERIODS**
Gripping tightly increases your pain and may damage your joints further. It is better to avoid it if possible. If you grip something that is small or narrow it can require greater power to hold and manipulate it. More power usually means an increase in pain and an increase of forces through the joints. Some examples of how to decrease strain on joints include:
- Using thicker or padded pens for writing
- Resting books on a table or book rest
- Using a chopping board with spikes to secure vegetables
- Using nonslip mats under bowls to hold them
- Allowing hand washing to drip-dry rather than wringing it out
- Relaxing your hands regularly during activities such as knitting or writing
- Building up objects using foam tubing or using special grip aids
- Increasing the grip ability on a slippery object such as a shiny pen or toothbrush by using Elastoplast or Coban tape
- Many items have been ergonomically designed and can be purchased from many supermarkets and department stores.

**AVOID ACTIVITIES THAT COULD LEAD TO DEFORMING POSITIONS**
Some directions of force can be more detrimental than others to the hand. Damage to your joints could lead to deformities in your hand, such as your fingers appearing to drift in the direction of your little finger (ulnar deviation) or your individual fingers bending or straightening in unusual positions (swan-neck deformity). Activities can be changed to avoid these.
- When turning taps or opening and closing jars, use the palm of your hand and use one hand to open and the other to close. Remind others not to close them too tightly.
- Use a flat hand when possible such as when dusting or wiping.
- Try to use lightweight mugs with large handles rather than small teacups so pressure is not put on just one or two fingers.

**USE ONE LARGE JOINT OR MANY JOINTS**
Stronger muscles protect large joints, so it is better to use large joints when possible or try to spread the force over many joints.
- Use the palms of your hands and not your fingers when you carry plates or dishes.
- When standing up from a chair, try to rock gently forward and use your leg muscles to stand up rather than pushing from your knuckles or wrists.
- Carry light bags from a strap on your shoulder rather than your hands.
- Use your bottom or hips to close drawers or move light chairs.
- Use your forearms to take the weight of objects when carrying, not your hands.

**MAIN METHODS OF ENERGY CONSERVATION**
1. Balance rest and activity.
2. Organize and arrange space.
3. Stop activities or parts of them.
4. Reduce the amount of weight you take through your joints.
5. Use equipment that saves energy.

**BALANCE REST AND ACTIVITY**
It is important to balance your rest and activity to allow your joints to rest and repair. Stop before you feel tired or are in pain and avoid activities that you can’t stop when you need to.
- Try to plan ahead. Write a weekly or daily diary with activities in red and rest times in blue. Think about what you need to do and space the harder activities out over time.
Box 142-1 Patient Handout on Joint Protection and Energy Conservation Techniques—cont’d

- Activities such as vacuuming, ironing, and cleaning windows mean that you are doing the same movements lots of times and keeping the hand in the same position for long periods of time. Try to do them for very short periods, or when possible get someone else to do them for you.

ORGANIZE AND ARRANGE SPACE
Prepare your work areas so you have everything you need for that activity. Store items you use often in places that are easy to reach, and keep things in small refillable containers, rather than large, heavy jars.

STOP ACTIVITIES OR PARTS OF THEM
- Use clothes that are easy to care for.
- Make the bed on one side and then the other.
- Soak dishes before washing them and let them drip-dry.
- When possible use tinned, frozen, or prepared foods.
- Hang items within easy reach.
- When possible get someone else to help with activities.

REDUCE THE AMOUNT OF WEIGHT YOU TAKE THROUGH YOUR JOINTS
- Consider using wheeled trolleys rather than carrying things.
- Slide pans when possible, and use a wire basket or slotted spoon to drain vegetables.
- When you buy new equipment, make sure it is lightweight.
- Use a teapot or kettle tipper, and fill the kettle with a lightweight jug.

USE EQUIPMENT THAT SAVES ENERGY
Your therapist will discuss with you some of the things that are available to buy.

Automatic washing machines, frost-free freezers, and food processors are all energy-saving devices; and simple things such as sharp knives use less pressure and, therefore, less energy.

SHOULD I EXERCISE MY HANDS?
It is important to maintain the amount of movement you have in your joints so that you are able to use your hands as much as possible. You may find that without regular exercise your hands feel weak and activities become more difficult. Exercise can help to relieve pain, keep bones and muscles strong, and keep your joints moving. Strong muscles around your joints can help keep them in a good position, but do not overdo your exercises or use weights or resistance as this may harm your joints.

DO I NEED TO WEAR AN ORTHOSIS?
Your therapist will talk to you about wearing an orthosis. They can be used to rest a joint and allow the muscles around it to relax. This can help reduce swelling and pain. Orthoses can also be used to prevent deformities around the joint or stop existing deformities from worsening. It is often advisable to wear one during activity to support a joint and restrict movement.

There are various types of orthosis and your therapist may provide you with more than one.

A thermoplastic resting orthosis can be made, which due to its strength can also be used during activity to restrict movement around the joint. Softer orthoses made from neoprene are also available that allow more movement.

Other therapy tools that people have found useful are Lycra gloves worn at night and hot or cold gel packs. Your therapist will talk about your symptoms and your daily activities (Fig. 142-11).

Cubital Tunnel Syndrome
The boundaries of the cubital tunnel are the medial epicondyle anteriorly, the ulnohumeral ligament laterally, and the fibrous arcade formed by the two heads of the flexor carpi ulnaris (FCU) posteromedially. A fibrous band from the olecranon to the medial epicondyle forms the roof of the tunnel. The pertinent clinical biomechanical features are a 55% narrowing of the cubital tunnel, along with a marked increased pressure, during elbow flexion. In vivo, additional pressure may be caused by FCU muscle contraction. The latter is evidenced by the high incidence of cubital tunnel syndrome in the left hand of string players, in whom a combination of elbow flexion and FCU contraction is found (Fig. 142-15).

Piccolo players’ right and left arms and the left arm of cellists are at high risk of developing cubital tunnel syndrome because they are required to play with extreme elbow flexion for extended periods.

The most common clinical findings are a positive Tinel’s sign over the cubital tunnel. With the patient’s elbow fully flexed and the wrist held in a neutral position, the examiner taps over the nerve with her finger (not a reflex hammer). A positive elbow flexion test can produce paraesthesia in the ulnar aspect of the hand. The examiner should document in the medical notes the length of time it takes for the symptoms to appear as this is an objective marker and can assist in evaluating symptom history and treatment effectiveness.

Weakness in the abductor digiti minimi is also a common presenting feature in cubital tunnel syndrome.

Although electrodiagnostic testing may be helpful in evaluating the severity of the condition, it may be negative, even in the face of florid symptoms. One must always treat the patient, not the test.
be used during the day. The hinge is adjusted to allow full extension and up to about 45 degrees of elbow flexion (or less, if 45 degrees still produces a positive elbow flexion test). In extreme cases, an ulnar “gutter” may be added to the orthosis to block abduction of the fifth finger. As the symptoms subside, the hinge is adjusted to allow progressively increased amounts of elbow flexion (but never to the point of paresthesia production). When 90 to 100 degrees of flexion is attained without producing paresthesia, a “weaning-off” schedule is instituted by removing the brace for 30 minutes twice a day and progressing until the patient is off the brace.\(^7\)

Figure 142-13 The extreme wrist flexion and finger abduction assumed by some players to access the lower strings and play certain chords on the instrument can cause acute positional carpal tunnel syndrome.

The mainstay of treatment is prevention of sustained or repetitive elbow flexion. A semirigid night orthosis is better tolerated than a rigid one because it achieves better compliance. If night positioning alone is inadequate to control symptoms, an adjustable, hinged elbow brace may need to be used during the day. The hinge is adjusted to allow full extension and up to about 45 degrees of elbow flexion (or less, if 45 degrees still produces a positive elbow flexion test). In extreme cases, an ulnar “gutter” may be added to the orthosis to block abduction of the fifth finger. As the symptoms subside, the hinge is adjusted to allow progressively increased amounts of elbow flexion (but never to the point of paresthesia production). When 90 to 100 degrees of flexion is attained without producing paresthesia, a “weaning-off” schedule is instituted by removing the brace for 30 minutes twice a day and progressing until the patient is off the brace.\(^7\)

Return to playing the instrument must consider a gradual resumption of elbow flexion and FCU contraction (see section on Resuming Playing After an Injury). Oral medications such as NSAIDs or gabapentin may be very helpful. Injection of soluble corticosteroids can be helpful but must be done with caution to avoid intraneural injection. Sometimes these patients require a surgical release, with or without transposition depending on the surgical finding and

Figure 142-14 Utilizing a wrist orthosis to retrain wrist position and encourage larger movements of the elbow and shoulder when accessing the lower strings on a classical guitar.
Aspiration is commonly performed; however, there is a 50% recurrence rate after this procedure. A more effective method is to rupture the ganglion. The clinician fills a 10-mL syringe with a mixture of half sterile water and half 2% lidocaine. The skin is anesthetized by using Fluori-methane spray. Using an 18-gauge needle, lidocaine is injected until the ganglion ruptures. This may require quite a bit of force. The thick viscous gel spreads subcutaneously over the dorsum of the hand and is reabsorbed in a few days. A compression dressing with sterile gauze and Coban should be applied and left in place for a day or two. Wrist active ROM exercises should be commenced as soon as possible following this procedure in order to minimize any decrease in range.

General Treatment Principles for the Musician

Standard therapeutic modalities such as ice, compression, electrotherapy, orthotic positioning, exercise, sensory reeducation, postural reeducation, acupuncture, environmental assessment, examination of technique, holistic approach, breathing, myofascial release, and nerve glides can be useful when treating musicians; however, when possible the instrument should be used as the therapeutic tool.

Instrument-specific rehabilitation techniques such as the use of surface electromyographic biofeedback while the patient is playing the instrument can help detect the presence of excessive muscular activity in the forearm flexors, extensors, or trapezius muscles. Levy and colleagues carried out electrical studies on biceps, deltoid, trapezius, and sternomastoid muscles of violinists while they played two sections of music. As the musician’s neck dimensions increased, the shoulder rest was more likely to promote diminished electrical activity from the tested muscles, and thus the investigators demonstrated that the shoulder rest had a great effect on muscles used to support the violin and that with proper rest musculoskeletal injuries might be decreased.

Video feedback may be used to increase awareness of posture and technique and is complementary to biofeedback. In video feedback, the patient faces a video monitor and plays his instrument while the therapist gives postural cues. The video camera is placed at various angles, allowing the musician to see his posture from several perspectives. The camera can record the session for further study and review. Where possible the patient is assessed on and off the instrument, as sometimes their difficulty will only become evident when they are in the playing position or demonstrating playing.

Orthotic Intervention

Various types of orthoses are available, and it may be appropriate for the patient to have more than one during the day depending on the activity being performed.

Functional Thumb Metacarpophalangeal Joint Extension Blocking Orthosis

Hyperextension of the first MCP joint is commonly observed in people with hypermobility and arthritis and in
professionals such as musicians\textsuperscript{2} and hand therapists.\textsuperscript{83} This may be due to decreased stability of the first carpometacarpal (CMC) joint or MCP joint,\textsuperscript{84} which subsequently leads to degenerative changes. Butler and Svens\textsuperscript{85} present an alternative orthosis based on Van Lede's\textsuperscript{86} anti-swan-neck orthosis for fingers, which restricts MCP joint extension of the thumb (Fig. 142-16). This orthosis can be very useful for retraining awareness of joint positioning on the instrument and while writing. It can decrease joint strain and in time assist in increasing the strength of the muscles surrounding the joint and thus aid joint stability.

**Osteoarthritis and the Thumb Carpometacarpal Joint**

A thermoplastic resting orthosis can restrict joint movement while functional tasks are being performed. This orthosis can also be worn while sleeping (Fig. 142-17). Softer orthoses made from neoprene allow more movement and provide
some warmth to the affected area. Other therapy tools that osteoarthritis patients can find useful are Lycra compression gloves worn at night and hot or cold gel packs.

**Functional Orthoses**

Following an ulnar nerve injury, hyperextension at the MCP joints and an adducted thumb can render the hand fairly dysfunctional. With careful orthotic positioning, ADLs and a graded return-to-play program can commence (Fig. 142-18). Prefabricated wrist orthoses can be used to retrain wrist position while on the instrument (see Fig. 142-14). Neoprene orthoses can be worn to support a joint or area and limit some movement, while increasing proprioceptive awareness and warmth. A thermoplastic reinforcement can be added to increase support or further limit movement (Fig. 142-19). These orthoses can be a useful way for a musician to gradually progress from a wrist orthosis to a neoprene orthosis to no orthosis.

**Dynamic Orthoses**

Injury may result in a lack of full ROM. This can limit the possibility of certain positions on the instrument. Following surgery certain structures may need protection while they heal. If the therapist wants to promote gentle motion, then dynamic positioning is often the most appropriate means (Fig. 142-20). Figure 142-21 shows a dynamic MCP joint extension orthosis with radial pull that a pianist used during the daytime while performing functional tasks as well as in a graded return-to-play program. She was supplied with a resting orthosis with an ulnar border build-up to wear at night. This patient had a 35-year history of rheumatoid arthritis and she was finding playing increasingly difficult. A crossed intrinsic transfer with synovectomy was performed and she commenced light playing after 4 days of surgery, with the orthosis on. She commented: “I have been amazed with the results, as I have not been able to play like this for 20 years. I did not think this improvement was possible. My finger is articulating in a crisp way. My husband can hear the difference already as well.” Getting the patient back on the instrument as soon as is reasonably possible and anatomically safe is integral to the whole healing of a musician.

**Musical Ergonomics**

**Musical Instrument Modifications**

Guitars and, recently, violas have been designed with part of the body of the instrument recessed to permit the use of a more neutral wrist and more optimal ergonomic position
violins finesse this problem altogether by virtually eliminating the body of the instrument.

The lower “bou” of the acoustic guitar (the part where the right forearm crosses the instrument) also can present a physical obstacle (Fig. 142-23A), resulting in either excessive right wrist flexion or protraction of the right shoulder for the right hand to access the strings. The larger the body size of the guitar or the smaller the player, the bigger the problem. Laskin has developed a small beveled edge for the classical guitar where the right forearm crosses the instrument. This idea was further developed by Norris and Dommerholt to a more radical bevel, improving right-hand access to the strings with minimal distortion of right shoulder and wrist position (Fig. 142-23B).

For the soloist or short double bass player, the instrument should be selected with sloping shoulders if one does a lot of playing in the high positions (e.g., soloists). This minimizes impingement of the left forearm against the sharp edge of the instrument or thrusting the left shoulder forward to avoid forearm impingement when reaching down the neck.

The bassoon can be designed and made with levers and extended keys to decrease an excessive span of the fingers and thus prevent development of an intrinsic muscle strain.

**Reduction of Static Loading**

Static loading, which occurs when the weight of a tool is sustained and supported by the hand, has long been recognized as an etiologic factor in workers’ injuries. Industry has addressed this by developing ways to suspend tools to remove the weight from the hand. This approach has also worked for musical instruments. Adding an end pin to the cello.
Key Modifications

Many instruments can be modified to make playing them more comfortable and safer.

The levers that operate the valves on the French horn can be lengthened to provide greater leverage and widened to provide increased contact area.

A hooklike device can be soldered onto the upright post of a trombone, significantly decreasing the stretch required for the left index finger to support the mouthpiece. The post itself can be wrapped with Coban to prevent digital nerve compression (Fig. 142-24).

The location of the flute keys can be customized (Lunn Flutes, Newport, New Hampshire) to fit the players’ hand, and the cluster of keys worked by the right little finger can be angled in toward the finger, thereby reducing strain between the fourth and fifth fingers. The keys operated by the left fourth and fifth fingers can be lengthened to achieve a more neutral left wrist position. A flute with a U head can be useful for children, or covering the open holes of a flute following injury to the hand can facilitate ease of return to play, and in time the keys can be “unblocked” and open holes can be used again as the patient recovers and gains confidence. In addition to these modifications, children can benefit from disks being soldered to the keys for the right index, middle, and ring fingers to reduce the distance between keys, thus reducing hand strain.

Although left-hand problems outnumber right-hand problems in flutists, quite a few players have suffered from strain relieved the player from supporting the instrument by grasping it with the legs. End pins have also been successfully employed in the bassoon, English horn, and tuba. The end pin for the last two instruments has been modified into a ball that rests on the chair between the thighs.

Several devices available on the market relieve the right thumb strain so common to oboe and clarinet players. Freeing the right hand also allows alternative fingerings that may be more efficacious. The Weightlifter (Robert James Products, San Marcos, California) is a tripod support upon which the bell of the instrument rests. It can be used whether the musician is seated or standing. It is relatively heavy, making it somewhat impractical for travel. The FHRED (Quodlibet, Englewood, Colorado) is a lightweight, height-adjustable post that attaches to the thumb rest and rests on the seat between the player’s legs. It can be used only while seated. A small support can be applied to the body of the flute to take the strain off the left index finger and to remind the player not to press this finger into the instrument (see Fig. 142-4C).

The bassoon is most commonly supported by a seat strap that is attached to the end of the instrument. This still leaves quite a bit of weight to be supported by the left hand due to the leftward inclination of the instrument. There is also torque on the left hand because it must counteract the tendency of the instrument to roll outward. Some bassoonists prefer a body harness onto which the instrument clips.
CHAPTER 142 — ASSESSMENT AND TREATMENT PRINCIPLES FOR THE UPPER EXTREMITIES OF INSTRUMENTAL MUSICIANS

and physical tension in the base of the right thumb and the muscles pertaining to this area. One could argue that this most likely represents an error of technique, with the person using an excessive amount of tension in the right hand or incorrect placement of the right thumb. However, certain intrinsic balance problems with the instrument benefit from the enhanced stability attained with the use of orthoses or “rests.”

Discomfort may arise from the very small area of contact between the edge of the right thumb and the flute when the hand is held in the “natural” position, with the ulnar edge of the thumb facing the pad of the index finger. This is the position the thumb falls into when the hand is relaxed. This position concentrates the force from the flute over a small bony area of the thumb, which does not have a very high pressure tolerance. The common solution to this problem is to supinate the thumb so that the soft pad contacts the flute. Achieving and maintaining this position requires muscular force. Increased muscular tension in the thumb and hand may not only cause pain and injury but also may inhibit dexterity.

The flute rest uses a nonslip, cork-lined metal clip that grips the flute and has an adjustable, foam-padded metal extension customized to fit the thumb (Fig. 142-25). This device serves two main purposes: it distributes pressure from the flute over a wider area of the thumb, thus allowing the thumb to be comfortably held in the natural position, and it encourages stability by positioning the weight of the rods to fall through the base of support, thus preventing the flute from rolling inward.

Adaptive Equipment for the Physically Disabled

Musical instruments can be modified or adapted to increase the ease of playing them, if the individual has a physical or mental disability. French horns, normally played with the left hand, have been built to accommodate left upper extremity amputees. Adaptive prosthetic terminal devices have been fabricated to allow holding of the trombone, and drumsticks and metal picks have been affixed to the end of the prosthesis to allow guitar playing (Fig. 142-26).

For quadriplegics and people with severe neurologic impairments, sip and puff controls can be adapted to the computer and used in conjunction with one of a number of musical software packages to allow composition and playback.

Resuming Playing After an Injury

The treatment of musicians’ injuries has two distinct phases. Reducing pain or symptoms is the first stage. The second consists of a structured protocol for returning to full musical activity. If the player has had to stop or significantly reduce playing during the pain reduction phase, a structured protocol for return to play is essential to decrease the chances of repeated relapses. In this protocol, the musicians perform their specific tasks, but start out at a greatly reduced level of time and intensity. Injured musicians are often anxious about being away from their instrument, and miss playing so much that they return to playing prematurely and suffer disastrous consequences. Fry(1986) quotes Poore(1887) on this:

“The most important point in treatment is rest. The excessive use of the hand must be discontinued, and it is often necessary to insist on this rather forcibly. Piano playing, if not prohibited altogether, must only be practiced to a degree short of that which causes pain or annoyance. It is often difficult to restrain the ardor of these patients in the matter of playing. Directly they feel in a small degree better, they fly to the piano; and I have known the progress of more than one case very seriously retarded by the undoing, as it were, of the good effect of rest by an hour’s injudicious and prohibited practicing.”

It is critical that the treating clinical team be fully educated in both the psychological and practical aspects of guiding their patients through the difficult and often treacherous stages of resuming full musical activities so as to avoid the despair that can accompany setbacks, treatment failure, or career abandonment. Musicians should be reassured that they are not going to lose their technique during the course of a few weeks’ rest and that they can put their “time out” to good use by working on music theory, harmony, sight-reading, solfege, mental practice, silent practice, critical

Figure 142-25  The flautist’s right thumb “rest” stabilizes the instrument and enhances right thumb comfort by better distributing the pressure. This, in turn, allows a neutral, as opposed to a supinated, thumb position.

Figure 142-26 A, Guitar pick affixed to end of prosthesis. B, Adaptive device for holding trombone.
listening to recordings, or learning something about the business aspects of music and career promotion.

The musical patient usually resists the recommendation to completely refrain from the instrument and, fortunately, this is necessary only in extreme cases. Usually it is sufficient to reduce the intensity or time of playing, select a less taxing repertoire, or take more frequent breaks. It may be necessary, however, to cancel or postpone performance commitments, exams, or auditions.

If one hand is injured, the player can sometimes continue to do some playing with the unaffected side. It isn’t necessary to be completely asymptomatic before beginning the return-to-play program. A person who is not yet ready or able to deal with the physical instrument can go through the motions of playing without the instrument, what Menuhin referred to as “shadow playing.” It is preferable that the recovering player have the endurance to shadow-play comfortably for 10 minutes or so before beginning to play the actual instrument.

The Return-to-Play Schedule

When the person is ready to return to the instrument, a detailed return-to-play schedule is reviewed. It is inadequate for the clinician merely to advise the player who is ready to return to playing to “go back little by little.” This is too vague and open to misinterpretation. The value of a written schedule is that it minimizes the risk of overdoing things. Even if they believe that they can do more, players must be advised to strictly adhere to the schedule. The use of a clock or timer is more than helpful: it is critical, because the patient often fails to recognize overexertion during the musical activity. The pain can often evolve only hours later.

Depending on the severity of the injury or the length of time taken away from the instrument, the musician may begin cautiously with a single 2- to 3-minute period, or even less, and see how they feel later that day and the next day. It may be necessary to grade the return to play even more and to instigate miming or performing the movements required to play the instrument without even holding the instrument. For example, a violinist may move their left arm up into the playing position three or four times an hour each hour during the waking day, to rehabilitate and “remind” the body about the playing position. Shadow playing can be the next stage in a graded return-to-play program. In this, for example, the violinist moves their fingers over the strings but does not depress the strings onto the violin. In time, light pressure may be applied to the strings, and then half pressure, full pressure, gentle vibrato, and in time full vibrato. Grading of positions played and strings played on stringed instruments can also be a way of increasing the difficulty and technical requirements for the playing position.

To return the musician back to their pre-injury performance level can take a long time. The graded return-to-play program provides an outline for how to achieve this. A gentle encouraging approach by the treating medical professional is often necessary to keep the musician in good spirits and to facilitate a gentle pace of return to play. If the musician rushes their return to play, he can in turn cause an increase in symptoms and may require reverting to a lower level of playing.

A brief physical warm-up and cool-down should precede and follow playing, and if there is still some pain or discomfort, the sore part may be iced for 10 minutes or so after the playing session. It must be emphasized that the ice is not directly placed on the skin, but rather in a moist cloth or using a purchased cold pack that is kept in the refrigerator.

The return-to-play schedule can and should be modified to suit the individual player. In addition to the warm-up and cool-down, the musician should begin with slow, easy pieces or études. A metronome at a medium setting may be used, and gradually tempos can be increased by notch every few days. The musician should also gradually work down toward slower tempos, since the control required to play slowly can be very demanding as well. With time, the player gradually resumes more technically difficult material. Thus the progression is really in three dimensions: gradually increasing duration, tempo, and technical difficulty of the material.

The schedule (Table 142-1) is divided into play and rest periods. Each level represents a unit of time, usually from 3 to 7 days, although this can be adjusted to meet individual

### Table 142-1 Returning to Play

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- Start with slow and easy activity or pieces. Gradually progress to faster, more difficult tasks or pieces.
- In general, perform a maximum of 50 minutes continuous work or play with a minimum of 10 minutes rest.
- **Warm up before playing!**
- If pain occurs at any level, drop back to level of comfort until able to progress without pain.

needs. The musician should be comfortable at a given level before progressing to the next level. The play periods gradually increase with each level, and the rest periods gradually decrease. However, the play periods do not increase beyond about 50 minutes, and the rest periods do not fall below 5 to 10 minutes. If the injury has been severe, the musician would probably progress even more slowly.

If pain reappears after progressing to the next level, the player should drop back one or two levels until the symptoms subside. If absolutely necessary, the player may need to stop for a day or two before resuming playing. If they encounter difficulty progressing, it may be necessary to do a miniprogression, changing only one vertical column every 3 to 4 days. For example, if the musician is at level four, rather than increasing all the play and rest periods at a single time to level five, an alternative would be to increase only the first play period to level five, leaving the remainder of the play and rest periods at level four. After a few more days, the second play period is increased, then the second rest period decreased, and so forth. In this fashion, the player may be able to make steady, albeit slow, progress and this in turn will hopefully assist in avoiding or decreasing levels of discouragement and depression. In the sample program, level 10 represents about 4 hours of playing time. A performer who requires more than this would simply keep adding more play and rest periods, as shown, until achieving the desired goal.

To assist in decreasing the disruption in the flow of practice, the musician can record the practice session and critically review what she has just practiced during the break periods.

A “Healthy Practice Habits” handout (Box 142-2) can be helpful when reintroducing patients to their instrument after an injury or indeed, time away for any reason. This can also be used as an educational tool to assist in preventing injuries and as a way of mapping progress. Sometimes a clock may be utilized so the musician can time practice sessions carefully and not overdo it by accident. After a period of not playing musicians must return with a slow graded progression—in duration, tempo, and complexity of playing, and they may require psychological support.

Instrument-Specific Rehabilitation Protocols

To provide care on a sophisticated level, it is necessary to modify the concept of return to play to address specific injuries and instruments. Here are a few examples of the principle of instrument-specific return-to-play protocols:

**Box 142-2 Healthy Practice Habits for Musicians**

<table>
<thead>
<tr>
<th><strong>TECHNICAL AWARENESS</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Often the technical solution to a problem is also its musical solution.</td>
</tr>
<tr>
<td>• Extreme fatigue can indicate something is wrong technically (e.g., inappropriate fingering).</td>
</tr>
<tr>
<td>• Volume and resonance can be produced with muscle release and by using gravity.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>INSTRUMENT SUPPORTS</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Neck straps, floor stands, customized chin rests, individualized thumb stops or keys, instrument posts, backpack-style carrying cases, or wheels on instrument cases are available to minimize extraneous loading.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>MENTAL TRAINING</strong></th>
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<tbody>
<tr>
<td>• Strive to REDUCE practice time prior to a performance and increase mental training.</td>
</tr>
<tr>
<td>• Score read AWAY from the instrument to analyze and memorize the music out of the habitual posture.</td>
</tr>
<tr>
<td>• Use visualization to hear and see your performance.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>FITNESS AND RELAXATION</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Balance relaxation with fitness activities that minimize the risk of injury and help to alleviate your particular muscle imbalances (professional advice may be required).</td>
</tr>
<tr>
<td>• A strong flexible muscle resists strain better than a strong inflexible muscle.</td>
</tr>
</tbody>
</table>
Harpist
A harpist with left shoulder strain initially avoids passages with low notes. This is because the left shoulder has to flex forward and protract to reach the lower bass strings, thus placing increased strain on the anterior deltoid.

Piccolo
Piccolo players recovering from cubital tunnel syndrome should commence practicing on the flute because the elbows are more extended on this instrument.

String Players
A cellist or bassist with a left shoulder strain is recommended to commence their graded return-to-play program primarily with thumb position (down toward the bridge), where the deltoid is more relaxed than in the first position (up by the tuning pegs), which requires shoulder abduction. Because the thumb position requires less elbow flexion, it is also advisable for a cellist recovering from cubital tunnel syndrome.

String players with de Quervain’s tenovaginitis of the right wrist should avoid using the proximal third of the bow, playing at the heel, because the wrist assumes an increased flexed and ulnar-deviated position as the hand approaches the strings on the upbow.

A cellist with right rotator cuff injury should initially avoid bowing out to the tip of the bow, especially on the two treble strings, to avoid abduction and internal rotation, which aggravates impingement of the cuff. A violinist or violist with the same problem, on the other hand, begins on the two treble strings because reaching for the lower strings with the bow necessitates humeral abduction, often above shoulder height, which can aggravate rotator cuff impingement.

Guitarists
Guitarists with left hand or shoulder problems could place a capo (a rubber-coated steel bar that clamps across the strings) on the third fret, thus decreasing the stress of supination with external rotation that occurs when playing on the first three frets. Because the distance between the frets decreases as one goes higher up the neck, the finger abduction required for chords or intervals is also lessened. Guitarists can change to lighter-gauge strings as a way of grading their return-to-play program.

Pianists
A pianist recovering from a hand or shoulder problem might avoid using the thumb on the black keys or crossing to the opposite side of the keyboard to avoid wrist ulnar deviation and shoulder abduction. It may be easier for the pianist with painful forearm overuse to resume playing on a synthesizer or electronic keyboard because the key depression requires less force.

Surgery
Surgery on musicians must be entered into cautiously—either all other treatment options should have been attempted first, or surgery must be the only appropriate treatment indicated. Importantly, the interface must be assessed and altered as necessary, prior to surgery, for most conditions. Surgery is often seen as the last treatment option available to a musician.

Winspur reports that of the musicians presenting with recognizable orthopedic or rheumatologic conditions in the upper limb 4% to 6% are candidates for surgery. Nonsurgical treatment should always be tried first, and it should not be forgotten that in some situations adjustment or modification of the instrument or playing technique (the interface) may solve the problem rather than surgery.

The implications of surgery are profound for musicians, whose hands are their livelihood. Thus respect for their hand and career must be paramount. Accurate diagnosis, analysis of need and disability, and precision in planning all need to be carefully considered to ensure optimal outcome of surgery. In the area of acute trauma, techniques that permit early return to function (e.g., rigid fixation of fractures and early rehabilitation) are often advantageous. Electrodagnostically documented carpal or cubital tunnel syndrome and ligamentous injuries leading to instability that have not responded to activity modification or nonoperative therapy can be considered appropriate indications for surgery in the musician’s hand.

Winspur states that four areas must be identified and specifically addressed when planning surgery on a musician’s hand:

1. The incisions must avoid critical tactile areas.
2. Repair should be anatomic whenever possible.
3. Adjustment must be considered for any anticipated anatomic compromise to the musician’s specific musical needs.
4. The surgery should allow for an early return to limited playing.

A large series of professional musicians operated on by a single surgeon are presented by Butler and Winspur. These are the results from that study:

- 127/130 musicians operated on returned to full-time professional work or were able to complete their final-year music college examinations.
- Piano players appear to take the longest to initially return to their instrument (3.3 weeks) and string players appear to take the most time to fully rehabilitate (11 weeks), that is to return to full playing on their instrument.
- Trauma appears to be the most difficult condition from which to initially recover, with patients taking an average of 5.2 weeks to return to part-time playing.
- Full return to play took the nerve-release group an average of 17 weeks, the arthrodesis and arthroplasty groups 13 weeks, and the trauma group 12.7 weeks.
- The most common medical condition requiring surgery in the series was nerve compressions (32.3%).
- Of the musicians undergoing hand surgery, 35.4% played the piano or organ as their primary instrument.

For three patients the surgery was deemed unsuccessful:
- One was misdiagnosed with CTS, despite abnormal NCS. This patient had multilevel cervical disk disease
and required spinal surgery. This patient was able to return to teaching but not performing at a professional level, after spinal surgery.

• One young pianist had a hypermobile thumb and was lost to follow up. Early surgical results appeared to be unsatisfactory following a synovectomy.

• One patient with a hypermobile distal radial ulnar joint did not return to full-time professional performance levels and now only does some teaching, due to a recurrent dislocating extensor carpi ulnaris.

These important points must be considered when working with musicians who may require surgical intervention:

• All other treatment options must be attempted first.

• Surgery must only be considered when the condition interferes with playing.

• Surgery must be strongly indicated, and the pros and cons of the surgery must be discussed clearly with each patient in respect to lifestyle, level of performance, and the demands of the instrument.

• A specialized, multidisciplinary, and instrument-focused approach is absolutely necessary when rehabilitating musicians.45

The following conclusions can be drawn from this large series of 130 professional musicians, all of whom were operated on by a single surgeon:

• The musical instrument must be utilized as the rehabilitative tool, for the player to gain confidence levels, ROM, desensitization, strength, and psychological support during the rehabilitation phase, and thus strong surgical techniques that can withstand early return to play must be implemented when appropriate and indicated.

• Do not operate on hypermobile painful joints, but rather utilize other therapeutic devices, such as positional orthoses, to assist this patient group.

• Appropriate surgical intervention will not end a musician's career, provided it is performed properly, for the correct reasons, and with postoperative instrument-focused hand therapy available.

Summary

There has been an increase in focus on health issues that relate to performing artists in recent years. There is frequently hand and arm pain in this patient group. Their playing conditions and lifestyles are often not conducive to ergonomically sound approaches to performance and general living standards can vary greatly. Rapid repeated movements are often required, and frequently unusual postures are held for extended periods of time. Overuse whilst playing, practicing, and performing is common in music students and experienced performers alike. Musicians are often perfectionists who are striving for excellence in their field, and they are usually ill-prepared for the physical and emotional demands that may be placed on them in their student and professional lives. When assessing and treating this group, early assessment and accurate diagnosis are imperative. Happily, surgical intervention is not usually required and holistic approaches to practice schedules, an ergonomic approach to playing, and relevant warm-up and cool-down exercises can assist the musician's return to playing with much less pain or discomfort. Where possible, the musical instrument should be utilized as a rehabilitative tool. A specialized multidisciplinary approach to rehabilitation is advantageous and necessary when working with musicians. Prevention of injury is the primary aim of performing arts medicine. Scientific research and practical advice regarding minimizing the affects of performance and playing on the musician's bodies must be our focus, as well as educating the wider community about these strategies. In this way, we can all enjoy a wide variety of music and musical expression and the performers can enjoy the experience of playing their instrument and sharing music with the audience, with minimal tension and pain in their bodies.

REFERENCES

The complete reference list is available online at www.expertconsult.com.