Common Medical Problems of Instrumental Athletes

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Abstract
The fields of sports medicine and performing arts medicine have begun recent initiatives to collaborate more closely and to share information pertinent to the treatment of athletes and performing artists. This article provides a review of the common musculoskeletal and neurological problems encountered among performing artists who play instruments. Approaches to history, examination, diagnosis, and treatment are offered, based on literature reviews, expert opinion, and the authors’ own experiences in a musician’s clinic. Treatments focus on conservative management within a multidisciplinary framework, and indications are given for appropriate surgical referral. Providers are encouraged to build an understanding of the unique issues affecting instrumental athletes.

Introduction
Until recently, the fields of sports medicine and performing arts medicine have been like proverbial ships passing in the night, following somewhat parallel paths of development, but without much collaboration. The last decade, however, has seen a new commitment from professionals within both fields to share information, recognizing the many similarities between athletes and artistic performers and the mutual benefit that may result from a closer partnership among providers who care for these populations (2). The purpose of this article is to provide a review of the common musculoskeletal and neurological problems encountered among performing artists who play instruments. To emphasize the connection between sports medicine and the performing arts, we will use the term instrumental athlete in reference to musician patients. While there are many similarities between sports athletes and instrumental athletes, however, there also are significant differences as highlighted by Hoppmann (21): “Even though athletes and instrumentalists are both highly skilled performers and spend a great deal of time performing and practicing, many of the injuries in sports medicine result from high-impact movements and physical contact, neither of which is a part of performing music.” Instead, instrumental athletes are more often affected by repetitive movements of small finger and wrist muscles along with prolonged static activity of trunk and proximal muscles (23). These and other problems of performing artists will be reviewed in the latter part of this article.

Epidemiology
There are several studies of injury rates among instrumental artists. Caldron et al. (6) reported that of 250 “high-level” musicians surveyed, 56.8% reported musculoskeletal problems related to playing their instrument. The most common problems were tendinitis, muscle spasm, and nerve impingements, often leading to loss of practice time and income. Fishbein et al. (12) obtained 2,122 responses from 4,025 instrumentalist members of the International Conference of Symphony and Opera Musicians, with 76% reporting at least one medical problem significant enough to affect performance and 36% reporting four severe problems. Finally Larsson et al. (25) published survey results of 660 students from the Eastman School of Music, indicating that more than 50% experienced musculoskeletal symptoms while playing. Prevalence was highest among string players (>77%). Women reported more symptoms than men, although both sexes experienced equal rates of impact on playing (~40%). The most commonly described problems were tightening, pain, stiffness, and fatigue.

Risk Factors
Traditional endurance athletes are at risk for injury with increased training time, intensity, and frequency or changes in methods or equipment (8). Risk factors for injury among instrumental athletes are somewhat analogous to those of...
endurance athletes, as they often involve changes in the normal routine of practice and performance. This may include new or improper techniques, playing with inadequate rest, and increasing the duration, intensity, or frequency of rehearsals. Additional factors include poor posture, unnecessary muscle tension, and the effects of specific instruments. Cold ambient temperatures often play a role, along with confined spaces, poor equipment, and inadequate lighting. Conditioning and endurance of instrumental athletes are important factors, particularly in regard to posture, strength, and appropriate flexibility. Comorbid health conditions also may predispose to injury (20).

**Obtaining a Good History**

A thorough history is fundamental to approaching the complaints of instrumental athletes. Pain is typically the primary symptom, but the presentation of pain may differ from classic depictions since instrumental athletes are often very sensitive to minute changes that may impact performance. Pain may or may not be connected directly to the experience of playing. It is important to define the onset of symptoms, their evolution, and the factors that provoke or improve symptoms. Attention should be given to the numbers and types of instruments played, years of study, time spent in rehearsals and performances, changes in technique or teachers, and changes in playing time and intensity. Be alert to upcoming auditions, music camps, and actual performances as these commitments often necessitate an increase in playing time or intensity. Previous injuries, prior attempts at diagnosis and therapy, concomitant illnesses, and any additional demands on the upper extremity (such as computer use or weight training) are important considerations for diagnosis and treatment (5).

**Physical Examination**

A good physical examination should include all of the standard elements found in a thorough musculoskeletal and neurological examination, including visual inspection, palpation of areas of concern and their supporting structures, assessment of active and passive range of motion, and special tests related to the muscles and joints in question. For example, scapular dyskinesis in instrumental athletes suggests inadequate balance in strength around the shoulder. Patients should be encouraged to bring their instruments to model how they typically play. Attention should be given to posture while playing, as this may provide clues to excessive muscle tension, imbalanced muscle development, and guarding or splinting because of pain (5) as well as evidence of fatigue and improper instrument fit. Also look for hyperlaxity and alterations in range of motion specific to the instrument (e.g., in pianists, facility with hand stretches over many keys or tightness of first dorsal interosseous muscles).

**Musculoskeletal Problems**

**Overuse Syndrome**

Overuse syndrome refers to pain symptoms associated with activity but without a specific diagnosis. Patients also may experience weakness or loss of fine motor control, but sensory loss likely will not be present. The mechanism of injury may be due to soft tissues that have been worked beyond their physiological limits. Overuse syndrome is remarkable, however, for a lack of histologic evidence of localized inflammatory changes that would correlate with symptoms. In the absence of recent injuries suggesting an acute inflammatory response, overuse syndrome may refer to tendinopathies, which are often characterized by degeneration and disorganization of collagen fibers and increased healing time (8). Brandfonbrener (5) cautions that pain constellations in musicians may not always be associated with typical upper extremity diagnoses such as tendosynovitis, epicondylitis, or De Quervain syndrome. Studies suggest that overuse syndrome may be the most common complaint of musicians, with prevalence greater than 50% in instrumental athletes (6,16).

Foundations of treatment include relative rest and physical rehabilitation. Nonsteroidal anti-inflammatory drugs (NSAIDs) prescribed in chronic tendinopathies are controversial (35) and require careful consideration in overuse syndromes given a lack of associated inflammatory processes. Appropriate instrument modification, by contrast, has shown some benefit (20). Violinists and violists, for example, often elevate and protract their shoulders, overusing the trapezi and neck muscles to hold their instruments. Elevating the chin rest and lowering the shoulder rest on these instruments are helpful to reduce shoulder tension. An optimized instrument position also may decrease the static tension required for left wrist positioning and fingering and may reduce the dynamic tension of the right bowing arm.

**Hypermobility**

Larsson et al. (25) proposed that hypermobility could be an advantage for musicians if occurring in joints responsible for intense repetitive motion. Hypermobility, however, also may be a disadvantage if stabilization of lax joints causes significant muscle tension (e.g., static support of instruments or stabilization of joints while playing). Joint laxity may occur in up to a quarter of the general population and is more frequent among women (44). Only a small portion of instrumental athletes will have a major syndrome such as Marfan or Ehlers-Danlos syndrome, and these should be ruled out by appropriate diagnostic testing.

Risk of injury is higher in persons with hypermobile wrists and fingers (7). The study of Larsson et al. (24) of 660 music students revealed that 27% had one hypermobile joint. Hypermobility of the wrist and thumb was greatest in flutists (63%), bowed string players (49%), and wind instrumentalists (47%) but was not always associated with pain while playing. Results did suggest that hypermobile musicians who played string, keyboard, or percussion instruments were more likely to complain of symptoms. Hypermobile distal interphalangeal (DIP) joints, proximal interphalangeal (PIP) joints, and sometimes metacarpal phalangeal (MCP) joints often collapse when in awkward playing positions. Antagonist muscles must then be recruited to stabilize lax joints, resulting in greater than necessary muscle tension and force and leading to muscle pain, impaired coordination, and problems with cocontraction of antagonist muscles.
Treatment includes appropriate carpal mobilization, strengthening of intrinsic hand muscles and shoulder and scapular stabilizers, splinting with soft or rigid wrist supports, elimination of inappropriate stretching programs, and taping. In addition, consideration may be given to application of silver ring splints to prevent DIP or PIP hyperextension (Fig. 1). Biofeedback with surface electromyography (EMG) can facilitate playing with less tension and cocontraction. Treatment also should include education on body mechanics and joint protection. Instrumental athletes may be counseled to modify or avoid activities that put excessive force on hypermobile joints, such as certain yoga movements, inappropriate use of free weights, and so on.

Shoulder Problems

Shoulder complaints are common among instrumental athletes and typically result from prolonged static or dynamic loads. Hoppmann (21) provides a summary of three common shoulder pathologies seen in instrumentalists: impingement, subacromial/subdeltoid bursitis, and bicipital tendinitis. Impingement results from compression of the supraspinatus tendon between the humerus and coracoacromial arch. Pain is often present between 60° and 120° of abduction, and frequently, there is tenderness over the greater tuberosity of the humerus. By contrast, subacromial or subdeltoid bursitis results from inflammation of the bursa under the acromion and deltoid muscle. Distinguishing between impingement and bursitis can be challenging, although pain with active shoulder abduction may suggest bursitis. Bicipital tendinitis results from inflammation of the long head of the biceps tendon as it passes through the bicipital groove of the anterior humerus. The biceps supinates and flexes the forearm, activities which are common among string players. Diagnosis may be accomplished by eliciting pain while rolling the long head of the biceps under the finger or with resisted supination. Treatment of the above shoulder conditions is typically conservative with consideration given to steroid injection.

Elbow Problems

Lateral epicondylitis refers to pain over the lateral bony surface of the elbow at the origin of the extensor carpi radialis brevis and longus tendons. Frequently referred to as “tennis elbow,” it is found in instrumental athletes such as percussionists who are required to perform repetitive wrist extension. Medial epicondylitis may accompany flexor tendinopathies or overuse. As noted previously, consideration should be given to acute inflammatory tendinitis versus chronic tendinopathy. Common diagnostic clues include local tenderness over the lateral or medial epicondyles, pain aggravated by resisted wrist extension or flexion, and normal elbow range of motion. Treatment includes relative rest, ice, consideration of acetaminophen or NSAIDs, the use of hands placed just distal to the elbow, and physical therapy. Systematic reviews have shown some benefit to corticosteroid injections at short-term follow-up, and physical therapy has been shown to be beneficial at intermediate and long-term follow-up, although lack of high-quality studies limits the conclusions that can be drawn from these reviews (4,40). There are encouraging results from ongoing research into alternative therapies such as injections of autologous whole blood, platelet-rich plasma, and botulinum toxin, as well as extracorporeal shockwave therapy, prolotherapy, and nitroglycerine patches (19,42).

Wrist and Hand Problems

Studies of occurrence of carpal injuries in instrumental athletes are not available; our Musicians’ Clinic has treated a few young pianists with wrist pain where magnetic resonance imaging (MRI) has shown edema of the lunate and stress fractures without other trauma or falls. Stress fractures of the scaphoid have been seen in gymnastics and other tasks requiring stressful wrist dorsiflexion and rotation (18). Presentation can include radial wrist pain, tenderness at the snuff box, and pain with range of motion. MRI may show sclerosis or cystic changes as well as Kienböck’s lesions (avascular necrosis of the lunate). Treatment consists of rest and immobilization. If lunate fracture is suspected or edema is seen on MRI, immobilization for 3 to 4 weeks in a thumb spica cast may be sufficient for healing. Longer immobilization and/or bone grafting may be needed if sclerosis and cystic changes are present in the lunate. Recovery also requires reconditioning and modification of playing technique to reduce forces affecting the wrist.

Triangular fibrocartilage complex

Persistent ulnar wrist pain may result from injury to the triangular fibrocartilage complex (TFCC). Even without trauma, degeneration of the TFCC has been shown to begin as early as the third decade of life (30). The TFCC provides a gliding surface across the distal face of the radius and ulna for flexion and extension; it also provides a mechanism for stable rotational movements of the radiocarpal unit around the ulnar axis. Nakamura et al. (32) showed that the TFCC twists at its origin during pronation and supination. The TFCC cushions the forces transmitted through the ulnocarpal axis. These areas are vulnerable in instrumental athletes such as pianists playing with excessive tension or pronation forces.
On examination, there may be wrist weakness, painful clicking with wrist ROM, ulnar deviation of the wrist, instability of the distal radioulnar joint, a prominent distal ulna with full pronation (called the “piano key” sign, Fig. 2), and tenderness at the lunotriquetral joint. If MRI shows tears in the central avascular portion of the TFCC, it must be debrided as there is poor potential for healing. Peripheral tears do much better with conservative treatment due to rich vascularization. Immobilization should be in slight flexion and ulnar deviation for 4 to 6 wk, followed by removable splinting and reconditioning. If not improved, then gentle debridement through arthroscopy is considered, and studies show good results among the general population for mild to moderately severe tears (34,36).

**De Quervain tenosynovitis**

De Quervain tenosynovitis results from thickening and stenosis of the abductor pollicis longus and extensor pollicis brevis tendons of the first dorsal compartment. This can occur with extensive playing of piano octaves (an expanse of eight keys) and large chords or when supporting an instrument on the thumb. Finkelstein’s test produces pain at the radial styloid. Conservative treatment includes a thumb spica splint or corticosteroid injection (11).

**Ganglion cysts**

Ganglion cysts have a low impact on functioning among the general population but may be more problematic for instrumentalists who perform repetitive wrist extensions. Treatment is difficult because evidence suggests that with observation, only 40% of lesions decrease over 6 years, most ganglions recur with aspiration, and surgical excision has a 10% recurrence rate with risk for scarring and other adverse effects (17).

**Osteoarthritis**

Osteoarthritis (OA) is a common complaint affecting aging instrumental athletes. Factors contributing to the development of OA include age, joint location, genetic predisposition, joint malalignment, trauma, and gender (12). Among instrumental athletes, it is unclear whether years of playing are protective of, or a risk factor for, OA. A small radiographic study of pianists practicing 2 h·d⁻¹ for at least 5 years revealed axial rotation of the ulnar digits along with degenerative changes at the MCP and DIP joints and evidence of sclerosis (3). Hoppmann (21) asserts, however, that current evidence does not suggest that repetitive stress significantly accelerates osteoarthritic processes unless joints experience high impact or have an underlying biomechanical abnormality.

Typical symptoms include pain worse with activity and improved with rest and joint stiffness after periods of inactivity. Physical examination often will reveal decreased range of motion, effusions, hypertrophy, crepitus, and/or instability. Radiographs often show a loss of joint space, subchondral sclerosis and cysts, and osteophytes at the joint margins. Among instrumentalists, OA of the thumb is common at the carpometacarpal joint. Examination may reveal a box deformity at the base of the thumb with tenderness to palpation and tenderness with axial loading of the first metacarpal against the first carpal. In addition to typical conservative therapies, instrumental modifications with posts and neck straps can unload forces on the thumb. Limited use of thumb splints also may be helpful. Referrals to hand surgeons experienced in working with instrumental athletes may be indicated in cases refractory to conservative treatment.

**Trauma**

Dawson (10) reported on the traumatic injuries of 276 professional and serious amateur instrumentalists treated in his hand surgery practice. The most common causes of injury were sports related (30.1%) or a fall or blow (32.6%). Among instrumentalists aged 10 to 40 years, sports were the most common cause of injury. Diagnoses included fractures (32.7%), sprains and strains (24.4%), and open wounds (10.8%). One hundred seventy-eight of these patients were followed to a final outcome, and 83.7% had a full return to performance, while 14.1% experienced a modified return.

**Neurological Pathologies**

**Nerve Compression**

Localized nerve compression in the carpal, cubital, or radial tunnel can produce paresthesias, pain, and weakness. Instrumental athletes require extraordinary dexterity and endurance, and this may be compromised by a mild compression neuropathy. It is important to ask if the onset correlated with changes in practice and playing habits, increased computer use, etc.. Observation of playing of the instrument can show if limb postures put certain areas at risk. EMG is particularly helpful for certain diagnoses but must be thorough and of good quality. Lederman’s series (26) shows that 95% of patients diagnosed with carpal tunnel had a positive EMG; however only about 50% of musicians with suspected ulnar neuropathy showed slowing of conduction velocities across the elbow. Needle stimulation and pickup and needle EMG of key muscles can aide in diagnosis of posterior interosseous nerve compression more than standard conduction studies.

Often, surgery can be avoided. Treatment should include reduction in playing time, modification of instrument or posture, nerve glide exercises, and nocturnal use of resting wrist splints for wrists or soft elbow splints to prevent elbow flexion. Yoga, biofeedback, first rib mobilization, postural...
correction, and the body awareness methods of Feldenkrais and Alexander may lower tension in playing and reduce local compression from spasm (31,38). Judicious local steroid injections also may be helpful.

**Carpal tunnel**

The incidence of carpal tunnel syndrome varies between 1% and 13% in Lederman’s series (26) of musicians, but overall, it is less than the general population. In addition to compression within the carpal tunnel, the median nerve also can be compressed more proximally at the thoracic outlet or more distally at the pronator region of the ulna and radius, causing a “double crush” syndrome (e.g., two sites of peripheral nerve compression, proximally and distally) or anterior interosseous neuropathies producing weakness in flexion of the tip of the thumb and index finger. Numbness or tingling in the thumb, index, and/or middle finger also may be due to temporary median nerve irritation from flexor tendinopathies. Treatment includes hand therapy for flexor tendinopathies, resting splints, thicker handled utensils and pens to reduce tension while grasping, and thicker bow handles to decrease flexor overuse. Surgery is reserved for persistent or worsening symptoms, but instrumental athletes should be careful about rapid return to play.

**Cubital tunnel compression**

The ulnar nerve lies superficially in the ulnar groove and is vulnerable to external compression as well as stretching. Cubital tunnel compression at the elbow is more common with instruments such as guitar or flute, which require prolonged static or repetitive elbow flexion plus supination. Pain may occur above the elbow and down the ulnar forearm or hand, tingling or numbness affects the fourth or fifth fingers, and there may be intrinsic weakness. Conservative treatment includes activity modification, a night splint that restricts elbow flexion, breaking up practice time, nerve glides, and modification of daily activities. For younger individuals with cases refractory to conservative management, surgical treatments such as anterior transposition can be effective, but there are less dramatic improvements using a variety of techniques for long-standing problems (9,14).

**Radial tunnel compression**

Radial tunnel compression can occur from extensor overuse or if there is vulnerable anatomy. Dynamic compression of the posterior interosseous nerve results in pain medial to the lateral epicondyle with playing. Typically pain occurs with repetitive movements incorporating forearm pronation with wrist flexion, resisted extension of the middle finger with elbow extended and with palpation over the radial nerve in the dorsal forearm. Nerve block confirms the diagnosis. Rest and splinting are usually only temporarily effective and careful surgical release can produce good results without weakness. In surgery, it has been noted that pronation of the forearm with wrist flexion can produce compression at the margins of the extensor carpi radialis brevis or at the Arcade of Frohse (29,41).

**Thoracic outlet syndrome**

Thoracic outlet syndrome can produce ulnar greater than radial forearm and hand discomfort and variable paresthesias in some or all fingertips. Most of the time, EMG studies are negative and imaging of the brachial plexus does not show abnormalities. Lederman (28) notes that a majority of patients have a “droopy shoulder” configuration. These symptoms can result from an elevated first rib and poor posture with protracted shoulders. Often patients describe temporary relief when they retract their shoulders. Thoracic outlet stretches, first rib releases, and strengthening of shoulder and scapular muscles may reduce symptoms. Surgery is rarely needed and should be avoided.

**Cervical radiculopathy**

Cervical radiculopathy in instrumental athletes may be particularly symptomatic if playing position requires fixed and awkward neck postures. However, there does not seem to be increased incidence of cervical radiculopathy in violinists (28). If there is left sided C5, C6, or C7 foraminal stenosis or nerve compression, then neck posture and muscle tension when holding the violin or viola may contribute to increased symptomatology. Along with usual conservative treatment including cervical traction and medications such as NSAIDs, steroids or gabapentin, the chin rest should be elevated and the shoulder rest minimized to reduce shoulder elevation and protraction along with neck flexion and rotational tension (33).

**Other nerve entrapments**

Other nerve entrapments can involve sensory impairment of the lip in brass instrumentalists resulting from localized excessive pressure on the lip from the mouthpiece against the dental ridge (27). Digital neuropathies may be seen in flutists as they brace or rest the radial aspect of their left index finger against their instrument. These usually resolve with reduction in playing time and technical changes.

**Focal Dystonia**

Focal dystonia consists of involuntary movement of limbs (often fingers or wrists) that occur when a specific motor task is attempted. Even a mild focal dystonia can derail a career due to the accuracy demanded of instrumental athletes. Focal dystonia is painless, although a feeling of tightness and aching may occur. Onset is insidious, affecting only a particular finger or phrase and then generalizes to other phrasing or tasks. Up to one third of patients may have genetic susceptibility, but most patients have a history of excessive practicing of repetitive stereotypical rapid movements. It most often affects the hand with the most complex demands, i.e., the right hand in pianists and the left hand in guitarists and string players. Strategies of nonmusician patients to overcome focal dystonias do not seem to work as well with instrumental athletes (15).

Research with functional neuroimaging shows redistribution or expansion of representation of the affected fingers in the sensory and motor cortices. It is felt that the overlapping receptive fields impair the central nervous system organization required to control individual digits. There are changes in spatial and temporal sensory processing as well as lack of inhibition of motor processing in the cortical areas for specific movements (21). EMG of affected muscles during movements that elicit symptoms shows inappropriate agonist-antagonist contraction.
Diagnosis is usually by observation of the instrumental athlete playing his or her instrument and also performing nonmusical tasks. Treatment is prolonged and prognosis is guarded; few instrumental athletes are able to return to a full performing career. Practicing harder does not help (15). There have been rare cases of improvement with oral trihexyphenidyl or baclofen (1) or botulinum toxin injection (39). Biofeedback and retraining at slow speeds (37), rest from the instrument (months to years), modification of the instrument and posture, treatment of underlying conditions, sensory reeducation, and even strategic immobilization (similar to constraint-induced therapy) are beneficial.

Embouchure dystonia can affect face, jaw, and tongue muscles of brass or wind players. For those patients in early stages, dental treatment, changes in type or size of mouthpiece, specialized speech therapy, and biofeedback may be helpful (45).

General Principles of Treatment

Brandonrener (5) suggests that the focus of treatment of instrumental athletes should be noninvasive. For example, in a retrospective review of 825 musician patients presenting to hand surgery with upper extremity problems, only 4% had a condition suitable for surgical treatment (43). Experience suggests that modified rest is better than absolute rest to minimize the deterioration of skills and to reduce symptoms of anxiety and depression while not playing. General treatment should include postural optimization, strengthening of shoulder and intrinsic hand muscles, endurance training over strength training in muscles with static demands, and modification of stretching exercises in patients with hypermobility. Intermittent splinting when appropriate is better to maintain conditioning than prolonged splinting. Steroid injections should be judicious and used only if other conservative therapy has failed. With a good partnership between the instrumental athlete, physician, therapists, managers, and teachers, the patient has a good prognosis to return to meaningful and pleasurable playing of his or her instrument.

Conclusions

There is much to be gained in the collaboration between practitioners of sports medicine and performing arts medicine, although effective cooperation will require delineating the similarities and differences among the unique problems of sports athletes and instrumental athletes. Given the demands of excellent musicianship, many instrumental athletes experience musculoskeletal or neurological problems that affect their careers or even their enjoyment of music as a hobby. History and physical examination should be tailored to the special circumstances and characteristics inherent in the performance of instrumental music, and diagnosis necessitates a thorough understanding of the common and not-so-common problems unique to instrumental athletes. Approaches to treatment tend to be more conservative, with surgical considerations occurring only in a relatively small number of cases. It is important to build relationships with other providers such as hand therapists and specialists with appropriate interest, training, and experience in working with musicians. Ultimately the care of instrumental athletes who themselves are committed to the communication of beauty and universal themes through music can be a very gratifying endeavor.

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References