



■ INSTRUCTIONAL REVIEW

Hand disorders in musicians

THE ORTHOPAEDIC SURGEON'S ROLE

S. Sheibani-Rad,
S. Wolfe,
J. Jupiter

From McLaren
Regional Medical
Center/Michigan
State University,
Flint, Michigan,
United States

Like athletes, musicians are vulnerable to musculoskeletal injuries that can be career ending or have a severe negative financial impact. All ages are affected, with a peak incidence in the third and fourth decades. Women are slightly more likely to be affected than men. It is incumbent upon orthopaedic surgeons to be able to complete a thorough physical assessment, be aware of the risk factors associated with musculoskeletal symptoms in musicians, and have a detailed knowledge of the specific syndromes they suffer and their appropriate treatment.

In this paper we review the common hand injuries that afflict musicians and discuss their treatment.

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Musicians, like athletes, are prone to musculoskeletal injuries. These injuries can end a career or affect the individual's earning potential, but a successful return to musical activity can usually be achieved following appropriate treatment. In 1990 Amadio and Rusotti¹ evaluated a series of 100 musicians, including 86 professionals, 85% of whom returned fully to musical activities and status following treatment. According to the Bureau of Labor statistics, in 2006, 264 000 musicians were employed in the United States, and musculoskeletal injuries were reported in 50% to 76% of professional musicians.^{2,3} In a study at the University of Texas, the prevalence of these injuries among brass instrument players (French horn, trombone, trumpet, tuba) was 61%.⁴ All ages were affected, with a peak incidence in the third and fourth decades, and women were slightly more likely to be affected than men.⁴ In a study performed by the International Conference of Symphony and Opera Musicians, 70% of women and 52% of men had performance-related musculoskeletal symptoms.⁵ The discrepancy between the genders may be attributed to the smaller anatomy of and diminished muscle mass in women.⁶ Hand and wrist injuries are particularly common in performers, especially pianists and string players.^{7,8} It is important for an orthopaedic surgeon to be aware of these injuries so that early and effective treatment may be instigated. In this paper we review the common hand injuries that afflict musicians, and discuss the risk factors for their development and the methods of treatment.

History and examination

As there is fierce competition for work, musicians may be reluctant to complain of injury or impairment. A musician may also believe that a surgeon lacks an understanding of their particular demands and requirements, or of the characteristic injuries and their treatment and rehabilitation. The musician may also ignore the symptoms for some time.

Most of a musician's work is performed by the upper limbs, so the shoulders, elbows, wrists and hands are the most frequently affected site of symptoms, at incidences of 18%, 9% and 9%, respectively.⁹ As part of a careful history hand dominance should be recorded and the role of each hand in playing their particular instrument. Pain is the most common primary symptom and is usually described as aching, burning, electrical or pulsating.¹⁰ It is important to ask whether the pain occurs during or after playing the instrument, and to know what happens to the pain during all aspects of playing. It should be noted whether the symptoms interfere with performance or practice. It is important to elucidate the technique used when holding and playing the instrument, as well as practice habits, which should include any changes of instructor or conductor, practice hours, warm-ups before and cool-downs after rehearsals, breaks during rehearsals, and changes in the conditions of practice (Table I).

Modifications to the instrument are also important. It is particularly important to inquire about the position the musician adopts

■ S. Sheibani-Rad, MD, MS,
Orthopaedic Surgery Resident
McLaren Regional Medical
Center/Michigan State
University, 401 South Ballenger
Highway, Flint, Michigan 48532,
USA.

■ S. Wolfe, MD, Chief, Hand
Surgery
Hospital for Special Surgery,
535 East 70th Street, New York,
New York 10021, USA.

■ J. Jupiter, MD, Director,
Orthopaedic Hand Surgery
Massachusetts General
Hospital, 15 Parkman Street,
Boston, Massachusetts 02114,
USA.

Correspondence should be sent
to Dr S. Sheibani-Rad; e-mail:
shahin.rad@gmail.com

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Table 1. Risk factors for musculoskeletal injury in musicians

Risk factor
Increase in playing time and/or degree of intensity
Recent change in musical instructor/conductor
Female gender
Awkward posture during playing
Joint laxity
Poor fitting of musical instrument
Repetitive movements
Improper technique during playing
Stress (e.g. new job)

while playing, the seat, stand height, and precise posture during play. The physician should also ask about any other daily professional, occupational or recreational activities, as these can be a source of symptoms. How the patient deals with the pain, including changes in posture or playing technique, amount of playing time, medications and previous interventions, should be noted. Any 'home remedies' or alternative treatments used should also be recorded. It is important to take a full history, including mood changes, anxiety, sleep disturbance, weight change and fatigue.

Musicians perform a detailed self-examination of their limbs whenever they perform, and so are aware of 'abnormal' signs or findings in their hands and arms. A methodical and comprehensive examination of the hands should be carried out. The entire upper limb, including the shoulder and cervical spine, should be exposed for examination. The musician should be asked to bring their instrument to the consultation, as this allows the surgeon to observe the positioning of the hands and fingers, and joints, the degree of movement when the instrument is played, and weight-bearing. This also allows the inspection of posture with and without the instrument, as musicians may sit or stand in an abnormal posture for a long period of time. It may be also be helpful to videotape the sessions for the analysis of movement.

Any atrophy, asymmetry, deformity, swelling or lesions should be noted. Pulses, peripheral sensation, ligamentous laxity, crepitus and coordination should be assessed. Fasciculations, tics or other involuntary movements should be recorded. Any nodules and triggering should be noted. The injured area needs to be palpated for tenderness, and the patient should perform range of movement exercises of the affected limb. Tenderness is often related to the posture in which the instrument is played, and to the body part(s) that are stressed by the instrument.

Additional testing should include Tinel's test (tapping over the carpal tunnel in order to reproduce pain, numbness or tingling caused by median nerve compression), Phalen's test for median nerve compression (full flexion of wrists and adduction of dorsal surfaces of hands together, with reproduction of pain, numbness or tingling after 30 seconds being a positive test), Finkelstein's test for tendinopathy (reproduction of pain through passive ulnar

deviation of the wrist) and Allen's test for vascular insufficiency. Neurological examination should include tendon reflexes, strength, position sense, coordination, sensitivity to touch and two-point discrimination.^{11,12}

Types of disorder

Overuse syndrome. The most common problem is overuse, which is poorly defined but represents the culmination of playing past the point of muscle fatigue.¹³ The most important factor is the constant repetition during intense practice sessions. Other risk factors include physical disproportion between instrument and musician, poor posture, fatigue, excessive finger angulation, increase in playing time and female gender.^{14,15} This condition causes tissues to be stressed beyond their anatomical and physiological limits. Over 50% of professional musicians overuse their limbs with consequent pain.¹⁶ It occurs frequently in the forearm and hand, presenting as weakness, tingling, stiffness and lack of dexterity. There is usually minimal tenderness on examination.

There are many theories regarding aetiology of overuse syndrome. Amadio¹⁴ proposed injury to muscles, tendons, joint capsules and ligaments as the cause. Bengtson et al¹⁷ studied five musicians with suspected overuse, without clinical evidence of inflammation, using pre- and post-exercise MRI; only one had any abnormalities, with a small area of non-specific T₂ signal enhancement. To date, no definitive cause has been found.

There are two phases in the treatment of overuse syndrome. In the acute phase treatment begins with rest, ice, short term anti-inflammatory agents and modification of activity. A minimum of 12 weeks' rest is advocated.¹³ Although not definitively shown to change the natural history of the condition, ergonomic modifications such as straps, altering the keys on woodwind instruments and chair adjustments can be instituted. In the rehabilitation phase a programme of physical conditioning, including aerobic activity, parascapular strengthening, postural exercises and core strengthening, should be instituted as pain diminishes. Up to 80% of patients have been reported to respond successfully to this regime, allowing them to return to a normal playing schedule.¹⁸ There are no data to suggest that long-term overuse syndrome becomes a chronic condition.

Entrapment neuropathies. Musicians are not immune from the two most common entrapment neuropathies of the upper limb: of the median nerve at the wrist, and of the ulnar nerve at the elbow.¹⁹⁻²¹

In 1983, Hochberg et al¹⁹ reported nerve entrapment in 15 of 100 musicians studied: the median nerve was the most common, followed by the ulnar nerve. In 1986, Lederman²⁰ reported that 143 of 640 musicians (22%) had an entrapment neuropathy. Of these 143 patients, 45% had entrapment of either the median or the ulnar nerve. These authors hypothesised that the playing position of the musician was an important factor in aggravating the condition. Pain and sensory abnormalities may extend beyond the territory of the affected nerves. Symptoms precede weakness

and atrophy of muscles. In cases of pathological entrapment, the symptoms are present regardless of whether the musical instrument is being played. Ulnar neuropathy is manifested predominantly by sensory symptoms; intrinsic motor weakness appears relatively late.²² Ulnar nerve entrapment is most frequently seen in the bowing arm of string players; in pianists it may be bilateral, or it may affect the extended and radially deviated hand of flautists.^{23,24}

The assessment of entrapment neuropathies is similar to that in non-musicians. The emphasis is on physical examination as well as provocative manoeuvres. Early diagnosis of neuropathy in musicians may be difficult, as pain is the presenting symptom and sensory abnormalities may be subtle or dynamic.²⁵ Electrodiagnostic testing may be the most sensitive investigation for nerve compression,¹⁴ but these tests are often normal in musicians as their symptoms are intermittent. Surgical decompression should be done cautiously if at all when electrodiagnostic studies are non-confirmatory.²⁶ Nerve conduction studies may be particularly helpful for ulnar nerve entrapment when localisation is difficult.²⁶

Conservative management with rest, splints and anti-inflammatory medication may be adequate in early entrapment syndromes. Proper body mechanics, modification of technique, postural exercises and conditioning also play a role. Inadequate response to conservative management, longstanding paresthesiae and muscle atrophy are indications for surgical management, provided electrodiagnostic testing is confirmatory.

When performing surgery, it is important to have a clear visualisation of all underlying structures. Although not mandatory, open carpal tunnel and cubital tunnel release may be more appropriate than an endoscopic technique to minimise potential nerve injury. Whether or not the ulnar nerve is transposed at the elbow is largely a matter of surgical preference. Outcomes have been successful in musicians with all these types of treatment.¹⁸

Focal dystonia. Focal dystonia is a painless disorder of motor control. In musicians it consists of spasms, sustained muscular contractions or posturing of isolated muscle groups, and interferes with the ability to perform without any obvious central or peripheral neurological cause.²⁷ Its incidence is estimated to be one in 200 musicians.²⁸ Keyboard players are most commonly affected, and it was originally described by British physician Dr Vivian Poore in 1887 as 'pianist's cramp'.^{29,30} It accounts for a small proportion of upper limb problems in musicians, and evolves very slowly over many years.^{31,32} The aetiology remains unknown and the diagnosis itself is controversial. Wilson, Wagner and Hömberg³³ reported that musicians with focal dystonia have reduced passive and/or active abduction between the central digits of both hands compared with unimpaired musicians, suggesting that this was an important factor in the development of the condition. In another theory, a process mediated in the basal ganglia is implicated as a cause.³⁴ Gavarini et al³⁵ reported that 68% (17 of 25)

of affected patients have MRI changes in the putamen, which supports the earlier theory of a central origin. It has been reported that increased sensory input through light touch or vibration can induce temporary relief of dystonia.³⁶ In a study of 18 musicians, Berque et al³⁷ found that a combination of constraint-induced therapy and specific motor control retraining may be a successful strategy for the treatment of musicians' focal dystonia.

The diagnosis and treatment are challenging, as there is no consensus on the diagnostic criteria.^{36,38} It is a clinical diagnosis, with symptoms that occur almost exclusively while playing the instrument, and include involuntary movements and postures. The patient should be examined while performing. Focal dystonia should be differentiated from other disorders in the hand, including the exceedingly rare exertional compartment syndrome of the intrinsic muscles, and compression neuropathy. To date, no proven treatments are available. Drugs such as baclofen and anticholinergics may provide modest relief.³⁹ Santamato et al⁴⁰ reported successful results with injections of botulinum toxin in a 25-year-old woman with focal dystonia. After five days of treatment with botulinum toxin type A to the flexor pollicis longus and the abductor pollicis brevis, she reported regression of most of her signs and symptoms; this was maintained at two-month follow-up.⁴⁰ Great caution should be used with botulinum toxin in performing artists, as there is a lack of trained providers, and weaknesses may outweigh the perceived benefits.⁴¹ Deep brain stimulation has received some attention as a safe form of treatment.⁴²

Osteoarthritis. Osteoarthritis (OA) is common in musicians, as a typical musician will have started his career at a young age, and many continue to perform at an intense rate well past the age of 80 years. No clear correlation has been established between the long-term playing of a musical instrument and the development of degenerative arthritis of the hand joints,⁴³ yet OA of the hands, either as a part of the patient's genetic predisposition or secondary to trauma, is sufficiently common in the general population for it to affect musicians. The main symptom of arthritis is pain.¹⁴ The most commonly affected joints of the hand and wrist are the carpometacarpal (CMC) joint of the thumb, the scapho-trapezio-trapezoid joint, and the distal interphalangeal (DIP) and metacarpophalangeal (MCP) joints. The most debilitating features are pain and loss movement. Other conditions, such as DeQuervain's tendinopathy, overuse and rheumatological conditions should be excluded.

There are few reports on the incidence of OA in performing artists. In 1984, Bard, Sylvestre and Dussalut⁴⁴ evaluated radiographs of the hands of 20 pianists and described an occupational entity called pianist's osteoarthropathy. The changes were characterised by altered alignment, consisting of axial radial rotation of the digits, particularly the fifth but also the third and fourth; degenerative changes at the DIP and MCP joints; and remodelling manifested as periosteal thickening and flattening of the phalangeal tufts associated with sclerosis. Only one patient was symptomatic,

suggesting that this may be more of an adaptive than a pathological condition.⁴⁵ As with other forms of OA, symptomatic management consists of splinting, non-steroidal anti-inflammatory medication and/or acetaminophen. Schwartz and Peimer⁴⁶ described a 70-year-old concert violinist with osteoarthritis of the DIP joint of the left index finger that limited his ability to play. A Swanson hinge arthroplasty (Wright Medical Technology, Arlington, Tennessee) was implanted and he returned to playing the violin professionally. Resection arthroplasty is the treatment of choice for symptomatic basal joint arthritis of the thumb with or without tendon interposition or reconstruction.⁴⁷

Joint hypermobility. The term hypermobility refers to increased movement beyond the normal range. Its prevalence is between 5% and 25% in musicians^{48,49} and is more common among musicians than in the general population,⁴⁹ which may be as a result of genetically hypermobile individuals becoming top-level musicians. However, hypermobility may adversely affect the playing of an instrument in several ways. Increased laxity can result in instability, or lead to the development of synovitis or neuropathy.^{42,50}

Larsson et al⁴⁹ studied 660 musicians and suggested that acquired laxity may be the result of chronic ligamentous stress in the first MCP and carpometacarpal (CMC) joints of string, woodwind, bass, cello and keyboard players. Increased laxity increases the load placed on the thenar muscles to provide dynamic stabilisation, leading to fatigue, spasm and pain. Interestingly, these authors found an inverse correlation between hypermobility of the wrist and symptoms: 5% of those with hypermobile wrists had pain, whereas 18% of those without hypermobility had pain. They concluded that hypermobility may be beneficial in joints that are subjected to repetitive movement, and detrimental in joints subjected to static loads.⁴⁹ Clearly, further research is needed in this area.

Treatment is based on the principle of offloading stressed joints and improving stability through strengthening and increasing muscle tone. Customised splinting to prevent gross instability may be helpful. In refractory cases, surgical treatment of the base of thumb or MCP joint hypermobility may be helpful, but should only be undertaken after all conservative measures have failed.⁴⁷

Thoracic outlet syndrome. Thoracic outlet syndrome is caused by neural or vascular compression between the neck and the axilla. It is common in musicians (9% to 13%¹³), especially flautists, most probably because of their posture when playing.¹³ Obesity is also a risk factor, and it is more common in women than men.⁵¹

Non-surgical treatment consisting of non-steroidal anti-inflammatory agents, weight loss, strengthening exercises and postural changes are the first-line treatment. If these remedies fail, surgical management may be needed.¹³ Lederman⁵² reviewed the treatment of 17 musicians with thoracic outlet syndrome, 15 of whom were treated conservatively with resolution of symptoms in 11; two underwent resection of the first rib also with resolution of symptoms.

Surgical assessment

Musicians have particular problems; they sometimes have several jobs to make ends meet, their leisure activities may involve playing their instrument and their occupation places higher demands on their hands than most others. Thus, besides a thorough history and physical examination, a period of observation during rehearsal may be indicated before any consideration of surgery.⁵³ A musician is likely to be hesitant to undergo surgery to their hands, considering the potential effects on their livelihood.

The orthopaedic surgeon must be aware of the anatomical requirements of the musician. For example, violinists use one hand in pronation and the other in supination. Pianists require good lateral movement of the fingers, but place less demand on flexion and extension.

Surgical indications must be sound, confirmed by appropriate diagnostic studies, and supported by a comprehensive non-operative programme. The surgeon must ascertain the impact of surgery on the performance of the musician with respect to mobility, strength, stability and length of digit. Musicians with a focal peripheral nerve entrapment as confirmed by electro-diagnostic (EMG) studies, and in whom conservative treatment with night splinting and modification of activity has failed, may respond well to surgical decompression.⁵⁴ In other patients, who have pain without focal findings, conservative measures should suffice.

In summary, musicians present with a variety of symptoms in the hands and a knowledge of their presentation is important for an orthopaedic surgeon. The surgical assessment of a musician involves a plethora of issues that may not affect the general population.

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