

Overuse Syndromes in Instrumentalists

Richard J. Lederman, M.D., Ph.D., and Leonard H. Calabrese, D.O.

The concept of overuse is well known in industrial medicine¹ and sports medicine² and appears to be relevant to the medical problems of performing artists as well.³ Overuse has many forms. We have all experienced the discomfort of acute overuse, with its attendant localized muscular pain, soreness, and stiffness. Chronic overuse, sometimes called repetition strain injury or occupational cervicobrachial syndrome, is a more subtle but also more important cause of disability in industrial workers, athletes (both professional and recreational), and performing artists. In this review, we will define and characterize the phenomenon of overuse injury, discuss the various syndromes that may be seen with overuse in the instrumental musician, particularly those problems involving the upper extremity, and outline an approach to prevention and treatment.

Overuse injury may be defined as the damage that occurs when a tissue is stressed beyond its anatomic or physiologic limits, either acutely or chronically. This may result in a series of pathologic changes characterized by microscopic tears, subsequent edema and hemorrhage, invasion by inflammatory cells, and ultimately (if not reversed) fibrin deposition, organization, and adhesion (scar formation).^{4,5} Because these changes may occur in multiple tissues simultaneously, because affected tissue is generally not available for microscopic examination, and because the clinical symptoms and physical signs are often insidious in onset and poorly localized, the syndromes as-

sociated with chronic overuse are frequently ill-defined. The potential irreversibility of the pathologic changes outlined above makes it important to recognize these symptoms and signs in the incipient stages. Our efforts must therefore be directed toward early diagnosis and proper management; ultimately, of course, the goal should be prevention.

Overuse injury occurs when a tissue is stressed beyond its anatomic or physiologic limit.

For purposes of review, we have elected to group the overuse syndromes into five categories, based upon the predominant pathophysiologic manifestations. It must be emphasized that, as noted above, multiple tissues may be simultaneously or sequentially affected. Injury to one tissue may place added strain upon another. The musician may contribute further to this in attempting to compensate for the initial symptoms by altering technique in a manner that subsequently injures a different set of tissues. The five categories of overuse syndromes include (1) those involving bones, joints, and bursae, (2) disorders of the musculotendinous unit, (3) primary muscular pain or cramp, (4) nerve entrapment, and (5) the poorly characterized group collectively known as occupational palsies.

Bone, Joint, and Bursal Syndromes

While bones are the structures that provide the greatest stability to the body, they are not static tissues, but clearly can be molded in response to stresses placed upon them. The long bones of a heavily utilized limb, as in a tennis

player or baseball pitcher, may hypertrophy in response to the increased workload imposed upon them.⁶ By itself, however, this enlargement of bone would not be expected to cause symptoms. More localized bone hypertrophy most frequently occurs in the spine in response to the altered stresses associated with degenerating intervertebral discs. Bone overgrowth may also occur near the true joints of the vertebral column, the facet articulations, or at any other joint in the form of spurs. This may cause symptoms by interfering with normal joint mobility or by impinging on adjacent structures such as nerves or tendons. Aging and major trauma are related to disc degeneration and spur formation but it is also likely that recurrent minor trauma, as may be associated with repetitive spine movement or prolonged static loading, contributes.

Microfractures of bone or "stress fractures" are considered to be a sequela of repetitive impact-loading and are the most serious overuse injury of bone. These may occur in the absence of a history of a precipitating event and are frequently observed in the lower extremities of runners and ballet dancers, but are unlikely to occur in the instrumentalist. Untreated, these may lead to major fractures.

There has been considerable controversy regarding the role of minor trauma or joint usage in the development of osteoarthritis. Acheson et al.⁷ showed that osteoarthritic changes in the hands, as demonstrated by x-ray, were more prominent in the dominant (and by inference the more often used) hand. Hadler et al.⁸ analyzed both clinically and radiographically three groups of textile workers performing tasks requiring different hand movements. They confirmed the asymmetry with handedness and also correlated the severity and location of joint changes with the degree and type of hand usage. Bard et al.⁹ studied hand

From the Departments of Neurology (Dr. Lederman) and Rheumatic and Immunologic Disease (Dr. Calabrese), and the Medical Center for Performing Artists, Cleveland Clinic Foundation, Cleveland, Ohio. Address correspondence to Dr. Lederman, Department of Neurology, Cleveland Clinic Foundation, Cleveland, OH 44106.

radiographs of 20 pianists and found degenerative changes in the right hand more often than in the left, particularly in the ring and little fingers. To our knowledge, there has been no attempt to determine the prevalence of such changes in a large group of musicians or to study the evolution of these changes over time.

Ligament damage may also occur with overuse, giving rise to localized pain and joint hyperextensibility. Hochberg et al.¹⁰ reported strain of the ulnar collateral ligament of the thumb in a clarinetist; Shulman and Milberg¹¹ described a radial collateral ligament swelling and tenderness with prolonged English horn playing.

Bursae are synovial-lined sacs located at points where muscles and tendons impinge on bone. There are more than 80 of these on each side of the body and most are un-named. Inflammatory changes in bursae and the overlying tendon often coexist and it may be difficult to differentiate one from the other clinically, particularly in the shoulder. Bursitis certainly can occur in the face of repeated movement or prolonged body positioning, as attested by the number of "occupational" bursitis syndromes.^{12,13}

Musculotendinous Unit Syndromes

Muscle-tendon syndromes are common in industrial workers^{14,15} and appear to be common in musicians as well.^{10,16} A variety of terms are used to describe these disorders. Epicondylitis at the elbow is an inflammation of the tendon attachment at the lateral ("tennis elbow") or medial ("golfer's elbow") epicondyle of the humerus. It appears to be caused by repeated overload to the musculotendinous unit attaching at these sites and is most often related, in the tennis player at least, to imperfect technique. Tendinitis refers to inflammation of the tendon itself, and tenosynovitis to involvement of the sheath surrounding the tendon. These terms are often (incorrectly) used interchangeably. It may be difficult to determine the exact site of pathologic change, particularly in the more chronic overuse syndrome. In actuality, the obvious changes of inflammation (heat, swelling, redness) are rarely seen in musicians or in most industrial workers, for that matter. The muscle-ten-

don syndromes are generally characterized by pain and localized tenderness over the tendon or adjacent muscle. Typically, there is increased pain on stretching the involved muscle or upon contracting it against resistance. In view of the lack of signs of inflammation in the large majority of these patients, perhaps a term more accurate than tendinitis is "musculotendinous overuse syndrome," although the former has the advantage of simplicity and longstanding common usage.

In musicians, as in industrial workers,¹⁵ pain is most commonly noted in the wrist, hand, or proximal forearm. Patients may report swelling or weakness, but rarely is there objective evidence of either. In the forearm and wrist, the extensor muscles are more likely to be affected than the flexor groups, a situation again similar to that seen in industrial workers.¹⁴ Upper arm and shoulder pain are somewhat less common although tendon injury may be associated with acromiohumeral impingement.

Muscle Pain Syndromes

Pain of apparent muscular origin is an extremely common clinical problem and one to which the performing artist is not immune. Muscular pain syndromes are a heterogeneous and frequently difficult group of disorders to evaluate.¹⁷ Many of these patients have what has been variously called myofascial pain, tension myalgia, fibromyalgia, or fibrositis.¹⁸⁻²⁰ While there may be obvious points of overlap between these muscle pain syndromes and the musculotendinous pain syndromes, the groups are usually quite readily distinguished. The characteristic fibrositis syndrome, with its diffuse muscular pain, multifocal trigger sites, and sleep disturbance, has been relatively infrequent in our musician-patients. A more localized form, which has been called a "referred pain syndrome," may more closely approximate what we have classified here as musculotendinous overuse.¹⁸ Acute, subacute, or occasionally chronic neck, upper trunk, or lower back pain syndromes may occur in response to unusually lengthy or intense practice sessions or rehearsals, prolonged carrying of heavy instruments, or adverse conditions such as cramped quarters or poorly designed chairs.

Neck, upper trunk, or lower back pain syndromes may occur in response to unusually lengthy or intense practice sessions or rehearsals, prolonged carrying of heavy instruments, or adverse conditions such as cramped quarters or poorly designed chairs.

Muscle cramp, which may be painful or painless, is another symptom of a heterogeneous and poorly understood group of ailments, represented at one end of the spectrum by a number of rare diseases and at the other as an almost universally-experienced phenomenon, often triggered by unaccustomed movement or prolonged muscular activity.²¹ Virtually any muscle may be involved, including a limb muscle in string or keyboard instrumentalists and a lip or palatal muscle in windplayers. Muscle cramps are generally transient and reversible, although sometimes annoyingly recurrent. A special form of cramp, commonly called occupational palsy, is discussed below.

Nerve Entrapment Syndromes

One may argue with the decision to include entrapment neuropathies among the overuse syndromes. However, symptoms of nerve compression may mimic or overlap those of musculoskeletal origin (e.g., radial tunnel syndrome), nerve entrapment may be associated with or precipitated by musculotendinous injury (e.g., carpal tunnel syndrome), and repetitive movement against resistance may at times lead directly to compression of nerve at specific locations.

Entrapment nerve injury tends to occur at predictable sites at which the nerve passes between relatively rigid structures such as bone, ligament, tendon, or muscle, or close to the body surface where the nerve may be compressed externally. Symptoms most often include pain, which may be aching in quality and poorly localized, and

paresthesias, characterized as numbness, tingling, burning, itching, or even swelling, usually localized to the distribution of the nerve in question. Sensory loss may be subtle or non-existent, especially in early or mild cases, and weakness is generally a late phenomenon. Characteristically, symptoms may be reproduced by tapping over the site of entrapment or may be aggravated by certain provocative maneuvers. Electrodiagnostic studies are often extremely helpful in diagnosis.

A more detailed description of these disorders is the subject of another report.²² The nerve compression syndromes affecting the upper extremity include cervical radiculopathies, the thoracic outlet syndromes, and the more distal entrapments. Cervical root compression, usually involving the sixth, seventh, or eighth cervical roots, occurs most commonly in association with spondylosis or disc herniation. The thoracic outlet syndromes are a controversial group of disorders having the common features of pain or aching of the forearm or hand (often associated with certain positions), and paresthesias, most often involving the medial (ring and little) fingers, hand, and forearm. There are probably several different types and more than one pathogenetic mechanism.^{23,24}

Entrapment of the major nerves in the forearm and hand may occur at multiple sites. The median nerve is most commonly involved at the wrist (carpal tunnel syndrome) but may be entrapped more proximally in the forearm (pronator syndrome) or distally in the fingers (digital branches). The ulnar nerve is most often compressed at the elbow, either in the condylar groove ("funny bone") or just distal to it by muscular or fibrous structures (cubital tunnel), and occasionally at the wrist or in the palm. The radial nerve is less commonly involved in instrumentalists. Entrapment of the posterior interosseous branch may occur in the proximal forearm and may, on occasion, mimic the syndrome of lateral epicondylitis ("resistant tennis elbow" or radial tunnel syndrome). Entrapment neuropathies in the trunk or lower limbs are uncommon in instrumental musicians, although two case reports have appeared involving the saphenous nerve in viola da gamba players.^{25,26}

Occupational (Craft) Palsies

This group of poorly understood ailments may be characterized as disorders of motor control. Gowers²⁷ provided the classic example of this overuse syndrome in his description of writer's cramp. Poore²⁸ reported 21 cases of a similar phenomenon in pianists, occurring almost exclusively (19/21) in females and affecting the left hand more often than the right. Hunter²⁹ lists various instrumentalists in whom this may be seen. The muscles affected are generally those involved in complex repetitive movements. While the upper extremity is by far the most commonly involved, muscles of the head, neck, lips, or tongue may be the target.^{29,30} The initial symptom may be a cramp or spasm in the muscles participating in the movement; pain or aching and tremor may also be seen. Ultimately, smooth coordinated movement becomes impossible, initially just for the offending activity only and often only after prolonged use. Eventually the symptoms may impair performance immediately after initiation and may spread to other activities involving the same limb. Etiology of these and related disorders of motor control remains elusive. Most would now agree that a purely psychogenic process is unlikely. Sheehy and Marsden³¹ argue strongly that these occupational palsies represent examples of focal dystonia. As such, the central nervous system is likely to be involved in the process, although the initiating event could well be a peripheral injury.

Factors Predisposing to Overuse Injury

One must wonder, since all musicians show basically the same repertory of musculoskeletal movements for a given instrument, why some instrumentalists remain free from injury throughout an entire career whereas others are plagued by musically related injuries from the start. Factors predisposing an individual to injury may conveniently be divided into two categories, intrinsic and extrinsic.

Intrinsic factors. Intrinsic factors relate to body habitus and the physical state of the performer. These include size, strength, muscle tone, flexibility, and the presence of any underlying musculoskeletal disease. For example, a female musician of slight build and

small frame may find it physically impossible to handle a double bass. The presence of scoliosis of the spine or some other congenital defect may lead to significant back pain during a career involving prolonged sitting. Since musicians' careers, unlike those of professional athletes, frequently span 40 or more years, osteoarthritis, which to some degree is inevitable with aging, must be reckoned with. Not infrequently osteoarthritis or degenerative disc disease of the cervical spine leads to significant pain, muscle spasm, and/or radiculopathy in older musicians.

Extrinsic factors. Extrinsic factors relate to the musician's technique and to his environment. Changes in the way a musician holds the instrument, the force used to play (or the lack of muscular efficiency), and an individual's posture all may predispose to overuse injuries. A factor frequently overlooked but of extreme importance in our experience is the organization of the practice schedule. A history of long hours of uninterrupted and often intense playing is frequently obtained from individuals with musically related injuries.

Management of Overuse Injury

Because of the diversity of manifestations of overuse, no single type of therapy or program will be applicable to all cases. In the experience of Hochberg et al.¹⁰ and Caldron and co-workers,¹⁶ the most frequently encountered overuse injuries are those involving pain in the musculotendinous unit. While, as noted above, one may debate the wisdom of calling this tendinitis, a pain syndrome following the anatomic distribution of a muscle-tendon unit which is increased by active motion may be approached functionally as tendinitis. Treatment of these common injuries can be divided into acute and convalescent phases.

Acute Phase. For the acute phase, rest is the cornerstone of therapy. Early or mild overuse injuries may require only relative rest, which may be accomplished by a decrease in practice time or the incorporation of more frequent rest periods. For more serious symptoms, and for those patients with signs of tissue injury, rest may have to be total, possibly combined with splinting. During this phase of treat-

ment, ice is extremely useful when applied properly. The technique of ice massage delivers intense cold to a relatively localized area and we have used it extensively in our practice.

Depending upon the gravity of symptoms, the use of other adjunctive measures, including analgesic anti-inflammatory agents, can be quite helpful. We favor the use of one of the new nonsteroidal anti-inflammatory drugs which are associated with a higher compliance rate and lower incidence of adverse effects than anti-inflammatory doses of aspirin. Certain injuries are amenable to local injection of corticosteroid including lateral epicondylitis and "trigger finger." For myofascial pain syndromes that escape the anatomic confines of a discrete musculotendinous unit and/or are associated with multiple discrete trigger zones, the above measures may not be equally efficacious. Injections of local anesthetics and/or corticosteroids into highly localized trigger zones may be more effective and used earlier in the course of therapy for these than for musculotendon unit injuries.

Surgery. Surgery for any of these forms of overuse injury is rarely indicated or necessary, except for the entrapment neuropathies, for which surgery may be the only effective approach. Even here, it should be considered only after a trial of conservative measures and, of course, after thorough evaluation of relative risks and merits.

Rehabilitation (Convalescent Phase). With subsidence of pain, the critical phase of rehabilitation should begin. This may involve several simultaneous steps, but once again a search for relevant intrinsic and extrinsic predisposing factors is essential. The performer's technique should be carefully reviewed again for correctable faults and for ways of reducing static and dynamic loading of the affected muscles. The teacher or musician-consultant may be extremely helpful at this point. A seemingly minor change in posture while playing, in the holding of the instrument, in embouchure, or in the execution of a particular bowing or fingering can make an enormous difference in efficiency and comfort. Similarly, the addition or change of a chin or shoulder rest on the violin or viola, alteration of the thumb rest on a wind

instrument, reduction of static loading by neck or shoulder strap on a guitar or percussion instrument, or the addition of a supporting post on a wind instrument can provide remarkable results in some cases.

Pain is to be recognized as a warning of incipient danger, not as an obstacle to be overcome by "playing through it."

The musician may return to playing with very brief practice sessions (such as 2 to 10 minutes) repeated several times during the day with gradual increments over the next weeks to months. Pain is to be recognized as a warning of incipient danger, not as an obstacle to be overcome by "playing through it." Warm-up exercises and cooling down periods, perhaps facilitated by ice massage, may be helpful. Various forms of stretching exercise to improve flexibility and strengthening exercise to restore function to muscles weakened by disuse or inherently deficient may be prescribed and supervised by the physical or occupational therapist. Postural training, relaxation techniques (of which there are many forms), and massotherapy may be extremely useful during this phase and beyond. Efficient practice technique, with sufficient interruption for stretching and relaxation, may have to be re-emphasized. The student, particularly, may have to be convinced that much can be learned away from the instrument.

The occupational palsies present a special therapeutic challenge that has not yet been solved. Some will respond to a program such as that outlined above; many, if not most, will not. Re-education with some change in technique may be attempted. Biofeedback may provide a means of altering the motor "program." A variety of drugs have been tried in these disorders, with variable, and generally limited success. We have recently been utilizing bromocriptine,³⁰ in doses of up to 20 mg per day, for hand and facial cramp, with mixed results.

Prevention

Although most overuse syndromes will subside with some combination of the measures discussed above, it is clear that the ideal goal will be that of prevention. This will require the combined efforts of teachers, performers, and health care professionals. Teachers and coaches must become more familiar with anatomic and physiologic principles as they relate to instrumental performance and practice. They must recognize that playing technique has to be molded, within obvious limits of course, to the individual characteristics of the student and must not be rigidly applied to all regardless of body habitus or physical capabilities. Sensible practice habits must be emphasized and taught. The student and performer must approach practice and rehearsal with the understanding that the body has limitations that cannot be exceeded with impunity. General muscular conditioning, certainly essential for the athlete and the dancer, has not been sufficiently emphasized for musicians. Practicing on the instrument should be carried out after adequate warm-up, and should be punctuated by rest periods during which stretching and muscle relaxation are carried out. The total time spent daily should be reasonable. Although consistency is generally to be encouraged, taking a relative or absolute rest of a day or two after exceptionally intense or prolonged practicing is often advantageous. Pain is to be recognized as a warning that the body's tolerance has been exceeded. Recurrent pain is to be considered a cause for serious concern and a signal for professional help. The health care professional must be educated as to the special needs of the musician and must be sensitive to the tremendous physical and emotional stresses to which the music student or the professional performer may be subjected. The physician, particularly, must become conversant with the more common occupational hazards associated with the performing arts if he or she is to be effective in recognizing the problems early on and in taking appropriate steps to modify the process before it progresses. It must be realized that the professional musician and the serious student are not generally in a position to "stop playing if it hurts and do something else!" These goals can

be achieved most effectively by continued dialogue and information exchange among the interested parties. This effort is currently in its infancy but seems to be progressing admirably.

References

1. Ferguson D: The "new" industrial epidemic. *Med J Aust* 140:318-319, 1984.
2. Stanish WD: Overuse injuries in athletes: a perspective. *Med Sci Sports Exerc* 16:1-7, 1984.
3. Fry HJH: Occupational maladies of musicians: their cause and prevention. *Internat J Music Educ* 2:63-66, 1984.
4. Howard NJ: Peritendinitis crepitans: a muscle-effort syndrome. *J Bone Joint Surg* 19:447-459, 1937.
5. Goldie I: Epicondylitis lateralis humeri (epicondylalgia or tennis elbow): a pathogenetical study. *Acta Chir Scand, Suppl* 399:1-119, 1964.
6. Jones HH, Priest JD, Hayes WC, et al: Humeral hypertrophy in response to exercise. *J Bone Joint Surg* 59-A:204-208, 1977.
7. Acheson RM, Chan Y-K, Clemett AR: New Haven survey of joint diseases XII: distribution and symptoms of osteoarthritis in the hands with reference to handedness. *Ann Rheum Dis* 29:275-286, 1970.
8. Hadler NM, Gillings DB, Imbus HR, et al: Hand structure and function in an industrial setting: influence of three patterns of retyped, repetitive usage. *Arthritis Rheum* 21:210-220, 1978.
9. Bard CC, Sylvestre JJ, Dussault RG: Hand osteoarthropathy in pianists. *J Can Assoc Radiol* 35:154-158, 1984.
10. Hochberg FH, Leffert RD, Heller, MD, et al: Hand difficulties among musicians. *JAMA* 249:1869-1872, 1983.
11. Shulman IA, Milberg P: English horn player's thumb. *J Hand Surg* 7:424, 1982.
12. Pinals RS: Traumatic arthritis and allied conditions. In McCarty DJ, ed: *Arthritis and Allied Conditions*, 10th ed. Philadelphia, Lea and Febiger, 1985, pp. 1205-1222.
13. Ginsberg M, Green R, Weisman M: Manure shoveler's hip: a previously unrecognized syndrome. *Arthritis Rheum* 22:940-941, 1979.
14. Wilson RN, Wilson S: Tenosynovitis in industry. *Practitioner* 178:612-615, 1957.
15. Kivi P: Rheumatic disorders of the upper limbs associated with repetitive occupational tasks in Finland in 1975-1979. *Scand J Rheumatol* 13:101-107, 1984.
16. Caldron P, Calabrese L, Lederman R, et al: A survey of musculoskeletal problems encountered in high level musicians. *Arthritis Rheum* 28(Suppl 4):597, 1985.
17. Mills KR, Edwards RHT: Investigative strategies for muscle pain. *J Neurol Sci* 58:73-88, 1983.
18. Smythe HA: Nonarticular rheumatism and psychogenic musculoskeletal syndromes. In McCarty DJ, ed: *Arthritis and Allied Conditions*, 10th ed. Philadelphia, Lea and Febiger, 1985, 1083-1094.
19. Simons DG: Muscle pain syndromes-part II. *Am J Phys Med* 55:15-41, 1976.
20. Wilke WS, Mackenzie AH: Proposed pathogenesis of fibrositis. *Cleve Clin Quart* 52:147-154, 1985.
21. Layzer RB and Rowland LP: Cramps. *N Engl J Med* 285:31-40, 1971.
22. Lederman RJ: Nerve entrapment syndromes in instrumental musicians. *Med. Probl. Performing Artists* (in press).
23. Gilliat RW: Thoracic outlet syndromes. In Dyck PJ, Thomas PK, Lambert EH, et al, eds: *Peripheral Neuropathy*. Philadelphia, WB Saunders, 1984, pp. 1409-1424.
24. Lascelles RG, Mohr PD, Heary D, et al: The thoracic outlet syndrome. *Brain* 100:601-612, 1977.
25. Schwartz E, Hodson A: A viol paraesthesia. *Lancet* 2:156, 1980.
26. Howard PL: Gamba leg. *N Engl J Med* 306:1115, 1982.
27. Gowers WR: *A Manual of Diseases of the Nervous System*, vol II. London, Churchill, 1888, pp. 565-674.
28. Poore GV: Clinical lecture on certain conditions of the hand and arm which interfere with the performances of professional arts, especially piano-playing. *Brit Med J* 1:441-444, 1897.
29. Hunter D: *The Diseases of Occupations*, 6th ed. London, Hodder and Stoughton, 1978, p. 857.
30. James I, Cook P: Bromocriptine for horn players' palsy. *Lancet* 1: 1450, 1983.
31. Sheehy MP, Marsden CD: Writers' cramp-a focal dystonia. *Brain* 105:461-480. 1982.

PREVIEW

Look for these articles in future issues . . .

Problems Associated with Ballet: Point

Overuse Syndromes in Orchestral Musicians

Stage Fogs and Their Hazards

Nerve Entrapment Syndromes in Instrumental Musicians

Eating Disorders in Dancers

Choral Conductors: Are They Healthy?

Tonsils, Adenoids, and the Professional Musician

Interview with Yo-Yo Ma

A Psychoanalytic View of Performance Anxiety

Instrumental Musicians with Upper Extremity Disorders

Castrati in Opera