

# SCANNING SAFELY: MUSCULOSKELETAL DISORDERS IN THE SONOGRAPHER'S WORKPLACE

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A growing crisis exists throughout the healthcare industry due to the trend of increased volume without sufficient work relief. The number of patients seen and diagnostic tests performed are consistently rising, but many departments within healthcare establishments are not increasing the number of staff members. The field of diagnostic ultrasound has been particularly affected by this trend. As a result, the rate of musculoskeletal disorders in sonographers is rising dramatically.

## INTRODUCTION

Many terms are used to refer to work-related injuries among sonographers. musculoskeletal injury (MSI), repetitive motion injury (RMI), repetitive strain injury (RSI), and musculoskeletal disorder (MSD) are only a few of the phrases. The Occupational Safety and Health Administration (OSHA) has adopted MSD as the generalized term for work-related injuries sustained by professionals, including those in the field of ultrasound. OSHA also recognizes that major risk factors to sustaining a MSD are posture, repetition, and force, which are the basic components of movements in all ultrasound procedures regardless of modality and hand dominance. Testimony before an OSHA committee on the topic of ergonomics revealed that nearly 80% of sonographers have experienced a work-related injury during their careers.<sup>1</sup> Moreover, 80% of sonographers have reported pain and discomfort on the job for almost half of their careers. Forty percent of sonographers label their pain as severe, and 20% have lost their careers due to MSD.<sup>2</sup> These figures are supported by multiple studies on the subject.<sup>1-8</sup>

## TERMINOLOGY

Before we discuss how and why these injuries occur, it is important to define the terms often used in describing the MSD-related injuries.

*Musculoskeletal system:* All of the muscles, bones, joints, and related structures—such as tendons and connective tissue—that function in the movement of the parts and organs of the body.

*Injury:* An action that damages or hurts.

*Disorder:* An abnormal physical condition related to disruption of or interference with normal functions or established systems.

To understand how sonographers might be affected occupationally, we must also define the many subcategories that fall under the blanket of musculoskeletal disorders. These can be broken down into tendon-related disorders, nerve-entrapment syndromes, muscular disorders, neurovascular disorders, and joint capsular disorders.

The most common disorders, such as *tendon-related disorders* and *nerve-entrapment syndromes*, occur in all categories of sonographers, regardless of their area of ultrasound subspecialty. Muscular, neurovascular, and joint capsular disorders are more frequently seen in general or vascular sonographers.<sup>3</sup>

## COMMON TYPES OF MUSCULOSKELETAL DISORDERS

### TENDON-RELATED DISORDERS

*Tendonitis:* An inflammatory condition of a tendon, usually resulting from strain

*Symptoms:* Pain, tingling, weakness, and swelling of the wrist and hand, and potential loss of function

*Treatments:* Rest, splinting of hand and wrist; elevation of arm to reduce swelling; and in more persistent cases, corticosteroid injections

*Alternative treatments:* Deep tissue massage, acupuncture, naturopathy, and yoga

*Tenosynovitis:* Inflammation of a tendon sheath caused by calcium deposits, repeated strain, or trauma

*Symptoms:* Pain, burning or tingling, and weakness

*Treatments:* Rest, adrenocorticosteroid injections

Alternative treatments: Deep tissue massage, acupuncture/acupressure, naturopathy, and yoga; surgical intervention possibly indicated if symptoms persist

**de Quervain's syndrome:** Inflammation of one or both of the tendons housed within a common sheath

*Symptoms:* Pain, loss of range of motion, tingling, and obvious swelling of hands and wrists

*Treatments:* Rest, hand and wrist splinting, corticosteroid injections

*Alternative treatments:* Deep tissue massage, acupuncture/acupressure, naturopathy, and yoga; surgical intervention possibly indicated if symptoms persist

## NERVE-ENTRAPMENT SYNDROMES

**Carpal tunnel syndrome:** Common and painful disorder of the wrist and hand induced by compression of the median nerve between inelastic carpal ligaments and other structures within the carpal tunnel

*Symptoms:* Weakness; pain with thumb opposition, burning, tingling, aching, sometimes radiating to the forearm and the shoulder joint; symptoms may increase with lack of use, leading to loss of digital dexterity and atrophy of muscles

*Treatments:* Splinting of the forearm and hand, arm elevation to reduce swelling, small motion exercises to prevent muscular atrophy; corticosteroid injections

*Alternative treatments:* Deep tissue massage, acupuncture/acupressure, naturopathy, and yoga; surgical intervention possibly indicated if symptoms persist (division of the volar carpal ligament usually a curative procedure)

**Cubital tunnel syndrome** [similar to radial syndrome]: Occurs when the elbow is flexed over a long period of time, resulting in compression of the ulnar nerve

*Symptoms:* Tenderness and pain of the elbow, often radiating to the forearm; also some burning and/or tingling of the little and ring fingers

*Treatments:* Rest; splinting of the upper forearm, distal to the elbow; anti-inflammatory medication

*Alternative treatments:* Deep tissue massage, acupuncture/acupressure, naturopathy, and yoga

## MUSCULAR DISORDERS

**Epicondylitis** (tennis or golfer's elbow): Inflammation of the muscle and surrounding tissues of the elbow due to repeated and excessive strain on the forearm

*Symptoms:* Disabling pain, tenderness extending from fingers to shoulder in more severe cases

*Treatments:* Rest, procaine injections (with or without hydrocortisone), splinting of the upper forearm distal to the elbow

*Alternative treatments:* Deep tissue massage, acupuncture/acupressure, naturopathy, and yoga; surgical intervention possibly indicated to release part of the muscle from the epicondyle

**Fibromyositis:** Generalized stiffness and joint and/or muscle pain, sometimes associated with more localized

inflammation of muscle and fibrous connective tissue; may have an acute onset with evolution into a chronic process

*Symptoms:* Joint and/or muscle stiffness, typically covering a larger area of the body (eg, back and left side from constant static poses while imaging)

*Treatments:* Rest; heat packs; for severe cases, possible administration of corticosteroid and procaine injections

*Alternative treatments:* Deep tissue massage, acupuncture/acupressure, naturopathy, and yoga

## NEUROVASCULAR DISORDERS

**Thoracic outlet syndrome:** Cervical disk compression of nerve roots and blood vessels of the axilla and neck

*Symptoms:* Paresthesia and pain in the neck, shoulders, arms, or hands; fluctuating sensations, depending on posture and activity

*Treatments:* Rest, heat

*Alternative treatments:* Deep tissue massage, acupuncture/acupressure, naturopathy, and yoga

## JOINT CAPSULAR DISORDERS

**Bursitis:** Inflammation of a bursa (the connective tissue surrounding a joint), the shoulder being the most commonly affected region; may result from excessive exercise or effort

*Symptoms:* Severe joint pain, particularly with movement

*Treatments:* Anti-inflammatory therapy, joint immobilization, cold compress therapy, adrenocorticosteroid injection into the bursa

*Alternative treatments:* Deep tissue massage, acupuncture/acupressure, naturopathy, and yoga; surgical intervention possibly indicated to remove calcium deposits

**Synovitis:** Inflammation of the synovial membrane, which acts as a lubricant for many bursae, joints, and tendons; often results from an injury such as a severe strain or sprain

*Symptoms:* Swelling, tenderness, and joint immobility

*Treatments:* Rest; usually self-correcting without medical or surgical intervention

*Alternative treatments:* Deep tissue massage, acupuncture/acupressure, naturopathy, yoga, all of which aid in prevention as well as treatment

These disorders are the most common of the work-related injuries experienced by sonographers. However, many other types of work-related injuries occur, but with less frequency.

## SONOGRAPHER SUSCEPTIBILITY

Why are sonographers so susceptible to these disorders? The answer is as multifaceted as ultrasound itself. Aspects that must be considered include the number of

studies a typical sonographer performs each day, the type of examinations performed, the type of equipment used, and the design of the workspace where the necessary paperwork for each examination is completed.

Research studies have been conducted that look at the effects of poor workplace ergonomics on musculoskeletal injury in sonographers.<sup>4-6</sup> Results from these studies have uncovered a few common causes that relate to the nature of the occupation:

- The rapid pace common to many ultrasound departments, with little time in between patients, sets the stage for muscle and joint fatigue—and ultimately an *overuse injury*.
- The gripping of the transducer, as well as the miniscule but repetitive motion used to manipulate the transducer accurately, may cause damage to the tendons and muscle fibers in the hand and wrist.
- The constant pressure that needs to be applied while bending and rotating the wrist during the ultrasound procedure creates constant wrist strain.
- Application of constant pressure to the patient's skin surface while the shoulder is abducted can cause mild-to-severe injury to the neck, shoulders, back, arms, and torso.
- The awkward scanning positions necessary to maintain the constant pressure and location of the transducer can result in unusual twisting motion of the neck and torso.
- Sonographer factors such as gender, age, height, and longevity in the field all contribute to the potential for work-related injury.
- Poorly designed equipment and workplace ergonomics involving
  - Workstation (keyboard) height and monitor direction
  - Chair and examination table height
  - Transducer size and shape
  - Improper room lighting

Unfortunately, sonographers must accept some of the blame for these problems. Sonographers should deal effectively with the psychological aspect of the likelihood of work-related MSD. That is, fear often causes sonographers to wait too long to seek treatment. This fear exists on several fronts:

- Fear of resentment from coworkers for not being able to handle a full patient caseload
- Fear of potential job loss
- Reluctance about applying for workers' compensation due to the amount of documentation required and the negative response expected from radiology department managers

The Society of Diagnostic Medical Sonographers (SDMS) encourages those sonographers suffering any job-related pain to overcome their fears and seek treatment. The Society hopes that if an increased number of sonographers seek treatment, there will be a trend toward increased awareness around the workplace and the addition of preventive measures to ensure sonographer safety.

## INJURY PREVENTION

The key to avoiding injury is prevention. This effort must be a collaborative effort between sonographers, employers, and equipment manufacturers. Persons from all three groups must take proactive roles in reducing the incidence of MSD. Each of these groups plays an important—but difficult—role in ensuring a safe and injury-free environment. Continual adherence to what should be standard practice in the ultrasound laboratory will be an ongoing and evolving process.

## SONOGRAPHER'S ROLE

Fortunately, a sonographer can do much to prevent the occurrence of MSD because she/ he is the focal point from which the key elements of the preventive process will originate and be sustained. From a broad prospective, the sonographer should consider factors such as diet, exercise, and quantity and quality of rest. She/he must also keep a mental list of the job's "do's and don'ts."

Much information is available on appropriate nutrition and its contribution to the overall well-being of an individual. However, even though the topic is outside the scope of this article, it can generally be said that a *healthy, well-balanced diet* with plenty of fruits and vegetables are optimal in reducing a sonographer's susceptibility to injury.

**Exercise/Stretching [Strength Training.]** *Exercise in the form of stretching and strength training* has proved to be quite beneficial in many respects. Increasing the strength of the muscles required for the activities of daily living will result in less muscular fatigue and will slow down or prevent the process of muscle loss associated with aging. In addition, exercise can strengthen the ligaments and bones, thereby decreasing the potential for injury. It is important, however, to stretch before any exercise to prepare the joints for motion. This will help to avoid injury and increase the range of motion. Stretching after exercise can prevent cramping and soreness. It will also aid in maintaining full range of motion in the muscles and joints.

Exercise and stretching regimens aimed toward the sonographer have been well-documented. The work of Christenssen<sup>6</sup> and Jakes<sup>2</sup> is particularly well known and accepted in the field. The following information is a summary of recommendations from these authors and the SDMS web site (<http://www.sdms.org>). As a precaution, before starting any new physical fitness program, it

is always recommended that an individual consult their personal physician to verify the new program's suitability. Furthermore, a physical therapist or personal trainer can customize exercises and techniques designed to be safe and beneficial for an individual's particular needs.

In general, programs typically consist of the following components.

- A series of upper body exercises and stretches, some requiring resistance bands or rubber tubing
- Hold band/tubing in hands with elbows bent and held against side of body
- Rotate arms outward
- Hold for 30 seconds, then release and relax arms slowly
- Raise one elbow to the shoulder
- Grasp elbow with the opposite hand
- Pull elbow and arm across chest until you feel a stretch
- Straighten elbow for additional stretch
- Hold for 30 seconds, then reverse arms and repeat
- Reach behind back with one arm and grasp other arm
- Pull arm upward until you feel a stretch
- Hold for 30 seconds, then reverse arms and repeat
- Place one hand above elbow of other arm
- Attempt to raise arm while applying resistance with hand
- Reverse arms and repeat
- Anchor band/tubing to solid object or door
- Stand, holding band in both hands with arms in front of body
- Pull arms backward
- Hold for 30 seconds, then release and relax arms slowly
- Lie on back holding weight (5 lb or less) with one hand
- Raise shoulder off the floor as weight is pushed toward the ceiling
- Reverse arms and repeat

- Stand upright and relax shoulders
- Raise shoulders toward ears
- Hold briefly, then slowly relax and lower shoulders completely
- Strength training designed to improve muscle strength

*Basics.* It is important to work each muscle group several times a week on non-contiguous days (ie, lower body one day, followed by upper body the next day). Breathing accurately is extremely important: exhaling on exertion (ie, while lifting) and inhaling during relaxation is the correct technique. Proper body alignment is necessary to perform various exercises. To ensure appropriate technique, a trained professional can provide valuable advice. Perform a minimum of 8 to 10 separate exercises that train the major muscle groups: arms, shoulders, chest, abdomen, back, hips, and legs. Perform every exercise through a full range of motion. Every motion should be slow and controlled to receive maximum benefit from the exercise and prevent jerking motions that may result in injury.

*Upper Body.* A good way to avoid most upper body injuries is by adhering to a balanced upper body strength routine. In other words, every push or press exercise must be balanced with a pull or row exercise. This will ensure the appropriate balance and stabilization of the skeleton, the supporting muscle, and associated apparatus. Upper-body exercises can be effective with either light free weights or the use of resistance equipment.

A wide variety of upper-body exercises are beneficial to the sonographer. An array of exercises work well because of the many isolated muscles and associated apparatus that are commonly affected by repetitive motion disorders and injuries. Strength-training exercises for the shoulders, back, abdomen, and arms should be included within an upper body routine. Many of the exercises prescribed by an instructor or physical therapist include more than one target area. However, the following exercises targeting one area are the most common and also the most easily accomplished.

- Side shoulder raise—for outer portion of the shoulders
- Front shoulder raise—for front portion of the shoulders
- Upright row—for shoulder, neck, and upper back
- Biceps curl—for biceps or front of arm
- Triceps curl—for triceps
- Push-ups—for front shoulders, upper chest, and triceps

- Dumbbell press—for front and outer deltoids
- Seated rowing—for upper and middle back
- Sit-ups—for upper and oblique abdominals
- Leg lifts—for lower abdominals

Variations in the way each of these exercises are performed can be adapted to the individual's abilities and level of fitness. Appropriate warm-up and cool-down is essential in maintaining muscle and joint integrity and lessening the likelihood of trauma or injury.

**Strength Training/Aerobic Activity.** In addition to stretching and strength training, the addition of aerobic activity into the weekly routine adds the benefits of improved cardiovascular functions, vascular elasticity, and reduced cholesterol and triglyceride levels. Aerobic training can be accomplished by almost any activity that results in an increased heart rate and improved lung efficiency. Walking, jogging, cycling, and dancing are just a few ways in which aerobic activity can be achieved. To attain the optimum benefit, aerobic activity or training should be performed a minimum of three times a week for at least 20-minute intervals. Like strength training, aerobic exercise should also follow the recommendations of either a physician or physical therapist.

Aerobic exercise also provides an outlet for negative emotions such as anger, frustration, and irritability. It comes as no surprise that individuals who adhere to a routine of regular aerobic exercise report having a more positive overall outlook. Exercise reduces the level of stress-producing adrenal hormones and stimulates endorphin production. Endorphins elevate the mood and have a pain-reducing effect on the body. The result of exercise is relaxation that leads to less stressful days and more restful sleep at night.

**Getting Proper Rest.** A good night's sleep can go a long way in rejuvenating one's physical ability to perform a full day's work in the ultrasound laboratory. However, sleep is not a cure-all for mental rejuvenation. As in most occupations, sonography requires both mental and physical health for optimal job performance. Like our fatigued muscles, joints, and tendons that require replenishment, our psyche also needs to renew itself. Listening to music, meditation, self-relaxation, and even biofeedback are all effective ways to reduce the mental stress and fatigue associated with the tension of a long day of ultrasound examinations. Among the many websites dedicated to the topic of handling stress is [www.Stressbusting.co.uk](http://www.Stressbusting.co.uk), which offers a number of effective exercises and stress-reducing techniques that result in improved physical and mental wellness. An upshot of stress reduction is that it often allows individuals to get the necessary amounts of rest and sleep.

**On the Job Do's and Don'ts.** When exploring a new staff position or looking at ways to upgrade their current work environment, sonographers can—and should—evaluate

the workplace environment for ergonomic friendliness as well as sonographer habits and practices. Sonographers have a great deal of control over the day-to-day situations that result in musculoskeletal disorder. Understanding this can lead to implementing the following list of preventive practices.

**Stretching:** Practice proper stretching techniques, which will prepare joints, muscles, and supporting structures for the physical demands of an ultrasound examination.

**Posture:** Use correct and upright posture, either sitting or standing, to ensure proper spinal and torso alignment, with no unusual twisting or bending.

**Support:** Ensure appropriate arm, wrist, and hand support using special cushions or towels to avoid extensive flexing of the wrist and arm.

**Patient positioning:** Whenever possible, have the patient in a position that is comfortable for the sonographer (ie, avoiding bending over or reaching).

**Breaks:** Release your grasp of the transducer during an examination, and allow time between patients for additional rest and relaxation of multiple muscle groups.

**Fatigue:** Be conscious of your muscle fatigue and be supportive of coworkers' fatigue. Report injuries and get help in a timely manner to avoid a more serious musculoskeletal disorder.

**Transducer cord:** Don't drape the transducer cord around your neck under any circumstances. Place the cord across your lap or use the ultrasound machine for support whenever possible.

**Educate:** Sonographers must assist in educating their supervisors, department managers, and coworkers about MSD and the importance of ergonomically adjustable equipment and adequate environmental controls.

## EMPLOYER'S ROLE

Department managers, with appropriate organizational support (ie, human resources, employee health department) are responsible for evaluating the work environment and making changes, if appropriate. It is the responsibility of employers to keep abreast of OSHA regulations and ensure that sonographers working in their facilities are aware of the rules that apply to them. Managers must make every effort to maintain adequate staffing levels to ensure that sonographers are not overworked to the point of injury.

The physical design of the ultrasound suite and the equipment available are also controlled by the employer. Equipment such as narrow, height-adjustable stretchers that drop low enough, ergonomically designed chairs, and room configurations that are designed with MSD prevention in mind make a significant impact in reducing injury.<sup>1</sup> The examination room environment should contain the following:

- Height-adjustable examination table and chairs

- Adjustable viewing monitors and keyboards
- Keyboard and control board layout to promote fewer keystrokes
- Transducer cord support system
- Ergonomically designed transducer caps, to allow for varied hand sizes
- Textured gloves to aid in gripping the transducer
- Adequate temperature control to ensure proper blood flow, therefore reducing grip force
- Appropriate lighting control system to reduce eye fatigue and strain

Conscientiously adhering to good preventive strategies makes good financial sense for hospital administration personnel. Many healthcare establishments have already felt the impact from injury to their sonographers. There is an enormous financial burden in lost revenue, workers' compensation, medical bills, and eventually replacement staff when a sonographer is seriously affected by MSD. It has been estimated that an ultrasound machine that lies idle for one week due to a single sonographer's injury causes an estimated loss of \$10,000 in chargeable revenue. (Four weeks of chargeable revenue loss is equivalent to the average annual salary of a sonographer.<sup>8</sup>) The compensation an injured sonographer receives is, on average, \$2700 per month.<sup>8</sup> This expense to an employer is further inflated by the cost of hiring temporary replacement staff, which can be in excess of \$5000 a month.<sup>9</sup>

Unfortunately, managers often do not have the support from their institutions to provide ergonomically sound environments for their employees, even when the most current information is available.<sup>1</sup> Given the pressure on the healthcare industry to reduce costs, there has been increasing pressure throughout the field to streamline productivity. With the support of the SDMS, many sonographers are working to improve their workplace by bringing the injury issue to the attention of OSHA. They are lobbying so that those sonographers who have experienced an ergonomic injury that has created a career-affecting disability have access to appropriate rehabilitation and work-site support without putting their jobs in jeopardy.

Employers must work collaboratively with sonographers to keep up with current regulations, maintain adequate staffing levels, and ensure that the work environment is properly designed.

## MANUFACTURER'S ROLE

Equipment manufacturers also play a role in the health and well-being of sonographers. Manufacturers must remain in touch with the needs of those persons for whom equipment is supplied. In its final report on

medical imaging technology, Industry Canada, a department of the Canadian Federal government, states, "Unfortunately, the modality presents a health threat to the operators because of equipment ergonomics and the manner in which examinations are performed."<sup>10</sup>

Transducer design is one example of how improved product engineering could have a major impact on the rate of injury. Transducer design has been identified as a major contributing factor to hand-wrist strains.<sup>9</sup> Newer, smaller transducers provide improved imaging, but this improved technology does require the sonographer to perform additional hand movements and have more hand strength to grip and apply the necessary forces. Manufacturers have recently shown interest in developing products that are "sonographer friendly." Proposed changes in transducer design include incorporating a small faceplate onto a large transducer or developing a transducer that has a detachable handle portion. In addition, thinner, lighter-weight transducer cords would help to alleviate strain and torque associated with transducer use.

It is clear that continued technologic advancement must coincide with improvements in the ease of equipment use. By considering ergonomics standards as established by OSHA and advocacy groups from the ultrasound community (eg, SDMS and the American Society of Echocardiography), manufacturers can look forward to increased financial profits as a result of the demand for user friendly, ergonomically correct ultrasound machines and auxiliary equipment.

## CONCLUSION

Ultimately, there are many contributing factors to the incidence of musculoskeletal disorders: overworked and inadequately rested sonographers, ergonomically poor workplace environments, and uninformed healthcare administration staff. Hopefully, the education of all levels of the workforce will help curtail the increasing numbers of sonographers afflicted with overuse injuries. However, the lion's share of responsibility still rests with sonographers themselves. The first step is understanding the cause and effects of MSDs and knowing what protective actions can be taken (both within the work environment and—just as important—outside of the examination room). The sonographer must then follow through by sharing this important information with those persons who can promote education in the workforce and make necessary changes in the daily routine. Such changes might consist of allowing for adequate breaks and rest between patients and/or providing equipment designed to avoid unnecessary strain and injury. When the many facets of the technologic environment are improved, the effort will pay off with an increase in the safety and satisfaction of sonographers and subsequent reductions in the costs associated with the occurrence of MSD.

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## SCANNING SAFETY: MUSCULOSKELETAL DISORDERS IN THE SONOGRAPHER'S WORKPLACE POST TEST

Expires: July 15 2009 Approved for 1 ARRT Category A Credit.

1. **What terms has OSHA adopted to describe work-related injuries sustained by professionals?**
  - a. Musculoskeletal injury
  - b. Repetitive motion injury
  - c. Repetitive strain injury
  - d. Musculoskeletal disorders
2. **Which of the following are recognized by OSHA as major risk factors contributing to musculoskeletal disorders?**
  1. Posture
  2. Repetition
  3. Force
    - a. 1 only
    - b. 2 only
    - c. 1 and 3
    - d. 1, 2, and 3
3. **What estimated percentage of sonographers have experienced a work-related injury during their careers?**
  - a. 10
  - b. 25
  - c. 40
  - d. 80
4. **Of sonographers who have experienced a work-related injury, what percentage had to end their careers?**
  - a. 3
  - b. 8
  - c. 20
  - d. 60
5. **All the muscles, bones, joints, and related structures—such as tendons and connective tissues—are collectively referred to as the**
  - a. osseous system.
  - b. musculoskeletal system.
  - c. extrapyramidal motor system.
  - d. integumentary system.
6. **What disorders commonly occur in all categories of sonographers?**
  - a. Tendon-related disorders and nerve-entrapment syndromes
  - b. Muscular and neurovascular disorders
  - c. Joint capsular and ophthalmologic
  - d. Thoracic outlet syndrome and bursitis
7. **de Quervain's syndrome is an example of a**
  - a. tendon-related disorder.
  - b. nerve-entrapment syndrome.
  - c. muscular disorder.
  - d. neurovascular disorder.

8. **Cubital tunnel syndrome occurs when**
  - a. the muscle surrounding tissues of the elbow are inflamed due to related and excessive strain on the forearm.
  - b. cervical disk compresses nerve roots and blood vessels.
  - c. the elbow is flexed over a long period of time, resulting in compression of the ulnar nerve.
  - d. the synovial membrane is inflamed, often from an injury such as a severe strain or sprain.
9. **Which of the following are examples of muscular disorders?**
  - a. Tendonitis, tenosynovitis
  - b. Carpal tunnel syndrome, cubital tunnel syndrome
  - c. Epicondylitis, fibromyositis
  - d. Bursitis, synovitis
10. **Which of the following are examples of joint capsular disorders?**
  - a. Tendonitis, tenosynovitis
  - b. Carpal tunnel syndrome, cubital tunnel syndrome
  - c. Epicondylitis, fibromyositis
  - d. Bursitis, synovitis
11. **Which of the following is NOT a suspected cause of musculoskeletal disorders in sonographers?**
  - a. Gripping the transducer
  - b. The repetitive motion used to manipulate the transducer
  - c. Continual exposure to ultrasound energy
  - d. Awkward scanning positions
12. **Increasing the strength of muscles will**
  - a. allow the sonographer to grip the transducer tighter.
  - b. upset the balanced relationship between tendon and ligaments, thereby increasing the risk of injury.
  - c. not prevent musculoskeletal disorders.
  - d. result in less muscular fatigue, slow or prevent age-related muscle loss, and strengthen the ligaments and bones, thereby decreasing the potential for injury.
13. **Stretching before exercise**
  - a. may result in tearing of a ligament, so this action should be avoided.
  - b. will increase the range of motion.
  - c. may result in cramping and soreness.
  - d. is recommended for children but not for adults.
14. **A strength-training regimen should be designed**
  - a. to work each muscle group, several times a week, on non-contiguous days.
  - b. to work the upper body three days in a row, then work the lower body the following three days.
  - c. to work only the upper body, because lower-body strength does not affect MSD.
  - d. with exercises that either push or pull, but never both.

- 15. Which of the following statements is TRUE concerning methods of breathing during exercise?**
- Breathing accurately is important; inhale on muscular contraction and exhale on muscular relaxation.
  - Breathing accurately is important; exhale on exertion, inhale during relaxation.
  - Breathing accurately is important; hold your breath in during exertion, and start breathing only when the weight has been entirely lowered and your grip has released.
  - Breathing techniques are only important in aerobic exercise such as running, cycling, and swimming.
- 16. To obtain the optimum benefit, aerobic exercise should be performed for a MINIMUM of**
- once a week for 20 minutes.
  - once a week for 60 minutes.
  - at least 20 minutes, three times a week.
  - at least 40 minutes, five times a week.
- 17. All of the following are suggestions for reducing the likelihood of musculoskeletal disorders EXCEPT**
- using correct posture when either sitting or standing.
  - using appropriate arm, wrist, and hand support.
  - positioning the patient so that the sonographer avoids bending or reaching.
  - reducing strain by draping the transducer cord around the neck.
- 18. All the following are examples of ergonomically designed equipment EXCEPT**
- stools that provide stability by eliminating swivel rotation and up/down adjustment.
  - adjustable keyboards.
  - transducer cord support system.
  - textured gloves.
- 19. It has been estimated that the loss of revenue for a single injured sonographer is approximately**
- \$2000 per week.
  - \$4000 per week.
  - \$6000 per week.
  - \$10,000 per week.
- 20. Which of the following is the employer's responsibility?**
- Knowing current OSHA regulations
  - Maintaining adequate staffing levels
  - Purchasing well-designed equipment
- 1 only
  - 2 only
  - 1 and 3
  - 1, 2, and 3



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- You must receive a score of 75% or better to receive credit in any section. Allow up to 4 weeks to process. A Record of Continuing Education will be sent to you.
- Include payment. Answer keys must be accompanied by a \$10 processing fee.
- In a hurry? RUSH SERVICE is available for an additional \$10 for CREDIT CARD ORDERS. Fax this answer key along with your credit card information to (810) 229-3235 for a 48-hour (M-F) turn-around! Whether faxing one answer key or several, only one \$10 charge is added to the total of your order when faxing multiple sheets at once!

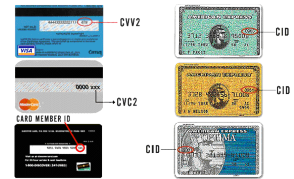
**YES**, in addition to the standard processing fee of \$10, please charge my credit card account **\$10 EXTRA for RUSH SERVICE**. FAX my expedited record of Continuing Education to me at: (\_\_\_\_\_) \_\_\_\_\_ - \_\_\_\_\_.  
 (If a fax number is not provided, a copy will be sent to the address indicated below within 48 hours)

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Account Number:                      V-Code \_\_\_\_\_

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**Identification Section (Please print legibly in blue or black ink)**

Name \_\_\_\_\_ Email \_\_\_\_\_

Address \_\_\_\_\_ Birth Month \_\_\_\_\_

\_\_\_\_\_ City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

Daytime Phone: ( \_\_\_\_\_ ) \_\_\_\_\_ - \_\_\_\_\_

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Please check ONE:

- MAIL my Record of Continuing Education
- E-MAIL my Record of Continuing Education

Article Title: **Scanning Safety: Musculoskeletal Disorders in the Sonographer's Workplace**

1. a b c d	6. a b c d	11. a b c d	16. a b c d
2. a b c d	7. a b c d	12. a b c d	17. a b c d
3. a b c d	8. a b c d	13. a b c d	18. a b c d
4. a b c d	9. a b c d	14. a b c d	19. a b c d
5. a b c d	10. a b c d	15. a b c d	20. a b c d

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