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Overuse Injuries in Museum Conservators

Museum conservators, like many industrial and office workers, are subject to a wide variety of overuse injuries as a result of their working conditions. These overuse injuries are also called work-related musculoskeletal disorders, cumulative trauma disorders (CTDs), repetitive strain/stress injuries (RSIs), repetitive motion injuries, and so forth.

Injuries can result from a single overexertion or can be cumulative. Acute injuries can affect the muscles or ligaments. Chronic overuse injuries tend to affect the tendons, nerves, or circulatory system. Table 1 lists examples of common overuse injuries.

Symptoms of overuse injuries can be very general and include aching, tenderness, swelling, pain, tingling, numbness, crackling, loss of strength, lost of joint movement, and decreased coordination.

Table 1. Types of Overuse Injuries

Upper extremity tendon disorders include:

- Tendinitis: irritation of the shoulder tendons, e.g. rotator cuff or bicipital tendons;
- Synovitis: irritation of the synovial membrane (joint lining);
- Bursitis: irritation of the bursa, the joint cavity lined by the synovial membrane, e.g., shoulder bursitis;
- Tenosynovitis: irritation of a tendon sheath, e.g., DeQuervain's Disease (base of the thumb) and Trigger Finger (stiffening of first finger or thumb);
- Ganglion Cysts: blisters containing synovial fluid, especially in wrists;
- Epicondylitis: elbow pain due to inflammation of tendons attached to elbow, e.g. tennis elbow (outside of elbow), golfer's elbow (inside of elbow).

Upper extremity nerve disorders include:

- Neuritis: irritation of nerves from sharp edges;
- Carpal Tunnel Syndrome: compression of the median nerve in the wrist;
- Thoracic Outlet Syndrome: compression of nerves and adjacent blood vessels between the first rib, collarbone and shoulder muscles;
- Cervicular Radiculopathy: compression of the nerve roots in the neck.

Other examples of overuse injuries include:

- Lower Back Pain;
- Tension Neck Syndrome: pain in the upper back and neck muscles.
- Synovitis: irritation of the synovial membrane (joint lining);
- Bursitis: irritation of the bursa, the joint cavity lines by the synovial membrane, e.g. shoulder bursitis.
- Hand-Arm Vibration Syndrome (Raynaud's Phenomenon) from pneumatic tools, chain saws and other vibrating tools. Cold can also cause Raynaud's Syndrome.

Risk Factors for Overuse Injuries

Occupational Risk Factors

Repetition: Performing the same movements over and over is one of the most important risk factors for overuse injuries. The more frequent the repetition, the greater the risk.

Duration and Recovery Time: Working for extended periods of time without rest is another risk factor. Working more than four hours a day at a repetitious task, even with breaks, is usually considered an important risk factor.

Posture: Working in awkward positions or holding the same position for long periods of time also increases the risk of overuse injuries. Examples include bending the back, neck or wrists, raising your arms above shoulder height, and sitting in one position for extended periods of time.

Force: Exerting excessive force while lifting, pulling, pushing, twisting, or gripping a tool or object can put stress on the muscles and tendons.

Contact Pressure: Direct pressure on soft tissues of the body from sharp edges can compress the tissues and cause pressure injuries.

Vibration: Using vibrating tools can affect the circulatory system and cause permanent damage such as Raynaud's phenomenon (white fingers).

Environmental factors: Poor lighting, temperature extremes, cluttered work areas, excessive hours, and stress are also risk factors for overuse injuries.

Any of these risk factors, especially if excessive, can cause localized muscular fatigue. If these factors are constant, then overuse injuries are more likely to occur. If more than one of these factors are present, the risk is greater, and overuse injuries can develop quicker.

Non-Occupational Risk Factors

A number of non-occupational factors are also risk factors for overuse injuries. Upper

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extremity overuse injuries, for example, can be influenced by joint disease, gout, diabetes, pregnancy, oral contraceptives, playing musical instruments, sports, gardening, home computing, etc.

Prevention

The basic approach to prevention of overuse injuries is to design tools and equipment to the person and to adapt the work process to the needs of the person. That is, fit the job to the person, not the person to the job.

This ergonomic approach involves minimizing the various risk factors discussed above. Posture is often one of the risk factors that can be minimized by adjusting tools, equipment and workplace design to the individual. People vary in overall height, length of legs, length of arms, size of hands, etc. These and other body measurements determine what is the best chair height, table height, arrangement of tools and equipment, size of tools, etc. for each person.

The basic concept is that the body undergoes the least strain when the neck, arms, hands, back, and legs are in neutral positions. This means that:

- the head is erect with eyes forward;
- the shoulders are not elevated;
- the upper arms are vertical with elbows at the sides;
- the forearms are horizontal and about 2-3 inches above the work surface;
- the wrists are straight;
- the back has its natural S-curve;
- legs are straight (but knees are not locked), or bent at an angle of about 90% if seated;
- feet are supported on the floor or on an adjustable foot rest; and
- there is adequate clearance between the knees and lower work surfaces.

If a particular risk factor such as repetition or force can't be easily decreased, then it is important to have more frequent rest breaks, especially during intense work. In addition there should be frequent microbreaks of 30 seconds to 1 minute in between to stretch or change positions to give the body time to recover from localized fatigue. Table 2 lists some exercises. You should stop work as soon as you feel pain.

Table 2. Exercises for Video Display Terminal Users

The following exercises for Video Display Terminals (VDT) operators are recommended by the New Jersey Department of Health to help relieve physical stress and strain. They are not a substitute for a well-designed work station or as physical therapy. You should consult a physician before beginning the exercises and if you have symptoms.

1. Deep breathing for overall relaxation: Inhale through your nose and exhale through your mouth. Repeat 6 times.
2. Relief of hand and finger tension: Make a tight fist with your hands. Hold for a second and then spread fingers apart as far as you can. Hold for 5 seconds. Repeat 4 times.
3. Relief of hand and wrist tension: Hold hands in front of you. Raise and lower hands to stretch muscles in the forearm. Repeat 6 times.
4. Relief of shoulder tightness: Raise arms to the sides with elbows straight. Slowly rotate arms in small forward circles. Lower arms. Repeat twice.
5. Relief of a stiff neck: Turn your head slowly from one side to the other. Hold each turn to the count of three. Repeat motion 5 times in each direction.
6. Relief of arm tension: Raise your arms over your head, stretching as high as you can. Hold for three seconds. Then bring your arms down. Rest a moment and then repeat 3 times.
7. Relief of shoulder and back tension: Raise hands to shoulders. Using arms, push back the shoulders. Keep elbows down. Hold for 10 seconds and repeat 3 times.
8. Relief of low back tension: While sitting, lower your head and slowly roll your body as far forward as you can towards your knees. Hold for 10 seconds. Push yourself up with your leg muscles. Repeat 3 times. (CAUTION: Be sure that your chair is stable and does not roll while you are bending.)
9. Relief of cramping and tightness in legs: While sitting, grasp the shin on one leg and pull towards your chest. Hold for 5 seconds. Then do the other leg. Repeat 3 times.
10. Relief of eye fatigue: Roll your eyeballs around 3 times, then counterclockwise 3 times.

Source: NJ State Department of Health. (1992). Cumulative trauma disorders in office workers. (9 pp.). Trenton, N.J.

Work Station Layout

Work stations can be seated, standing, or a combination (sit/stand). A work station should be laid out to minimize musculoskeletal strain. That means trying to maintain the best posture while working. Two of the most important factors determining posture are: 1) visual needs; and 2) physical reach.

Visual Needs

If a video display terminal (VDT), work piece, or other object is too far away, then the tendency is to lean forward for better vision. For reading or monitoring information, the recommended viewing distance is 18-24 inches or whatever is comfortable. Detailed inspection of work would require that the work be closer to avoid bending forward.

If the object is above or more than 45% below your horizontal line of sight, then you will have to bend your neck backward or forward to see the object. The most comfortable eye position is 15% below your horizontal line of sight.

Place equipment where you can best see it while still maintaining a neutral back and neck posture. If the work area is to be used by several people, then the equipment position should be adjustable since people have different optimal viewing distances.

Lighting is also important. If lighting levels are too low, then there is a tendency to lean forward to better view the object. Glare off reflecting surfaces such as VDT screens can cause headaches and visual fatigue. Directed task lighting is particularly useful for fine work or for use

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in combination with VDTs. Rest your eyes frequently by taking them off the screen and looking around.

Physical Reach

How far you can comfortably reach forward or sideways to lift or manipulate an object depends on the frequency of use, weight of the object, height of object, and whether you are sitting or standing.

In general, we define the primary access zone as the normal work area directly in front of you where the most frequent operations should take place. While sitting, the primary access zone extends from the work surface to shoulder height, and the distance within reach without bending forward. When standing, the primary access zone for one hand is from elbow to eye height, and the area within reach without bending forward or twisting the torso.

The secondary access zone is used for objects for which there is regular but not frequent need. Seated people usually have to lean forward in this zone to grasp something. Standing, the secondary access zone is an additional 8 inches for bends at the waist or an additional 14 inches of forward reach for bends at the hips.

The tertiary access zone is for objects that are rarely needed, and is beyond the maximum reach when seated, or involves excessive bending when standing.

Furniture

Adjustability of furniture is essential to adequate fitting of the work station to the person, rather than the other way around. The two most important pieces of furniture are work surfaces and chairs.

Work Surfaces

The correct seated working height depends on what is being done. Most manual tasks such as writing, computer work, and light assembly are best done with the work at elbow height. Since elbow height varies when seated for different people, the table height should be adjustable. For precision work, it might be necessary to raise the work surface closer to the eyes.

The optimal standing work bench height should allow you to keep your hands a few inches above the work surface. You should have room for your knees and feet without bumping against anything stored under the work surface. For standing in one place on cement or other unyielding surfaces for more than one hour, an anti-fatigue floor mat or cushioned shoes is essential to reduce fatigue. Sit/stand work stations can be used to relieve fatigue from constant standing when some of the operations can be done seated.

Seating

Seating must provide accessibility to the work, give proper support, be stable, be comfortable, and adjust to the different sizes of people. Chairs (and stools for

higher sit/stand work benches) should have adjustable seat heights, seat pan, seat back, and armrests. They should be easily adjustable while seated. See Table 3.

Tool Selection and Design

Tool size, shape and force to use them are also important factors in the prevention of overuse injuries. In terms of ergonomics, the most important part of the tool is the handle.

Tools are gripped in different ways. The power grip, where the tool is grasped by curling the fingers and palm around the handle and using the thumb to apply counter- pressure, allows the greatest use of force. The pinch grip, where the tool is gripped between fingers and thumb, is used where precision is needed and does not provide as much force as a power grip. A hook grip, where an object is suspended from the curled fingers, is used for carrying objects and requires less force than does the pinch grip.

Important factors in tool handle design are shape and length of the handle, grip thickness, hand span (for tools such as pliers), grip surface and texture, and weight and balance (especially for power tools).

Shape of Handle: When using a tool, the wrist should be straight (in the neutral position). When using an electric drill on a vertical surface, a pistol grip allows you to keep your wrist straight; on a horizontal surface, a straight or in-line electric drill is best. A bent handle can help keep wrists straight with some tools. Some tools, such as scissors, are designed for right-handed people. Where possible, tools designed for left-handed people should be obtained when necessary.

Handle Length: The handle should be long enough to clear the base of the palm and avoid pressure on the hand. A length of 4-5 inches is best for a power grip. With gloves, add another 0.5 inches.

Grip Thickness: For pinch grips, recommendations vary from 0.3-0.6 inches for screwdrivers, and 0.5-1.2 inches for pens. For power grips around a cylindrical handle, the fingers should go more than half way around the handle but the thumb and fingers should not meet.

Hand Span: Use of tools with two handles, such as pliers, requires force. Most people can apply maximum grip force when the handles are about 2.5-3.5 inches apart at the point where the greatest force is applied. If the maximum separation of the handles is too great, then the tool would need two hands to use.

Grip Surface and Texture: Metal handles should be covered with a plastic or rubber sheath, which should be slightly compressible, nonconductive, smooth (but not slippery), and have maximum surface area to distribute pressure evenly. The handle should generally conform to the contours of the grasping hand, and not have any sharp edges or ridges that dig into the palm. Fitted grips with indentations for fingers are not recommended.

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Weight and Balance: For power tools, the weight and balance is important to prevent fatigue. Weights of 2-3.3 pounds are acceptable, with a maximum of 5 pounds. Heavier tools should be supported mechanically. The center of gravity of the tool should be such that the weight is not concentrated at either end. Some heavy power tools have a second handle under the main body of the power tool to allow stabilization with the other hand. Tools with triggers should be activated by the stronger thumb or by several fingers, not just one finger.

Vibrating tools such as pneumatic hammers should be designed so the cold air backblast does not pass over the hands, and the handle surface should be thick enough to dampen the vibration without increasing the grip strength requirements.

—Michael McCann, Director of Ergonomics and Safety at the Center to Protect Workers Rights; [redacted]

Sources for More Information

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Call for Nominations
Award for Outstanding Commitment
To the Preservation and Care of Collections

AIC and Heritage Preservation seek nominations for their joint Award for Outstanding Commitment to the Preservation and Care of Collections 2001. Previous recipients include the Colonial Williamsburg Foundation, Alden B. Down Home & Studio, Bata Shoe Museum, Fairmount Park Art Association and Museum of Fine Arts, Boston. The award is presented annually to an organization(s) in North America that has been exemplary in the importance and priority it has given to conservation concerns and in the commitment it has shown to the preservation and care of cultural property. Nominees should be not for profit organizations of any size responsible for cultural property that may include collections, historic sites and structures. Cultural property is defined as material that may be artistic, historic, scientific, religious or social and is an invaluable and irreplaceable legacy that must be preserved for future generations. Collections can include fine arts, library and archival materials, natural history, natural science, musical instruments, textiles, technology, archaeology, ethnography and photography. Organizations that affect the care of cultural property through funding or advocacy are also eligible. Nominations for the 2001 award must be sent to AIC and postmarked by November 15, 2000. **For nomination guidelines and more information, please contact AIC at 202-452-9545 or info@aic-faic.org**