An Ergonomics Approach to Avoiding Workplace Injury

Oh, My Aching Back! (and Burning Eyes and Sore Wrists)

Working Americans spend about 2,000 hours a year in the workplace. Not surprisingly, all of these hours can take a toll—on your eyes, your back, your arms, and your neck.

Exposure to adverse working conditions can result in momentary pain or long-term injury. Moreover, poorly designed working environments contribute to reduced efficiency, decreased production, loss of income, increased medical claims, and permanent disability. Fortunately, professionals like the members of the American Industrial Hygiene Association use a science called “ergonomics” to help remedy the conditions that cause occupational disorders and injuries.

The ultimate goal of ergonomics is to design the workplace so that it accommodates the variety of human capabilities and limitations to prevent musculoskeletal disorders. While designing ergonomic hazards out of the workplace is ideal, other measures such as administrative controls (including training or employee rotation) and changes to work practices are often more feasible initially. We will examine several of the risk factors that affect employees, as well as solutions that you and your employer can use to eliminate or lessen these conditions.

Naturally, there are additional problems specific to certain industries, but the following pages will give you an overview of many of today’s most common occupational disorders, which often affect muscles, tendons, and nerves of the body. (Indoor air quality, another potential hazard in the home and workplace, is discussed in the AIHA brochure Is Air Quality a Problem in My Home?)

Let Your Fingers Do the Walking …

Perhaps the most commonly discussed workplace injuries of the last decade have been carpal tunnel syndrome and related maladies of the wrist and hand. Although typewriters have been in use for more than 100 years in American offices, the popularity of the computer—with intensive keyboard use for data entry and word processing—has given rise to a generation at risk for such injuries. Carpal tunnel syndrome and related disorders (including tendonitis, trigger finger, hand-arm vibration disease, deQuervain’s disease, and myalgia) are part of a group of illnesses known as cumulative trauma disorders (CTDs). CTDs are a family of muscle, tendon, and nerve disorders that are caused, accelerated, or aggravated by repeated movements of the body, particularly when awkward postures, high forces, contact stresses, vibration, and/or exposure to cold are evident. The elbow, shoulders, neck, and back are also subject to CTDs.

Despite the connection between CTDs and computer-related office jobs, many non-office workers who perform repetitive work may be at risk for these injuries. In particular, employees in the fields of aerospace, agriculture, automotive, clerical, electronics, fabric cutting, food processing, glassware, health care, manufacturing, postal services, metal forming, plastics molding, and the performing arts (particularly music and dance) are susceptible to CTDs.

What CTDs Are Not

First of all, cumulative trauma disorders are not fatigue. Though it is a potential contributing factor, fatigue is classified as tiredness, physical stress, and discomfort that subsides a few minutes or hours after you stop
the activity. Repeated and sustained activities that might potentially cause long-term problems usually cause fatigue as well. Although being weary after performing certain job tasks certainly has an effect on work performance and daily living, and may even cause pain, fatigue is not considered a serious medical problem.

As a general rule, symptoms that persist after a night of rest or interfere significantly with work or daily activities indicate something more serious than fatigue. At this point, you should see a physician; if the problem is indeed work-related, report the problem to the appropriate company representative. Finally, you should speak to your employer about adjusting your work environment or equipment to help alleviate the problem.

How CTDs Occur

The hands, wrists, arms, shoulders, neck, and back are comprised of a complex network of nerves, bones, tendons, and fluid. Irritation of these tissues during certain work activities can, over time, result in elevated fluid pressure around nerves. This can cause compression and may eventually cause nerve damage. Nerves can also be damaged by inflamed tendons pressing on them. Carpal tunnel syndrome is a common example of this: The median nerve in the wrist becomes compressed and ultimately damaged as tendon structures swell. A chief cause of this is repeated or sustained work involving high force or using a bent or extended wrist. Even truck drivers who grip a vibrating steering wheel all day may fall prey to this painful disorder.

Unfortunately, since repetition is one of the key factors in causing CTDs, non-work related activities, such as needlework, gardening, fly-casting, and bowling, can also affect the progress of the illness and recovery. These activities may aggravate CTDs. This can make it difficult at times to identify the main cause of a person’s CTD.

Risk factors for CTDs, as noted above, can occur in a variety of occupations. In order to properly analyze and correct these factors, job-related tasks must be evaluated for each of the risk factors. For instance, how many minutes or hours does a utility worker run a drill (vibration) or how long does a butcher handle refrigerated meat (cold temperature)?

Some occupations have combinations of stresses, such as prolonged contact stresses and posture (a fabric cutter using poorly designed scissors at a low workbench, for instance).

Cumulative trauma disorders are a major cause of lost time in many labor-intensive industries. If you notice repeated pain or injury related to your work, your specific environment may need to be analyzed, equipment adjusted or added, and procedures modified. Applying ergonomics to the workplace will help you and your employer strike a proper balance between production requirements and staff capabilities, lessening the likelihood of CTDs arising.

How Ergonomics Can Help

Specialists in the science of ergonomics offer numerous solutions to make the workplace a more hospitable environment for employees. Cumulative trauma disorders and lower back injuries in particular have received considerable attention. There are six major CTD risk factors; those risk factors and several possible corrections or solutions to each are offered below.

Repeated Actions and Sustained Postures

- Use mechanical aids. These might include arm or wrist rests for keyboard use or substituting power tools for manual tools. This is the most practical solution.
- Adjust the work standard. Modify the amount of work due in the allotted time to allow you to pace yourself.
- Use task rotation. Move through different tasks during the day to avoid undue stress and repetition of any one kind.
• Use work enlargement. Combine jobs of different motion patterns. (This may require redesigning the work setting.)

**Forceful Actions (Lifting, Carrying, Hoisting, Pushing, Etc.)**

• Select gloves that improve your grip on an object.
• Avoid thick gloves that interfere with closing your hand around the work object.
• Pick up fewer objects at a time to reduce weight.
• Select tools to reduce weight.
• Attach balancers and handles to steady tools.
• Use reaction bars and articulating arms to reduce powerful “bounce-back” recoils or counteractions.
• Use hoists to raise and support work objects and materials.
• Use rollers and powered belt conveyors to move materials.
• Use gravity to make materials handling easier.
• Use jigs and fixtures to hold parts.
• Use handles to make gripping easier.
• Enlarge grip size.
• Push rather than pull.

**Prolonged Contact Stresses From Tools, Equipment, Etc.**

• Use elongated handles on tools, such as scissors and pliers.
• Use rounded edges on handles and on work benches.
• Use materials that yield to pressure on handle grips, such as rubber, instead of using hard surfaces, such as metal.
• Use tools, rather than your hands, for pounding parts.
• Pad your hand or wear gloves.
• Avoid compression of leaning on wrists, elbows, and abdomen.

**Posture**

• Adjust the location of work and the angle of the workpiece in such a way that your body can maintain an unstrained, comfortable position with your arms, forearms, and shoulders relaxed.
• Select or design a tool size and shape to maintain a comfortable body position and a straight wrist when gripping the tool.

**Vibration**

Depending on the job, isolating the hand and wrist entirely from vibration may be impossible. If you begin to show symptoms of a CTD, however, you may need to discuss with your employer the possibility of minimizing exposure to vibration. This can be done through tool selection, gloves, or limiting your time of exposure.

**Cold Temperature**

• Use insulated gloves.
• Use handles and grips that do not conduct cold easily.
• For pneumatic tools, direct exhaust air away from yourself and not through the tool handle.
• Wear additional clothes on your upper body to retain heat.

**Making Your Computer Truly “User-Friendly”**
Computer workstations, including the components of monitors, keyboards, and chairs, present a whole set of problems in addition to the cumulative trauma disorders discussed above. The explosive growth in the use of computers over the last 25 years has led to a special group of ergonomic dilemmas unique to their use. For instance, the screen introduces new lighting and vision considerations. Many computer jobs offer few opportunities for alternate activities or postures, and, thanks to the fluidity of computer keyboards compared to typewriters, workers can key faster and for longer uninterrupted stretches than ever before.

In addition, some people who use computers are concerned about the effects of heat and electrostatic and electromagnetic fields in the immediate vicinity of their terminals. And working at computers is sometimes associated with psychological stress, either because of the technology itself or because of job conditions (such as monitoring) associated with the work.

As computers spread from the office to the factory to the fast food restaurant, workers and their employers need to be aware of these problems in order to avoid them. By following the recommendations below, computers can be time-saving and labor-enhancing devices and not potential "pains in the neck."

**The Eyes Have It (Soreness, That Is)**

The most frequent physical complaint by people who spend a lot of time in front of a monitor is eyestrain. Specialists in ergonomics have identified several problem areas and possible corrections for eyestrain, including:

- **Glare**
- Move or shield the light source.
- Move the monitor.
- Change the monitor’s angle.
- Apply a good quality glare filter to the monitor, preferably one made of glass or plastic instead of mesh, which tends to collect dust.
- When correcting for glare, don’t create other problems. For instance, if you move your monitor, don’t put it in a place that will produce neck strain. The monitor should be directly in front of you.
- When possible, place your monitor at a right angle with the window.

**Light Brightness Ratio (Between the Screen and Surrounding Environment)**

- Set the background lighting or source document so that it’s no more than 10 times brighter than the screen. Some experts recommend that it be no more than three times brighter.
- Adjust the screen brightness to match the surrounding room.
- Work with a light screen background (dark type or images on white or pale background)—you’ll find it is easier on your eyes.

**Lighting Levels**

- Following the preceding recommendations, adjust your screen position and lighting sources (lamps, etc.) to achieve best results.
- In almost all cases, avoid high levels of lighting.

**Viewing Distance and Document Height**

- Place the monitor and source documents so that they are about the same distance from your eyes. Use a document holder to place the document immediately next to the monitor.
- Rest the muscles of your eyes by focusing on a distant object occasionally.
- When using a laptop, look into the distance more frequently. A laptop monitor will probably not have the best placement, since it is usually attached to the keyboard.
Readability of Screen and Document

- Place monitors and documents so they are perpendicular to the line of sight to avoid character distortion.
- Upgrade or replace monitors with poor resolution or flicker.
- Adjust your monitor’s refresh rate.

Vision Correction

- If you wear glasses, consider getting full-frame reading glasses prescribed for a working distance of 20 to 30 inches. These will allow you to place the monitor correctly and see well without stressing your posture.
- Place the monitor so that the top of the screen is below your line of sight.
- Don’t skip visits to the eye doctor! Eye strain could indicate a problem with your vision beyond the use of a computer monitor.

Mom Was Right … Posture IS Important

In addition to cumulative trauma disorders and vision difficulties, back problems are another common complaint during the prolonged use of computer terminals. Poor posture (held for long periods), poorly designed work areas and poorly adjusted chairs, and sustained activity without breaks can all contribute to varying amounts of back, shoulder, and neck pain.

Posture

Although your own work habits can contribute to back and shoulder pain, using good posture is not a simple matter of finding the “right” position in which to sit. Even “poor” postures (feet up on chair rungs, slumping, twisting your body into odd positions) can prove comfortable if you don’t remain in them for extended periods of time. In fact, shifting about periodically actually proves useful for many people.

Ergonomic specialists recommend the following changes to your behavior and work environment to avoid back, neck, and shoulder pain:

- Change your body position periodically throughout the day.
- Use a document stand to reduce the amount of neck twisting or bending forward if typing from a source document.
- Position your keyboard directly in front of you and at approximately elbow height. This should enable you to type with straight wrists. If this is not possible with the keyboard atop the work surface, use an adjustable-height keyboard tray.
- Center your monitor with your keyboard and chair.
- Avoid ear-to-shoulder neck positioning while on the phone.
- Rearrange the work area to avoid excess bending, stooping, and reaching.
- Try to relax. Many injuries and painful episodes arise from continuously tensing your neck and shoulder muscles while working.
- Consider increasing the amount of exercise you get, since there seems to be a strong relationship between poor physical condition and workplace injury. Overall attention to all aspects of your health such as diet, stress management, and weight control is recommended.

Seating

Not surprisingly, a good chair can contribute significantly to reducing the risk of lower back pain or injury. A good ergonomic chair includes all or most of the following characteristics, not just one or two:

- Adjustable lumbar support;
• Angle between the backrest and seat that allows you to sit without leaning forward uncomfortably;
• Adjustable armrests;
• Slightly inclined backrest;
• Allows for a variety of seated postures;
• Seat height adjustability;
• Seat pan adjustability;
• Soft, rounded edges;
• Size that fits you;
• High backrest or headrest for deeply reclining postures; and
• Comfortable but slip-resistant fabric.

If your feet don’t reach the floor, consider using a footrest. In addition, if you have an older chair without lumbar support, try using a small pillow or towel roll to relieve pressure on your lower back. Don’t get too large a pillow, however, or you may find it forces you to lean forward too much, creating even more strain.

Also, remember that ergonomic features won’t help you if the chair doesn’t suit your body or sitting habits, so adjustability is important. Be sure to have the adjustable features of your chair explained to you to ensure the best fit.

Repetition

As with cumulative trauma disorders, one of the best ways to avoid back, neck, and shoulder injuries is to minimize sustained exertions. The following tips should help you:

• Alternate tasks. If possible, get up from your workstation periodically to use the phone, make copies, file paperwork, etc.
• Take several rest breaks. For many people, “microbreaks” that allow you to pause frequently are more effective than the traditional 15-minute break every two hours.
• Consider installing software that reminds you to take periodic breaks throughout the workday.
• Take short breaks that involve active exercise (walking, stretching); they are often the most effective in relieving stress on the back, neck, and shoulders.

Other Risks in the Workplace From Computers

Other problems posed by continued use of computers and possible solutions include:

Heat. Since computers, monitors, and printers create heat, employers should be sure that the work environment is properly cooled and ventilated. Panels, walls, and furniture should be placed in such a way that they do not block air circulation. The American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) has established guidelines for providing adequate ventilation in various types of workplaces and can offer more information for your specific work situation.

Electrostatic Fields. Besides causing annoying jolts of low-level electricity, constant exposure to static can cause dermatitis (skin inflammation) in some users. Use a grounded keyboard pad or grounded glare screen to reduce static electricity.

Electromagnetic Radiation and Magnetic Fields. Though this is an area of continuing debate, many workers have expressed worries about continuing exposure to electromagnetic radiation from their computers. The focus of research has been on extremely low frequencies (ELFs), the type of emission from all types of appliances and lighting, not just computers. Although research has not proven that work exposure is harmful in the long run—and some studies indicate that computer users are exposed to as many ELFs in the home as at work—it is recommended that you should sit at least an arm’s length from the back or side of any terminal. Very few emissions come from the front of your monitor.
Another area of concern is the relationship between ELFs and pregnancy. Most experts believe that standard exposure to ELFs in the home and office has no impact on pregnant women or their unborn children.

**Psychological Stresses**

Stress may be factored into work injuries in two interconnected ways:

- How stress contributes to physical ergonomic problems.
- How using a computer contributes to stress.

For instance, a stressful work environment may cause you to remain tense for long periods of time, use repetitive motions, take fewer breaks, or fail to report work-related medical problems when they arise. In addition, the use of computers, especially by new users, can contribute to this overall feeling of stress. Obviously, these two factors create a cycle that can contribute to pain and injury.

Although workers may not have extensive input into stressful elements of a job (such as the number of staff available to handle the workload), one way to reduce stress is to give personnel awareness of, and control over, ergonomic conditions. Understanding your work environment is essential; so is gaining control over certain aspects of your surroundings, such as user-adjustable chairs and lighting levels. Information and control go a long way to reducing stress levels.

**A Productive Partnership**

It is in everyone’s best interest to apply modern ergonomic science to the workplace. As we stated at the outset, poor working conditions are bad news for both employees and employers—resulting in physical suffering and adverse economic impact. Although the checklists and suggestions offered here should help, many employers may wish to take the extra step of consulting directly with a professional in the field of ergonomics to analyze specific working conditions and make recommendations. A partnership among staff, employers, and ergonomics specialists can help redesign the workplace to meet the capabilities and potential of every employee.

**For More Information**

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