Computer Workstation Ergonomics

Posture, Process & Environment

Millions of people work with computers every day. This guide illustrates simple principles that will help you work safely and comfortably at your computer workstation. There is no single "correct" posture, process or environment that will fit everyone. However, there are basic considerations when setting up a computer workstation or performing computer-related tasks.

- Top of monitor at or just below eye-level
- Head and neck balanced and in-line with torso
- Shoulders relaxed
- Elbows close to body and supported
- Lower back supported
- Wrists and hands in-line with forearms
- Adequate room for keyboard and mouse
- Feet flat on the floor

This guide provides suggestions to minimize or eliminate identified problems. Consider your working posture, process and environment as you read through each section of this guide and see if you can identify areas for improvement. For additional information on workstation ergonomics, see the guide *Computer Workstation Ergonomics: Components*.

Good Working Positions

To understand the best way to set up a computer workstation, it is helpful to understand the concept of neutral body positioning. This is a comfortable working posture in which your joints are naturally aligned. Working with the body in a neutral position reduces stress and strain on the muscles, tendons, and skeletal system and reduces your risk of developing a musculoskeletal disorder (MSD). The following are important considerations when attempting to maintain neutral body postures while working at the computer workstation:

- **Hands**, **wrists**, and **forearms** are straight, in-line and roughly parallel to the floor.
- **Head** is level, or bent slightly forward, forward facing, and balanced. Generally it is in-line with the **torso**.
- **Shoulders** are relaxed and **upper arms** hang normally at the side of the body.
- **Elbows** stay in close to the body and are bent between 90 and 120 degrees.
- **Feet** are fully supported by the floor or a footrest may be used if the desk height is not adjustable.
- **Back** is fully supported with appropriate lumbar support when sitting vertical or leaning back slightly.
- **Thighs** and **hips** are supported by a well-padded seat and generally parallel to the floor.
- **Knees** are about the same height as the hips with the **feet** slightly forward.

Regardless of how good your working posture is, working in the same posture or sitting still for prolonged periods is not healthy. You should change your working position frequently throughout the day in the following ways:

- Make small adjustments to your chair or backrest.
- Stretch your fingers, hands, arms, and torso.
- Stand up and walk around for a few minutes periodically.

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These four reference postures are examples of body posture changes that all provide neutral positioning for the body.

- **Upright Sitting Posture:** The user's torso and neck are approximately vertical and in-line, the thighs are approximately horizontal, and the lower legs are vertical.

- **Standing Posture:** The user's legs, torso, neck, and head are approximately in-line and vertical. The user may also elevate one foot on a rest while in this posture.

- **Declined Sitting Posture:** The user's thighs are inclined with the buttocks higher than the knee and the angle between the thighs and the torso is greater than 90 degrees. The torso is vertical or slightly reclined and the legs are vertical.

- **Reclined Sitting Posture:** The user's torso and neck are straight and recline between 105 and 120 degrees from the thighs.

Work Process and Recognition

Even when the design of the workstations is correct and environmental factors are at their best, users can face risks from task organization which can intensify the impact of other risk factors, such as repetition. Additionally, failing to recognize early warning signs could allow small problems to develop into serious injuries. Addressing task organization factors and medical awareness can help minimize the risk of developing musculoskeletal disorders (MSDs) and stop the progression to injury.

Prolonged Periods of Activity

Potential Hazard

- Computer work, whether it's for a job or for fun, may appear to be a low effort activity when viewed from a total body perspective, but maintaining postures or performing highly repetitive tasks for extended periods can lead to problems in localized areas of the body. For example, using a mouse for a few minutes should not be a problem for most users, but performing this task for several uninterrupted hours can expose the small muscles and tendons of the hand to hundreds or even thousands of activations (repetitions). There may not be adequate time between activations for rest and recuperation, which can lead to localized fatigue, wear and tear, and injury. Likewise, maintaining static postures, such as viewing the monitor, for a prolonged period of time without taking a break can fatigue the muscles of the neck and shoulder that support the head.

Possible Solutions

- Provide variation in tasks and workstations so there is time to recover from the effects of activity. There are several ways to provide recovery time for overused muscles.

  o Utilize an adjustable workstation so users can easily change their working postures. The use of easily adjustable furniture, for example, allows you to frequently change seated postures, which allows different muscle groups to provide support while others rest.

  o Ensure that there is enough work space so you can use each hand alternately to perform mouse tasks. This allows the tendons and muscles of the free hand to rest.

  o Substitute keystrokes for mousing tasks, such as Ctrl+S to save, Ctrl+P to print. Especially if your job is highly mouse intensive

  o High repetition tasks or jobs that require long periods of static posture may require several, short rest breaks (micro breaks or rest pauses). During these breaks users should be encouraged to stand, stretch, and move around. This provides rest and allows the muscles enough time to recover.

  o Alternate tasks whenever possible, mixing non-computer-related tasks into the workday. This encourages body movement and the use of different muscle groups.

Potential Hazard

◆ Employees who have not been adequately trained to recognize hazards or understand effective work practices designed to reduce these hazards are at a greater risk of harm. Without proper medical awareness, Musculoskeletal Disorders (MSD) signs and symptoms may go unnoticed and un-addressed. For example, users who do not understand the risk of bad body postures or techniques do not have the knowledge to actively participate in their own protection. Detection and reporting delays can result in more severe injury.

Possible Solutions

◆ Computer users should take the time to obtain general ergonomics awareness training on the following issues:

  o Factors related to specific computer components that may increase discomfort or risk of injury,

  o Being aware of discomfort (signs and symptoms), and

  o How to correctly use and adjust components and environmental factors.

Workstation Environment

Appropriately placing lighting and selecting the right level of illumination can enhance your ability to see monitor images. For example, if lighting is excessive or causes glare on the monitor screen, you may develop eyestrain or headaches, and may have to work in awkward postures to view the screen. Ventilation and humidity levels in office work environments may affect user comfort and productivity.

Lighting

Potential Hazard

◆ Bright lights shining on the display screen "wash out" images, making it difficult to clearly see your work. Straining to view objects on the screen can lead to eye fatigue.

Possible Solutions

◆ Place rows of lights parallel to your line of sight.

◆ Provide light diffusers so that desk tasks (writing, reading papers) can be performed while limiting direct brightness on the computer screen.

◆ Remove the middle bulbs of four-bulb fluorescent light fixtures to reduce the brightness of the light to levels more compatible with computer tasks if diffusers or alternative light sources are not available. *Note*—a standard florescent light fixture on a nine-foot ceiling with four, 40-watt bulbs will produce approximately 50 foot-candles of light at the desktop level.

◆ Provide supplemental task/desk lighting to adequately illuminate writing and reading tasks while limiting brightness around monitors.

◆ Generally, for paper tasks and offices with CRT displays, office lighting should range between 20 to 50 foot-candles. If LCD monitors are in use, higher levels of light are usually needed for the same viewing tasks (up to 73 foot-candles).

Potential Hazard

◆ Bright light sources behind the display screen can create contrast problems, making it difficult to clearly see your work.

Possible Solutions

◆ Use blinds or drapes on windows to eliminate bright light. Blinds and furniture placement should be adjusted to allow light into the room, but not directly into your field of view. *Note*—vertical blinds work best for East/West facing windows and horizontal blinds for North/South facing windows.

◆ Use indirect or shielded lighting where possible and avoid intense or uneven lighting in your field of vision. Ensure that lamps have glare shields or shades to direct light away from your line of sight.

- Reorient the workstation so bright lights from open windows are at right angles with the computer screen.

Potential Hazard

- High contrast between light and dark areas of the computer screen, horizontal work surface, and surrounding areas can cause eye fatigue and headaches.

Possible Solution

- For computer work, use well-distributed diffuse light. The advantage of diffuse lighting is that

- There are fewer hot spots (or glare surfaces) in the visual field, and

- The contrasts created by the shape of objects tend to be softer.

- Use light, matte colors and finishes on walls and ceilings to better reflect indirect lighting and reduce dark shadows and contrast.

Glare

Potential Hazard

- Direct light sources (for example, windows, overhead lights) that cause reflected light to show up on the monitor make images more difficult to see, resulting in eye strain and fatigue.

Possible Solutions

- Place the face of the display screen at right angles to windows and light sources. Position task lighting (for example, a desk lamp) so the light does not reflect on the screen

- Clean the monitor frequently. A layer of dust can contribute to glare.

- Use blinds or drapes on windows to help reduce glare. *Note*—vertical blinds work best for East/West facing windows and horizontal blinds for North/South facing windows.

- Use glare filters that attach directly to the surface of the monitor to reduce glare. Glare filters, when used, should not significantly decrease screen visibility. Install louvers, or "egg crates", in overhead lights to re-direct lighting.

- Use barriers or light diffusers on fixtures to reduce glare from overhead lighting.

Potential Hazard

- Reflected light from polished surfaces, such as a keyboards, may cause annoyance, discomfort, or loss in visual performance and visibility.

Possible Solutions

- To limit reflection from walls and work surfaces around the screen, paint them with a medium colored, non-reflective paint. Arrange workstations and lighting to avoid reflected glare on the display screen or surrounding surfaces.

- Tilt down the monitor slightly to prevent it from reflecting overhead light.

- Set the computer monitor for dark characters on a light background; they are less affected by reflections than are light characters on a dark background.

Ventilation

Potential Hazards

- Users may experience discomfort from poorly designed or malfunctioning ventilation systems, for example, air conditioners or heaters that directly "dump" air on users.

- Dry air can dry the eyes (especially if the user wears contact lenses).

- Poor air circulation can result in stuffy or stagnant conditions.

- Temperatures above or below standard comfort levels can affect comfort and productivity.

Possible Solutions

- Do not place desks, chairs, and other office furniture directly under air conditioning vents unless the vents are designed to redirect the air flow away from these areas.

- Use diffusers or blocks to redirect and mix air flows from ventilation systems.

- Keep air flow rates within three and six inches per second (7.5 and 15 centimeters per second). These air flow rates are barely noticeable or not noticeable at all.
- Keep relative humidity of the air between 30 and 60 percent.
- The recommended ambient indoor temperatures range between 68 and 74 degrees F (20 and 23.5 degrees C) during heating season and between 73 and 78 degrees F (23 and 26 degrees C) during the cooling season.

Potential Hazard

- Exposure to chemicals, volatile organic compounds (VOCs), ozone, and particles from computers and their peripherals (for example, laser printers) may cause discomfort or health problems.

Possible Solutions

- Enquire about the potential for a computer or its components to emit pollutants. Those that do should be placed in well-ventilated areas.
- Maintain proper ventilation to ensure that there is an adequate supply of fresh air.
- Allow new equipment to "air out" in a well-ventilated area prior to installing.

Additional Factors

Awkward Postures

Maintaining good postures, such as straight wrists, elbows close to the body and head straight and in-line with the torso is often difficult because of a misalignment between the user and the computer components and accessories.

For Example:

- A keyboard tray that is too small can cause you to move the mouse to a position of the desk that requires you to reach to perform mouse tasks. This pulls the elbow away from the body and can cause you to support your arm in an elevated position for an extended period of time.

- A monitor positioned too high can cause you to tilt your head back, which fatigues the neck and shoulder muscles.
- A keyboard that is too low causes you to bend your wrists at extreme angles, which can cause the finger tendons and tendon sheaths to bend around the bones of the wrist.

Working in awkward postures can irritate or strain the bone-tendon-muscle connections.

- Muscles can be stretched or compressed causing them to be inefficient and resulting in possible fatigue and overexertion.
- Non-neutral postures can pull and stretch tendons, blood vessels, and nerves over ligaments or bone where they can become pinched and restricted.
- Tendons and their sheaths can rub on bone and ligaments, which can lead to irritation and fraying. This can lead to swelling within confined areas such as the carpal tunnel, which then restricts nerves and blood vessels.
- Tingling and numbness of the fingers and hands as well as pain from tendinitis and tenosynovitis (inflammation of a tendon sheath) can result.

A properly adjusted workstation can help minimize awkward postures. Place the monitor in front of you at a height where you can look straight ahead and not tilt your head forward or backward. Place frequently used items, such as keyboards and pointing devices where you can reach them easily. Adjust and arrange keyboard trays and chairs so you don't have to bend your wrists up, down, or to the side. Adjust your chair so your feet and back are well supported. Proper neutral postures allow you to work with minimal stress on the musculoskeletal system.

Contact Stress

Contact stress can occur either internally or externally. Internal stress occurs when a tendon, nerve, or blood vessel is stretched or bent around a bone or tendon. External contact stress occurs when part of your body rubs against a component of the workstation,

such as the chair seat pan or edge of the desk. Nerves may be irritated or blood vessels constricted as a result.

- You can experience contact stress to your forearms when you rest them on the leading edges of work tables or, if the nerves in the forearm are affected, your fingers and hands may tingle and feel numb, similar to the feeling when you hit your "funny bone."

- You may experience pain and numbness in your legs if blood circulation is cut off by contact with the leading edge of a chair.

- Your forearms and wrists can be affected if wrist rests have sharp, hard leading edges.

- Tendons can be damaged when repetitive finger motion tasks are performed with a bent wrist.

To help solve these problems carefully select wrist rests, chairs, and desk surfaces and take frequent rest and stretch breaks to minimize the amount of contact stress that you may experience. Adjust your workstation to maintain neutral wrist postures.

Force

Force is usually thought of as a strenuous physical exertion, such as when lifting a heavy weight or pushing a heavy load. Computer work seldom requires this type of strenuous exertion, but there are tasks that require concentrated force that can affect smaller, localized muscle groups.

What are some examples?

- Your finger and forearm muscles may become sore if you use a pointing device at a setting that is so sensitive that it is hard to control. Hand and arm muscles must work continually to keep the device steady.

- Your shoulder and neck muscles are continually being used to lift the arm away from your body if the mouse is placed too far away.

- The muscles of the back can become strained if you must tilt your head back to view a monitor that is too high.

Although the muscle is usually the first point of pain when these injuries occur, the tendon, which attaches the muscle to bone, can also be affected. Localized pain, stiffness, and tenderness can signal that the muscle or tendon has been exerted beyond its capacity.

To help avoid these problems, properly arrange computer components on the work surface to maintain neutral postures and provide adjustable furniture to minimize the amount of time spent in one posture.

General Controls

The arrangement of work components and the purchase of new equipment should encourage the following body postures:

- Keep your head and neck vertical and in-line with the spine, not bent or twisted.

- Keep your torso straight, not twisted, especially when lifting or bending.

- Generally, whether standing or sitting, keep your torso vertical or within 20 to 30 degrees of vertical.

- Keep your elbows close to your body by avoiding frequent reaching to your side, in front, or above your head.

- Keep your forearms approximately parallel to the floor.

- Maintain a neutral forearm posture whenever possible, by not rotating your forearm repeatedly, especially when your wrist is bent.

- Keep your wrists straight and in-line with your forearms, not bent up or down or to either side.

- Keep your thighs approximately parallel to the floor or your hips slightly higher than your knees.

- Keep your feet firmly on the floor and your legs approximately perpendicular to the floor.

- Place your keyboard and mouse close together at about the same height to reduce reaching.

- Use a fully adjustable chair so your body is fully supported and you can change your body postures frequently.

- Use adjustable height work surfaces so all users can sit with their feet firmly on the floor. If the work surface is not fully adjustable, use an adjustable foot rest.

- Place all frequently used components such as monitor, keyboard, and mouse in front of you so you don't have to turn your head from side to side.

- Place your monitor low enough so its top is not above your horizontal line of sight. This will limit the need for you to tilt your head backward to see the screen.

- If laptops are to be used as primary work computers where intensive keyboard use is necessary, provide auxiliary, full-sized, keyboards and monitors.

Repetition

Many computer workstation tasks are highly repetitive. You may perform the same motions repeatedly at a fast pace and with little variation. When motions are isolated and repeated frequently for prolonged periods, there may be inadequate time for your muscles and tendons to recover. Combining repetitive tasks with factors such as awkward postures and force may increase the risk of injury.

- Computers require little task variation. Old typing activities, such as adding paper or mechanically advancing pages, have been reduced or eliminated. Users can stay in their chairs and type or perform mouse work for an almost unlimited amount of time. Under these conditions, a proficient typist can easily perform more than 18,000 keystrokes per hour. These repetitive motions can lead to tendon and tendon sheath injuries, especially if the wrist is bent during the activity.

- Similar repetitions occur when using a pointing device such as a mouse. Here, the hazard may be greater because the motions are often concentrated in only a few fingers of one hand.

- A computer operator may remain in essentially the same posture for an entire shift. This forces a few isolated muscles to repeatedly activate to accomplish a task such as holding the head up or focusing on a computer screen.

- A poorly designed workstation may cause you to repeatedly reach to use a mouse or answer the phone. This can fatigue the muscles of the shoulder and irritate the tendons.

You can reduce repetition by properly arranging the workstation and its components. For example, a mouse that is placed close to the keyboard should minimize repetitive reaching. However, even the best designed workstation can not eliminate all highly repetitive motions, especially for data input. For this reason, it is extremely important to maintain good posture by providing adequate adjustability at the workstation. You should perform all hand tasks with the wrist in a straight, neutral posture to allow the tendons to slide easily without interference.

The following work process suggestions may also help reduce repetition.

- Task Rotation or Job Enlargement—If you perform a variety of tasks, when possible, intersperse them throughout the work day. Minimize long blocks of uninterrupted computer time by doing other non-computer tasks such as photocopying, phone work, cleanup, etc.

- Micro Breaks or Rest Pauses—Build short micro pauses into computer use sessions. Frequent short breaks are desirable. Every hour, take a five-minute break from computer tasks. Look away, stretch, get up, or walk. These brief pauses provide time for muscles and tendons to recover.

MSD Signs and Symptoms

It is important to report signs and symptoms as early as possible to prevent serious injury or permanent damage. Users at risk for MSDs associated with computer use may experience some of the following signs or symptoms:

- Numbness or a burning sensation in the hand
- Reduced grip strength in the hand
- Swelling or stiffness in the joints
- Pain in wrists, forearms, elbows, neck, or back
- Reduced range of motion in the shoulder, neck, or back
- Dry, itchy, or sore eyes
- Blurred or double vision
- Aching or tingling
- Cramping
- Weakness

Although these symptoms may not necessarily lead to an MSD, if experienced, the user should make an evaluation of their working positions and their workstation layout. For additonal information see the guide *Computer Workstation Ergonomics: Components*.

Source: U.S. Occupational Safety and Health Administration.

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