Office Ergonomics

I. Introduction

The arrival of computers in nearly every office setting has contributed to the development of musculoskeletal disorders (MSD) among many office workers. One key to the problem is to select and arrange necessary workstation components in such a way as to permit the individual to work with the body in a relaxed, neutral posture. There is no single posture or arrangement of the workstation that is best for everyone. This Advisor identifies the basic ergonomic goals for workstation design and offers suggestions for alternative approaches to achieve these goals.

II. Posture

The goal of ergonomic workstation design is to permit the worker to assume a neutral posture that minimizes stress on the muscles, tendons, and skeletal system and reduces the risk of developing a MSD. Listed below are several factors important to achieving a neutral posture.

- The hands, wrists, and forearms are in a straight line. This line should be roughly parallel to the floor.
- The shoulders should be relaxed. The upper arms should hang normally at the side of the body or the arms should be supported by an armrest.
- The elbows should be kept close to the body and should be bent to an angle between about 90 to 120 degrees.
- The head should be facing forward. It should be balanced on the neck; level, or bent slightly forward.
- The back should be straight and vertical or leaning back slightly. The lumbar region should be well supported.
- The angle of the hips should be 90 degrees or greater.
- Thighs should be supported by a well-padded seat and approximately parallel to the floor.
- The knees should be at approximately the same height as the hips.
- The feet should rest on the floor or they should be supported by a footrest.

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These goals are most often achieved with the **Upright Sitting Posture**, pictured here. In this posture, the user's torso and neck are approximately vertical and in-line, the thighs are approximately horizontal, and the lower legs are vertical.

However, several variations are possible, which still provide the desired neutral 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. Note that armrests are needed.

Where a **Standing posture** is required, the user's legs, torso, neck, and head should be approximately in-line and vertical. The user may also elevate one foot on a rest while in this posture.

It is important to note that, no matter how good the posture, remaining in any fixed position for a prolonged period of time is unhealthy. Workers should be able to move freely within a range of comfortable positions. This may include periodic small adjustments to the chair or backrest, repositioning the footrest, etc. Computer intensive jobs should be expanded to include other tasks which will permit the employee to stand up and walk around. Computer users should also be encouraged to perform frequent stretching exercises of the fingers, hands, arms, and torso.

III. Workstation Components

The proper selection, placement, and adjustment of each component of the workstation is necessary to achieve the neutral postures described in the preceding section. All of the parts of the workstation are interrelated and must work together as a system. A change to one part may necessitate a corresponding change elsewhere.

Chair

A well-designed and appropriately adjusted chair is among the most critical components of a safe and productive computer workstation. A good chair provides necessary support to the back, legs, buttocks, and arms, while reducing exposures to awkward postures, contact stress, and forceful exertions. A high degree of adjustability is desirable to ensure the best possible fit for the user. This is particularly important if the chair will be used by more than one person. It is critical, however, that the adjustments be easy to make and that the users be trained in their use.

Key features to look for in a chair

- The backrest should conform to the natural curvature of the spine, and provide adequate lumbar support. For an existing chair with inadequate lumbar support, a back support cushion can be added.
- The backrest should have an adjustment that allows the user to recline at least 15 degrees from the vertical. The backrest should lock in place or be tension adjustable to provide adequate resistance to lower back movement.
- The backrest should also be able to move forward and backward. This will allow shorter users to sit with their backs against the backrest without the front edge of the seat pan contacting their knees. Taller users will be able to sit with their backs against the backrest while still having their buttocks and thighs fully supported. **Note:** some chair designs provide this adjustability by changing the position of the seat pan.
- The seat must be height adjustable, especially when shared by a number of users. The chair height is appropriate when the entire sole of the foot can rest on the floor (or a foot rest) with the back of the knee slightly higher than the seat of the chair.

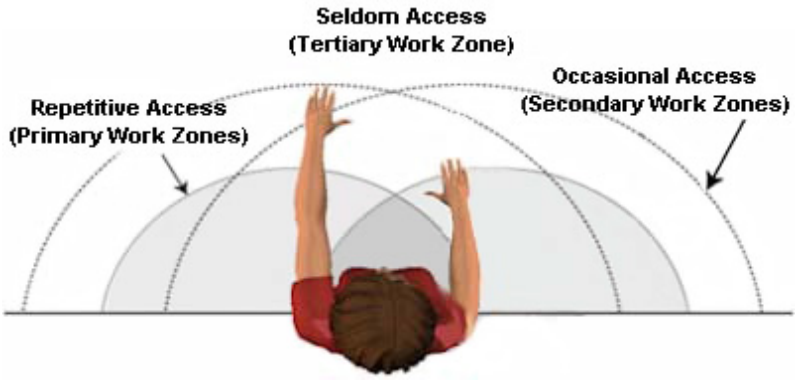
- The seat pan should be well padded and should have a rounded, "waterfall" edge to minimize contact pressure stress to the back of the knee.
- The seat pan should be wide enough to accommodate the majority of hip sizes. Chairs with oversize seat pans should be provided for larger users.
- Armrests, if provided, should be soft, allow the shoulders to relax and the elbows to remain close to the body. Armrests should be adjustable, and it is important to ensure that they will not interfere with proper positioning of the chair relative to the desk or keyboard tray.
- The chair should have a stable, five-leg base with casters that allow easy movement along the floor.

It is important to try out several different chairs before purchasing. It is also wise to seek a reputable vendor who will support their products with initial set-up and user training. This service should extend beyond the initial sale since, as employees turn-over, new users will need to be trained.

Desk

A good desk will provide adequate clearance for the user's legs, allow proper placement of computer components and accessories, and minimize awkward postures and exertions. The size and arrangement of the desk surface should permit the monitor to be placed directly in front of the user, and at least 20 inches away. The height of the underside of the desk should provide sufficient clearance for the user's knees and thighs. The space beneath the desk should be spacious and should be kept uncluttered so that the legs can be moved freely; this is not the place for computer towers, trash cans, stored files, etc.

The desktop should be arranged thoughtfully, with frequently used equipment and articles within easy reach on the primary work zone. Less frequently accessed items can be placed further from the user. Here too, clutter should be avoided to allow the user a wide range of freedom of motion.



Some desks and tables have hard, sharp edges that can cause contact pressure stress to the user's wrists and forearms. Sharp edges should be avoided if possible, or they should be covered with soft padding material.

Monitor

The monitor screen should be located directly in front of the user. Positioning the monitor off to one side forces the user to twist his neck and/or torso. The top of the screen should be positioned at eye level, or just below eye level. This permits the head to be balanced on the neck; level, or bent slightly forward. The distance from the eye to the monitor should be about an arm's length away, at least 20 inches away. If the existing workstation does not provide sufficient depth to accommodate a conventional CRT monitor, a flat-screen should be considered.

A user who wears bifocal glasses may tend to tilt his head backwards in order to peer out of the lower reading lens at the screen. This can cause significant stress to the neck and back and should be avoided. Special prescription lenses are available to alleviate this problem. In some cases, a low cost alternative would be single focal reading glasses for computer use.

Keyboard

The keyboard should be placed directly in front of the user at a distance that allows the elbows to stay close to the body with forearms approximately parallel with the floor. The user's wrists should be straight and in-line with their forearms. Keyboards that are too high or too low can lead to awkward wrist, arm, and shoulder postures. For example, when a keyboard is too low the user may type with his or her wrists bent up. If the keyboard is too high, it may be necessary to raise the shoulders and elevate the arms. Performing keying tasks in such awkward postures can result in hand, wrist, and shoulder discomfort

Elevate the back or front of keyboards to achieve a neutral wrist posture. For example, if the operator sits lower in relation to the keyboard, slightly elevating the back of the keyboard (*positive tilt*) may help maintain a neutral wrist. Similarly, tilting the keyboard away from the user (*negative tilt*) may help maintain neutral wrist postures for users who type with the keyboard in a lower position. Do not use keyboard feet if they increase bending of the wrist.

A traditional, straight keyboard may cause users to bend their wrists sideways to reach all the keys.

Consider alternative, angled or split keyboards to promote neutral wrist postures. Alternative keyboards may be provided on a case-by-case basis and users may need time to become accustomed to these devices. **Note:** alternative keyboards help maintain neutral wrist postures, but available research does not provide conclusive evidence that using these keyboards prevents discomfort and injury.

Wrist/Palm Rest

The use of a wrist or palm rest has been shown to reduce muscle activity and to facilitate neutral wrist angles, thus reducing fatigue and increasing comfort. If used, wrist/palm rests should be part of an ergonomically-coordinated computer workstation in which the chair, desk and keyboard have been properly adjusted to maintain a neutral, in-line wrist posture.

The hands should not contact the wrist/palm rest while typing, but should move freely over the keyboard. When resting, the support pad should actually contact the heel or palm of the hand. Weight or pressure should not be born on the wrist.

Keyboard Tray

A keyboard tray may be a useful accessory if the proper keyboard height or angle cannot otherwise be achieved by adjusting the work surface or chair. It is also of value if there is limited desk space or if the chair has armrests that interfere with proper positioning.

The keyboard tray should

- Be easily adjustable in both height and tilt.
- Be of sturdy and stable construction.
- Provide adequate leg and foot clearance.
- Have adequate space for both the keyboard and a mouse or other pointer.
- Provide space for a wrist/palm rest, if desired.

Mouse or Pointing Device

The conventional mouse is only one of a wide variety of pointing devices currently available. Alternatives to the mouse include trackballs, touch pads, joysticks, various rollers, and other devices. Regardless of type of pointing device used, there are several key points to keep in mind.

- Ensure that the pointer used is of an appropriate size and shape for the individual user. Inappropriate pointers can increase stress, cause awkward postures, and lead to overexertion. A pointing device that is too big or too small may cause the user to increase finger force and bend the wrist into awkward positions. Using the left hand to operate a device that is designed for right-hand use can also create force and postures issues and may create contact stress to the soft tissue areas in the palm of the hand. Contact stress can create irritation and inflammation.
- Locate the pointer close to the keyboard to avoid excessive reaching. If a keyboard tray is used it should be large enough to accommodate the pointer without the need to reach to the desk-top.
- Sensitivity should be set so that the pointing device can be controlled with a light touch. Most current devices have sensitivity settings that can be adjusted through the computer control panel. A mouse that has insufficient sensitivity may require large deviation of the wrist to move the pointer around the screen. The pointer should be able to cover the full screen while the wrist is maintained in a straight, neutral posture.
- Encourage the use of keyboard short cuts to reduce frequent and extended mouse use.

Document Holder

Document holders keep printed materials needed during computer tasks close to the user and the monitor. Proper positioning of document holders depends on the task performed and the type of document being used. Appropriate placement of the holder may reduce or eliminate risk factors such as awkward head and neck postures or frequent movements of the head and neck to look from the monitor to a document. Poor posture can lead to muscle fatigue and discomfort of the head, neck, and shoulders. Frequent head movement can cause fatigue, headaches, and eye strain due to constant re-focusing.

A document holder should permit the placement of documents at about the same height and distance as the monitor, to minimize head movement. A document holder should be of sturdy construction, especially when heavy source documents (such as books) are used.

Telephone

Telephone use can contribute to the development of MSDs, especially when that use is frequent or prolonged. For frequent phone users, the location of the phone is important. Placing the telephone too far away can require the user to repeatedly reach, resulting in strain on the shoulder, arm, and neck. Place the telephone in the primary or secondary work zone, depending on usage patterns, to minimize repeated reaching.

Prolonged conversations with the phone pinched between the shoulder and head may cause stress and neck pain.

A "hands-free" head set should be used if the employee spends a lot of time on the phone. Speaker phone options may also be appropriate, provided the volume of this feature will not annoy co-workers.

IV. Work Environment

The quality of illumination is one of the most important environmental considerations for an office computer workstation. Glare from light fixtures or windows reflecting on the display can "wash out" images, making it difficult to clearly see the screen. Placement of the video screen in front of a window or other bright light source can produce a direct background glare that can overpower the image on the screen. Both of these conditions can lead to eye fatigue. To control both reflected and direct glare, consider the following:

- Arrange workstations to minimize glare from overhead lights, desk lamps, and windows. Orient workstations so that bright lights from open windows are at right angles with the computer screen.
- Use blinds or drapes on windows to eliminate bright light.
- Install "egg crate" or parabolic louver diffusers in overhead light fixtures to direct lighting downward to the work surface, without creating “hot spots”.
- Tilt the monitor slightly downward to prevent it from reflecting overhead light.
- Clean the monitor frequently. A layer of dust can contribute to glare.
- Consider the use of glare filters that attach directly to the surface of the monitor. Care should be taken to select glare filters that will not significantly degrade screen resolution.

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

Air quality also has a significant impact on the level of comfort at an office workstation. It is important to maintain appropriate air circulation and to ensure that there is an adequate supply of fresh outdoor air. For general office spaces, an outdoor air supply of 20 cubic feet per minute (CFM) per person is recommended. Air supply diffusers should be adjusted to redirect and mix air flows from ventilation systems to keep air flow rates within three to six inches per second. These air flow rates are barely noticeable or not noticeable at all. Employees should avoid sitting directly under air conditioning vents that "dump" air right on top of them.

The recommended ambient indoor temperatures range is between 68° and 74° F (20° and 23.5° C) during heating season and between 73° and 78° F (23° and 26° C) during the cooling season. Keep relative humidity between 30% and 60%.

V. Work Process

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. Addressing task organization factors can help minimize this risk. Computer work 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. 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.

Provide variation in tasks and workstations so there is time to recover from the effects of activity. Alternate tasks whenever possible, mixing non-computer tasks into the workday. This encourages body movement and the use of different muscle groups. Incorporate several, short rest breaks into the task routine. During these breaks users should be encouraged to stand, stretch, and move around. This provides rest and allows the muscles enough time to recover. 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.

Failing to recognize early warning signs and delays in reporting can allow small problems to develop into serious injuries. Computer users should receive training in basic ergonomic awareness, to understand effective work practices and to recognize hazards. 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.

Training should also promote awareness of the signs and symptoms of MSDs, in order to promote early intervention. Without proper medical awareness, MSD signs and symptoms may go unnoticed and un-addressed.

VI. Assistance

For additional information or assistance in the development and implementation of an Office Ergonomics Program to meet the needs of your organization, contact your Sompo International Risk Control Team or email us at: GRSRiskControlQuestions@sompo-intl.com.