Computer Workstations: Design & Adjustment

Background
This guideline outlines a practical approach for the optimal design and adjustment of computer workstations. The majority of University staff use a computer workstation in the course of their work, and a large proportion of musculoskeletal injuries amongst staff are reported to be related to tasks performed at computer workstations. The optimal design and adjustment and use of computer workstations is an important measure for the prevention of musculoskeletal injury.

The intention is for this document to be used a general guide as it is not exhaustive. In the case that an individual has special needs the University’s Ergonomics & Rehabilitation Adviser should be contacted for specific prescription. Examples of individual or special needs include musculoskeletal injury, pain and discomfort, tall or short stature, or a specific disability.

The following photographs illustrate variations in optimal workstation design and adjustment:

Sitting Workstation
Sitting Workstation

A standing height workstation allows variation between standing and sitting postures with the use of a high ergonomic chair.

Postural variation
It is unrealistic and undesirable for people to sit in one position at computer workstations, particularly when working for prolonged periods. It is important that workstation design and adjustment is coupled with regular movement of the body in order to offset the static loading effect on musculature and compressive forces on the spine.

Key steps for optimal workstation adjustment:

Step 1: Seat Height
Sit in the chair, relax and position your shoulder, elbow and wrist in the posture illustrated.
Neutral shoulder position:
- shoulder and arms relaxed with upper arm close to the body
- avoid reaching out to the side
- avoid forward/backward/upward reaching
- avoid elevated or hunched shoulders

Shoulders, elbows and hips in a straight line.
- 90 degree angle at the elbows

Wrist in a neutral posture (20 degrees extension)

Position your arms as illustrated above, move to the desk and adjust the seat height so that your hands are resting comfortably on the keyboard, mouse or work surface. When the seat height is adjusted correctly, your elbow height should be at approximately the same height as the work surface. Individuals may find it comfortable to position their seated elbow height to be just above or just below the desk surface.

(The front lever on the right hand side beneath the seat adjusts the seat height).

The illustration below depicts a well adjusted seat height and well positioned upper limb.

Step 2: Feet Support
After adjusting the height of the seat relative to your arm position, check if your feet are resting comfortably on the ground or whether they are dangling or in need of support. If you experience pressure behind your thighs or feel as though your legs and feet are not supported you will require an adjustable footrest as illustrated below.
**Step 3: Backrest Angle Adjustment**
Sit with your buttocks at the back of the seat so that the back rest is supporting the weight of your spine. Adjust the back rest so that the angle at your hip or between your trunk and your legs is between 92-100 degrees.

(The back lever on the right side beneath the seat adjusts the backrest angle)

The picture below demonstrates a well adjusted back rest angle and sitting posture.

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**Step 4: Backrest Height Adjustment**
Adjust the backrest height so that the lumbar support in the lower part of the backrest supports the lumbar curve of your back. This is also known as the ‘small’ of your back. The backrest height is adjusted by moving the backrest to its highest point to disengage the ratchet, moving the backrest to its lowest point and clicking it into the ratchet and then moving it slowly and gradually through its increments until a suitable height is achieved.
The illustration below shows a backrest correctly adjusted in both height and angle.

Step 5: Armrest Adjustment
If you have height adjustable, recessed arm rests you should ensure that they support
the arms but do not elevate the elbow or shoulder ie they should be adjusted to .5-1cm
below the elbow when the shoulder is relaxed and the upper limb is in the posture
illustrated in step 1.

Recessed or shortened armrests will usually allow close access to the desk surface,
whereas the older style, longer and non-adjustable armrests do not allow close access.
If the seat height results in the armrests preventing close access to the work desk, then
the arm rest position should be either lowered or elevated to be clear of the desk
surface.

Armrests may hinder desk access at corner workstations.

Step 6: Forearm Support
Move your chair close to the work surface so that your abdomen is almost touching it.
Sitting close to the work surface will allow your forearms to be supported by the desk
whilst operating the keyboard/mouse/pen or when reading. Relaxing your arms and
using the work surface for support will reduce static loads on muscles.

A gel wrist rest for use with the keyboard encourage support of the forearm, facilitate
a neutral wrist posture, and reduce contact stress between the forearm and the desk
edge.
The use of a gel wrist rest with the mouse may be a hinderance as it can inhibit the mobility of the upper limb when moving the mouse and may result in awkward positions of the wrist and shoulder. The use of a lower profile mouse that does not extend the wrist (bend it back) beyond 20 degrees, or a mouse with an alternative and appropriate design is recommended, as discussed in step 9.

**Step 7: Screen Adjustment**

The computer monitor screen should be placed directly in front of the user and reference documents should also be placed close to the midline of vision, as this will encourage a neutral head and neck posture.

The existing guidelines and recommendations in the ergonomics literature on both viewing angle and viewing distance differ, sometimes significantly from one another. For this reason they should not be taken as a commandment “carved in stone” but merely as guidelines. As such, they can be used as a starting point for tailoring any given situation. The following options for computer screen adjustment are outlined below:

Previous guidelines that recommended that the monitor be placed at eye level were based in part on the belief that the resting position of the eyes (considered to be the most comfortable gaze angle) is 15 degrees below the horizontal. New evidence shows that, while the eyes might be most comfortable with a 15 degrees gaze angle when looking at distant objects, for close objects they prefer a much more downward gaze angle. The figure below shows the optimum position for the most important visual display, 15-50 degrees below the horizontal line of sight, according to the International Standards Organisation (ISO 1998).
It has been found that a lower monitor height and low gaze angle results in reduced headaches and eyestrain. It has also been found that lower monitor placement exposes less of the eyeball to the atmosphere and reduces the rate of tear evaporation. This keeps the eyes more moist and reduces the risk of Dry Eye Syndrome.

Your computer monitor should be at a height that allows your head and neck to be within 20 degrees of the upright position and relaxed.

The monitor should be tilted back so that the top is slightly farther away from the eyes than the bottom.

As a general rule the height range described above may be more comfortable and less fatiguing, however there are individual variations and preferences.

Bifocal and multi-focal wearers need to give particular attention to the placement of their monitor. They often unknowingly tilt their head backwards so they can read the screen through the lower portion of their glasses. This can sometimes lead to neck, shoulder and back discomfort.

Potential solutions include either lowering the computer monitor or purchasing glasses designed specifically for working at the computer. In specific cases the University may provide financial contribution toward the purchase of glasses used at a University computer workstation. This would be an occasional arrangement and would be on the advice of the Ergonomics & Rehabilitation Adviser.

The screen should also be adjusted to a suitable distance for comfortable viewing. The screen should be within a 500 – 750 mm distance to the table edge and sitting too close to the screen is more likely to contribute to eyestrain than sitting at a distance within the specified range.
Flat panel LCD monitors should be used for desk depths of 800mm and less, however larger computer monitors require a minimum desk depth of 900mm to accommodate the need for forearm support and adequate viewing distance.

The OHS Unit should be contacted for further assessment of lighting, glare and reflectance issues.

**Step 8: Laptop Adjustment**

One reason that musculoskeletal problems are often associated with laptop use is that the screen is not independently adjustable from the keyboard and awkward postures result. It is for this reason that laptop computers are not usually recommended as primary computers.

In the case where they are used, it is preferable to select and use laptops with the following design criteria:

- Screen and keyboard separation/detachment and screen height adjustability
- A light weight and small lap top
- A light weight carrying case with handle and shoulder straps
- The capacity to plug in an external keyboard and mouse.

The laptop workstation should be adjusted using the key steps outlined in this document.

When transporting the laptop computer eliminate unnecessary baggage from the case and use a wheeled luggage bag whenever possible taking care not to forcefully pull it.

Where a laptop is used, a separate keyboard and mouse should be plugged into the hard drive so that independent adjustment of the keyboard and screen in both the horizontal and vertical planes can be achieved.

When travelling with a laptop and using it at a hotel, props such as pillows can be used to raise the seating height or support the back and docking stations or separate keyboards and mice may be borrowed from the hotel.

**Step 9: Keyboard and Mouse Design and Placement**

The computer input devices (e.g. mouse and keyboard) should be placed within a comfortable reach distance so that the upper limb and spine are in a neutral working posture. The keyboard and mouse should be placed far enough onto the desk to allow forearm support, and close enough so that the shoulder, elbow and wrist approximate the neutral posture as specified in step 1.
The use the traditional alpha-numeric keypad with a right sided mouse is likely to cause shoulder abduction and elevation particularly in users with a smaller shoulder span. Prolonged shoulder abduction and elevation may be associated with neck, shoulder and upper limb musculoskeletal disorders. A keyboard without a numeric keypad or with the numeric keypad on the left hand side should be used, to eliminate right shoulder abduction that occurs when using a right sided mouse. The supplier details for the compact keyboard and left side numeric keypad can be obtained from Kris Fraser, Ergonomics & Rehabilitation Adviser ext. 56122.

Awkward shoulder posture using alpha-numeric keypad

Neutral shoulder posture using numeric only or left hand side numeric keypad.

A keyboard without numeric keypad may be too small for users with large hands and broad shoulders, and should be avoided in this instance.

The split keyboard which has a mound shaped surface, promotes a neutral posture of the forearm, wrist and hand may be effective in the prevention and rehabilitation of wrist, forearm and elbow soft tissue strain. For smaller users, a split keyboard without a numeric keypad would be considered appropriate.
There are a range of computer mouse designs, and it should be noted that the risk of soft tissue injury to the hand, wrist and upper limb will not be eliminated by mouse design per se. Selection of a well designed mouse should be coupled with task variation, use of keystrokes, and other strategies designed to minimise use of the mouse.

The traditional mouse requires awkward posture and movement of the wrist and forearm: pronation, ulnar and radial deviation, and wrist extension beyond 20 degrees.

**Traditional Mouse**

Alternatives to the traditional mouse that are presented in this document are the pen mouse, the evoluent mouse or the touch pad.

The pen mouse facilitates a forearm and wrist posture that is closer to neutral and less awkward ie the forearm and the wrist are closer to the mid position without the need for full pronation, excessive extension and ulnar and radial deviation. Subjectively, the grasp force required to use the pen mouse is low. It is important to note, however, that a static posture and repetitive movements are required for its use. Pen mouse technology has recently improved, possibly making it easier to use.

**Pen Mouse**
The Evoluent Mouse retains the traditional mouse shape and controls, however the mouse is re-oriented so that the forearm is in the mid-position, and the hand uses a comfortable gross grasp. The safe use of this mouse is dependant on the user avoiding repetitive wrist extension beyond 20 degrees and wrist flexion. Users are encouraged to use relaxed, fluid and gross arm movements rather than isolated and awkward wrist and elbow movements.

( Photo courtesy of Ergonomic Office at www.ergonomicoffice.com.au/ )

The touch pad uses up to 20 different hand gestures and provides variation in posture and movement beyond that illustrated below. Repetitive movements of the fingers with the forearm in pronation are required, and these pose a risk. The suitability of the touch pad in comparison with other input devices should be assessed on an individual basis.
In the case that you are susceptible to soft tissue problems in the hand, wrist or forearm that may be associated with use of the mouse or keyboard, the Ergonomics & Rehabilitation Adviser should be contacted to assess the suitability of alternative input devices.

**Step 10:**
Hard copy documents that are referred to whilst operating the computer should be placed close the midline of vision and be elevated so that a neutral neck and head position can be encouraged. A document holder or an adjustable reading surface should be provided and placed in a position close to the midline between the keyboard and the computer screen or adjacent to the computer screen as depicted below. Where there is limited desk depth, placement of the reading surface between the screen and keyboard may prevent forearm support so in this case the angled reading surface should be placed adjacent to the computer screen.

![Document holder for single documents](image1)
![Angled reading surface for books](image2)

**Step 11:**
A common problem experienced by receptionists or office employees who frequently used a standard telephone, is cradling the phone between the neck and shoulder when using the computer and telephone simultaneously. A telephone headset allows simultaneous use of the computer and telephone with a neutral posture of the neck and upper limb and is strongly recommended for frequent telephone users.

Graeme Wilson (Voice Networks, Information Technology Services ext 52200) should be contacted in relation to the selection of appropriate telephone headsets.

Blue Tooth ear pieces are now available for use as telephone headsets and your computer hardware supplier should be contacted in relation to these.
Additional Information

   (www.risk.admin.uq.edu.au/frmLogin.asp?ss=1&TaskID=&AuthorID=)

A generic risk assessment for Ergonomics Computer Use has been completed on the University’s Risk Assessment Database. Its purpose is to assist University Managers and Staff to complete risk assessments for computer tasks in their work area. The following tasks are examined for risk factors and risk controls:

- Keyboard use
- Mouse use
- Prolonged sitting
- Viewing the computer screen
- Viewing hard copy documents
- Simultaneous use of the mouse, keyboard and telephone hand set

As individual worker needs and tasks at computer workstations are highly variable, the Ergonomics & Rehabilitation Adviser should be contacted for further information and discussion if appropriate.

2. Selection & Purchase of Computer Workstation Furniture/Equip.

The Ergonomics & Rehabilitation Adviser is responsible for ensuring that the University complies with ergonomics criteria for the selection of office workstation furniture and equipment. Compliance with the Office of Australian Safety and Compensation Commission Standards and other relevant Australian Standards is a requirement for furniture and equipment purchased by the University.

All Schools purchasing new computer workstation furniture and equipment should contact the Property and Facilities (P&F) Furniture Procurement Section at furniture@pf.uq.edu.au. The range of furniture and equipment that is supplied via P&F meets ergonomics requirements, and can be viewed P&F Furniture Showroom at the Central Warehouse, cnr. Walcott Street and Sir Fred Schonell Drive.
The guideline “Screen Based Equipment Furniture Design and Selection” on the OHS Unit website provides practical guidance for desk design and selection.

The Ergonomics & Rehabilitation Adviser should be contacted on ext 56122 for further information about this topic.

3. **Height adjustable keyboard & mouse segments**

Height adjustable keyboard and mouse segments are not generally used at the University for the following reasons:

- It is preferable to have all desk equipment and tools on 1 level
- Adjustable keyboard surfaces do not have enough depth to allow forearm support on the desk when operating the mouse or keyboard
- The adjustable mechanism beneath the surface increases the thickness of the desk beyond the maximum 25mm specified by the Australian Standard and impinges on thighs when attempting to get adequate elevation in the chair.
- A desk which is height matched to the height adjustable range of the chair will suit the anthropometric requirements of the majority of people. Very small or very tall people should contact the Ergonomics & Rehabilitation Adviser for workstation design and adjustment advice.

4. **Voice Activation Software**

Voice Activation Software such as Dragon Naturally Speaking (Professional) is an effective means of reducing the use of input devices such as the keyboard and mouse, and therefore will reduce the risk of soft tissue injury to the upper limb and spine that may be associated with computer use.

The use of a voice activation package is particularly useful for individuals who have high computer usage or who have musculoskeletal symptoms that persist despite all other ergonomics modifications. The software can be used with text documents; however it is not usually applicable to data entry and analysis or email tasks.

5. **Postural variation, stretching and movement**

The overall strategy for prevention of musculoskeletal injury should include the following additional measures to complement workstation design and adjustment:

- Relaxed posture
- Task variation
- Regular movement
- Regular postural variation / changing between sitting and standing or walking postures on a 30 minute basis. Stretching and mobilisation of the upper limb, neck, mid and lower back during standing and walking is recommended.
- It is preferable to vary posture and stretch for brief periods regularly (eg a few minutes every 30 minutes) than for longer periods irregularly (eg 10 minutes every hour).
- Dynamic backrest
- Workload management and prioritisation.
- Stress management to reduce muscle tension and anxiety / psychological factors
- Constructive and harmonious working relationships
6. **Ergonomics software**
Computer users often don't realise how long they've been sitting and working at the computer. Prolonged sitting at the computer and operation of the keyboard and mouse are risk factors for musculoskeletal injury. Ergonomic software can be used to monitor your keyboard and mouse use; prompt you to vary your posture, tasks and to stretch regularly.

The best software will run in the background and it will monitor how much you've been using the computer. It will prompt you to take a rest break at appropriate intervals, and it will suggest simple exercises.

The use of a software package to pace work, prompt variation in posture and tasks, and suggest stretching exercises is an effective means of ensuring healthy work habits. WorkPace is a software package that is commonly used across the University.

7. **Touch typing**
Touch typing can increase the efficiency of hand and wrist movements and will minimise the requirement for excessive neck flexion that is required to view the keys. There are a range of touch typing teaching software available for PCs and Macs.

8. **Strains / Sprains, Headaches, Sore eyes.**
In the case that computer users experience a strain / sprain, headaches that may be related to muscle tension or lighting, or sore eyes that may be related to viewing the computer screen, the Ergonomics & Rehabilitation Adviser should be contacted for further assessment. Contact with the Ergonomics & Rehabilitation Adviser should be made as soon as possible after the onset of symptoms.

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