MONOGRAPH

Why do I have to put my Computer Screen there?

Robert G M Sellars

Computer screens on office desktops in Australia are generally placed so that the top of the screen is about level with the eyes with the distance varying according to the desk it is placed on and at about arm's length away from the operator. However recommendations for screen position vary considerably from country to country. The questions that can be fairly asked are…Why does the screen have to be placed there and what is the research to indicate that placement? What is the relationship between posture, computer use and injury? Is there actually a perfect position?

This Monograph summarises the history of typewriting typing and computing, the current recommendations from around the world, the research into the causes of injury, and proposes a logical solution to the question "Why do I have to put my Computer Screen there?

INTRODUCTION

Ever since monks started writing and copying manuscripts 1500 years ago in Scriptoriums the default working position was to look down at the work being done at desk level or on a sloping board.

Commercial copy shops opened up 700 years ago to produce handwritten copies of books and documents. However the work was arduous.

A 10th century Prior complained *"Only try to do it yourself and you will learn how arduous is the writer's task. It dims your eyes, makes your back ache, and knits your chest and belly together. It is a terrible ordeal for the whole body".*

The advent of the typewriter meant that the operator could now sit upright but still had to look down at the work being produced.

Then computers came along. Screens were placed high low and in-between – as can be seen in the photos in this monograph.

Between the 1970's and the 1990's there was a massive increase in various 'overuse' injuries of the neck, arms and hands (RSI OOS CTD[1] etc.). These were primarily blamed on the mechanical setup of computers, screens, keyboards and workstations.

But was the hardware really to blame for these injuries, or are there other contributing factors?

Read on…

Historical Aspects

The first mechanical device to impress letters on paper were invented by an Italian Printmaker, Francesco Rampazzetto in 1575 who called his machine a scrittura tattile (writing tactile). However, this did not sell, possibly because no one could pronounce the name or had no idea what it meant.

More mechanical writing devices were invented over the next 300 years but the first commercially successful machine (called a type-writer and featuring a QWERTY keyboard) was produced in 1873 and manufactured by Remington Sewing Machine Co.

Prototype of the Sholes and Glidden typewriter, 1873, the first commercially successful typewriter, and the first with a QWERTY keyboard.

Mechanical typewriters became increasingly more sophisticated over the next 100 years with electric

[1] The term "Repetitive Strain Injury" or "RSI" has been abandoned due to the lack of diagnostic physical signs.

typewriters being introduced in the early 1900's. The 'state of the art' typewriter was the IBM Selectric 'Golfball' typewriter that featured a computer keyboard style with a type ball moving across the page rather than a moving platen with mechanical keys.

IBM Selectric Typewriter 1961. Note the elevated position of the keyboard.

Personal computers came along in the late 1970's and quickly replaced typewriters. The first computers had small monitors with word processing programs that were often difficult to learn.

The Macintosh Apple II computer of 1977 is credited with being the first mass produced personal computer.

Mac Apple II computer of 1978. Yes, this was a real advertisement showing a typical use of the computer designed for home use.

IBM entered the market with the IBM Personal Computer in 1981 and this was the forerunner of the Windows powered computers that are the mainstay of office computing today.

IBM Computer 1981. Note the elevated position of the monitor but much lower keyboard compared to the 1960's typewriter.

Portable (or more correctly transportable) computers were introduced in 1981 although they were so big that they could barely fit under an airplane seat. They were designed to be placed on a table rather than on the lap.

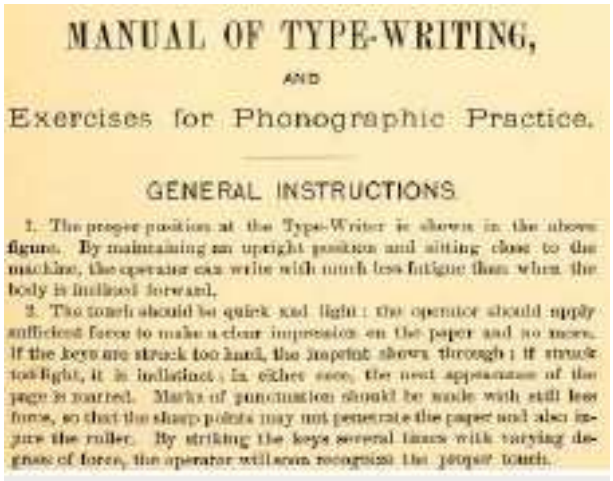
Osborne I 'portable' computer – 1981 – 10 kgs, no battery and tiny screen.

The monitor position of early computers varies considerably ranging from desk level (Apple II) to above eye height (IBM PC).

Working Posture through the Ages

Typists always had to look down onto their machine because that is where the machine was placed. The working posture of the typist in 1867 remains the same today, regardless of the chair being used.

In 1887 the recommended postural position was similar to the recommendations in 2014…



MANUAL OF TYPE-WRITING,

AND

Exercises for Phonographic Practice.

GENERAL INSTRUCTIONS

1. The proper position at the Type-Writer is shown in the above figure. By maintaining an upright position and sitting close to the machine, the operator can write with much less fatigue than when the body is inclined forward.

2. The touch should be quick and light: the operator should apply sufficient force to make a clear impression on the paper and no more. If the keys are struck too hard, the imprint shows through; if struck too light, it is indistinct; in either case, the neat appearance of the page is marred. Marks of punctuation should be made with still less force, so that the sharp points may not penetrate the paper and also injure the roller. By striking the keys several times with varying degrees of force, the operator will soon recognize the proper touch.

From Humphrey's Manual of Type-Writing. A guide to the art of type-writing for use in schools and copying offices 1867

Typing posture instructions occupied half a page in 1946 (Stella Pajunas – 216 words per minute on an early IBM electric typewriter. Average speed today is about 30 - 75 wpm).

Today there are numerous articles, books, manuals and recommendations about computer posture. Enter the search query "How to sit at a computer with good posture" into a well-known search engine and 3 million replies pop up – advice, photos, YouTube videos, blogs etc. New Zealand leads the field with a 100 page ACC Publication 'Guidelines for using computers'[1].

The advice is variable (see 'Eye to screen distance', page 5) and there does not appear to be any reliable research on how many of these recommendations on equipment position were arrived at.

TYPING TECHNIQUE . . . POSTURE

by the World's Champion Typist

The best typing posture is one that is natural and comfortable for *you*. To gain this posture, follow these simple principles:

1. Adjust the height of your chair so that your feet are flat on the floor when you are seated directly in front of the typewriter. The back rest should support you comfortably.

2. Sit so your arms incline slightly forward from the shoulder and your forearms assume the same upward slope as that of the IBM keyboard. Your wrists should be slightly lower than your knuckles; your fingers should curve naturally toward the keys.

CHECK YOUR TYPING POSTURE AGAINST THIS PICTURE OF STELLA PAJUNAS, WORLD'S CHAMPION SPEED TYPIST.

Causes of Injuries to Computer Operators

Various soft tissue disorders of the neck and arms have been described in typists ever since the typewriter was first invented.

Research has been difficult, partly from an absence of an agreed system of classification of disorders and partly from difficulties in accurately measuring the mechanical factors that might contribute to injury.

- Neck pain: The available evidence suggests that neck pain is due to a combination of psychological and occupational psychosocial variables (i.e. abnormal posture, repetitive tasks, lack of support, high demands and poor control over work)[2]. The evidence for prevention, based predominantly on ergonomic principles is not convincing.
- Shoulder pain: As with neck pain, psychological and occupational variables have an important role.
- Non-specific forearm pain: This is significantly associated with psychological distress but not with any mechanical exposures, including keyboard use or repetitive tasks[3].

Research – Neck and Arm Disorders

Ergonomic design and training for prevention of Injury

This was a Cochrane Systematic Review[4] published in 2012[2].

Introduction: Work-related upper limb and neck MusculoSkeletal Disorders (MSDs) are one of the most common occupational disorders around the world. Although ergonomic design and training are likely to reduce the risk of workers developing work-related upper limb and neck MSDs, the evidence is unclear

Review: The review found 13 Randomised Controlled Trials involving 2397 workers. 11 of the 13 studies evaluated effectiveness of ergonomic equipment, supplementary breaks or reduced work hours and ergonomic training.

Findings: Findings were limited by dissimilarity between studies with more high-quality evidence being needed to determine the effectiveness of interventions. The findings were…

1. Moderate-quality evidence suggested that the use of arm support with alternative mouse **may** reduce the incidence of neck/shoulder MSDs, but not right upper limb MSDs.
2. Moderate-quality evidence suggested the incidence of neck/shoulder and right arm MSDs is **not** reduced when comparing mouse use with and without arm support.
3. Very-low to low-quality evidence suggested that other ergonomic interventions **do not** prevent work-related MSDs of the upper limb and neck

Computer work and musculoskeletal disorders

This was a Systematic Review[5] published in 2010.

Introduction: There is an increasing trend for complaints of neck and arm pain due to computer use.

Review: 22 studies looking for association between computer work and neck and arm disorders were found.

Findings: There was very limited evidence for some association between computer use and neck and arm disorders. All the evidence was weak.

[2] The Cochrane Review is a systematic, up-to-date summary of reliable evidence of healthcare benefits and risks of a particular procedure or intervention, derived from the parent database maintained by the Cochrane Collaboration.

1. Workstations and work tasks varied considerably. Examination protocols and concluding diagnoses also varied considerably, which made comparisons difficult.
2. One study with more than 6,000 subjects found no significant associations between tension neck syndrome and several ergonomic factors.
3. There were no significant associations between computer use and shoulder tendonitis or elbow epicondylitis or Carpal Tunnel Syndrome.
4. There was limited evidence for a relationship between extended mouse and keyboard use and wrist tendonitis.

Psychosocial Factors

Most research into musculoskeletal problems amongst computer users included the influence of psychosocial variables. All the research indicated that psychosocial factors were significant. Some highlights…

1. High job demand, low decision autonomy, time pressure, mental stress, job dissatisfaction, high workload and lack of support were all risk factors. Increasing hours of computer usage were consistently associated with musculoskeletal disorders[6].
2. In a study of Dutch Computer Office Workers[7], prolonged sitting with a bent neck was the most common ergonomic cause of neck pain with the strongest predictor being previous history of symptoms. The negative impact of task difficulty (i.e. stress) was significant.
3. A Malaysian Study[8] also found that psychosocial work factors were found to be more important than others in musculoskeletal discomfort.
4. An Estonian study confirmed the influence of psychosocial risk factors and noted "…presenting computer use as a serious health hazard may modify health beliefs in a way that is unhelpful".

Summary

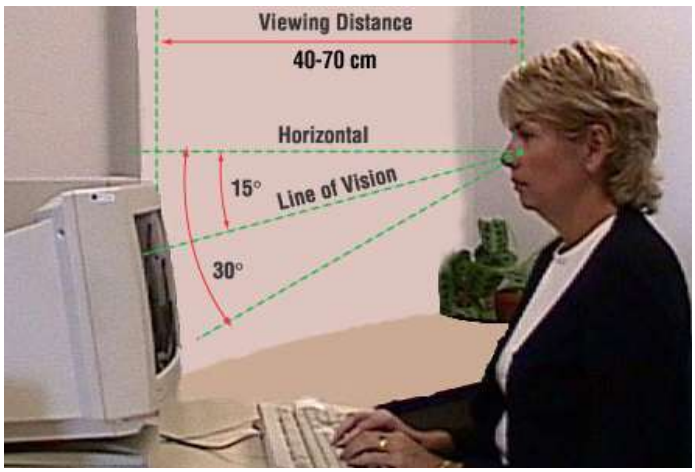
Overall, there is minimal evidence that external interventions have any effect on the incidence of work-related arm and neck disorders.

The psychosocial risk factors are of significantly greater importance in determining how much any discomfort or pain will bother the person.

CURRENT SCREEN RECOMMENDATIONS FOR COMPUTER OPERATORS.

New Zealand: *Guidelines for using Computers – ACC*

USA: *OSHA – Computer Work Stations*



Canada: *Canadian Centre for Occupational H&S*

Australia: *University of Western Australia*

Critical Comment on Sitting Position Recommendations

In the photos on the previous page, sitting positions vary slightly, screen height varies from below eye height to above eye height, three chairs are armless, and one chair has arms.

None of these recommended positions take into account the placement of document holders or the use of phone, dictation devices, reference materials or multiple screens.

Few computer users would ever sit for prolonged periods of time simply typing non-stop without using other devices. The recommended positions might be 'perfect' but do not represent real life for the great majority of computer users.

Virtually all Computer Users waste time at work doing non work-related activities, mostly on the Internet or Social Media and of course this could be on the office computer or other personal communication devices. Check http://www.forbes.com/sites/cherylsnappconner/2013/09/07/who-wastes-the-most-time-at-work/

Eye to screen distance

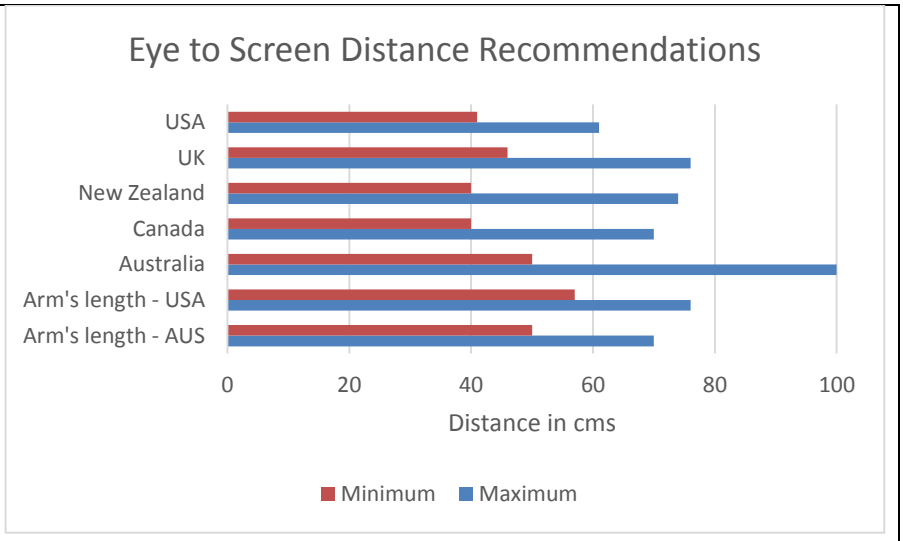
Recommendations vary from country to country. Australians believe you can have a computer screen up to 100 cms away from your eyes (perhaps because it's a bigger country with wide open spaces?).

Recommendations vary significantly from country to country

Minimum Distance: 20% variation

Maximum Distance: 39% variation

Many other publications simply recommend a distance at about the midway point or at "arm's length"[9] [10]



The distance from an average desk to eye height is about 45 – 55 cms.

Whether we are writing or using a desktop computer or laptop the automatic 'best distance' remains roughly the same.

Text on a computer is usually at a font size of 10 to 12, the same size as most paper publications.

HUMAN ANATOMY, PHYSIOLOGY AND FUNCTION AND COMMUNICATION

Anatomy is the construction of the body – bones, ligament, tendons, muscles etc. Not much we can do about our anatomy, we are what we are.

Physiology is the way the body works. Posture, fitness and working conditions affect the efficiency of how well we operate. Fitness and being comfortable in our working conditions and the people we work with enhance productivity.

Function is what we do, or want or are able to. It's made easier with good working conditions and harder if we are struggling with our surroundings or the amount of work we are asked to do.

Communication with others is either direct (i.e. usually talking to another person in front of you) or indirect (i.e. using a 'third party' medium to do the communication). The most common everyday 'third party' instruments today are phones, computers, and written texts (books, magazines, newspapers).

Physiologically our posture reflects how we are communicating and the circumstances and environment. Consider the following photos and the posture we automatically adopt.

Talking: 'Body Language' will change according to whom we are talking to and how interested we are in the other person and what they are saying.

Phone: With the advent of mobile phones we can talk anywhere. So, we may be walking and talking (looking out for hazards) or standing or sitting.

Computing: Whether for work, education or play most people will simply adapt to however the equipment is setup.

Reading: Our usual position for reading is at waist or desk level with the eyes, not the head down.

Strange ways of using electronic devices….

Humans automatically use devices such as smartphones and computers according to how they feel comfortable. Most of us pay little heed to the pious 'best practice' guides published by various government authorities or experts…

So, What is the Best Position for My Computer Screen?

By and large, it really does not matter too much so don't get too hung up on measuring your screen position with a tape measure to get the 'perfect' position. Absolute perfection doesn't exist!

The screen is simply one of many factors when trying to maximise workplace comfort and productivity.

In summary…

Screen Position: Set the screen at a distance about equal to the 'natural' position you adopt when reading a book or newspaper.

Set the screen height to what **you** feel comfortable with. If your normal posture is really upright and straight then you will probably be comfortable with the screen higher. If your normal posture somewhat 'bent forward' then you will probably prefer it lower. But….do experiment.

If you wear glasses, particular bi or trifocal then make sure your screen and keyboard and document areas are in focus without having to adopt strange head positions.

Aches and Pains: Work stress and previous injuries are the most important factors is determining how much the aches and pains of daily life bother you.

Its fine to experiment with your workplace ergonomics to see if that helps. However, do take stock of how you are coping with your job, how much control you have over your work tasks and how well you get on with bosses and colleagues.

Evolving Technology: The world never stands still. Smartphones, Tablets, Notebooks, Laptops, Multiple Screens are all relatively recent and the way we use them for business and pleasure is constantly changing. Wireless technology is getting cheaper by the day and computing power keeps increasing exponentially.

Use technology to your advantage. Multiple screens mean that reference documents can be displayed in full alongside the main computer, smartphones enhance connectivity, and Bluetooth brings multiple devices together. Use them!

Humans are meant to move: We are built to be active, nature never intended us to be sitting still in one position for hours on end.

If some part of your body is hurting from sitting at your desk then move it, do a bit of exercise, alter the way in which you are sitting – easily done, just put your chair or screen up or down a bit and shift things around so you work in different positions.

Get up, move around, stretch, go and talk to colleagues rather than phone or email them, get in some general exercise out of working hours, play sport and enjoy the great outdoors!

Don't worry, be happy: It's a trite saying but quite true when it comes to worrying about injury from computer use.

There is no evidence that any serious injury occurs from computer use. You are much more likely to feel worse because you worry about it, get tense and start convincing yourself that trivial everyday aches and pains are worse than they really are.

In summary: Computing is just one part of your life, don't let it rule what you do. Compute to live, don't live to compute!

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Robert Sellars

C/- mlcoa

1/38 Montpelier Retreat

Battery Point TAS 7004

Ph 03 6224 2133