

Ergonomic Review: Armrests

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The nature of job tasks in the office work environment has changed significantly since armrests were added to office chairs. This literature review examines applicable research in an effort to understand the importance of adjustable armrests and to distinguish some of the issues surrounding proper design features. Evidence suggests that adjustable armrests can relieve muscle activity and promote better seated posture in workers who use computer input devices as a regular part of their job.

Overview

It is difficult to grasp how dramatically seating has changed in recent decades. The standard secretarial chair in the 1950's provided a low backrest that might adjust a few inches...but little else in the way of adjustability. Typically, these chairs afforded no relief for the upper back and arms.



Armrests were largely considered status symbols for executives. But even they could not adjust these supports.

In the last decade, we have learned that not only computer users experience high rates of physical discomfort; many office workers are more uncomfortable than once presumed¹.

Musculo-Skeletal Disorders (MSD's) are not new - but they are prevalent in today's computer workplaces. From 1982 to 1997, recorded rates in the US increased more than twelve-fold.

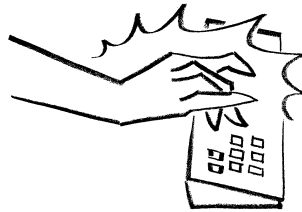
Some generally recognized risk factors for MSD's include:

- Static and constrained postures
- Awkward and unnatural positions
- Excessive force
- Repetition

... or a combination of these factors. The design of the armrest may affect all of these risk factors.

Why use armrests?

Designing good armrests is not easy. Not only do people come in a broad range of sizes; they often develop their own sitting styles. Women tend to sit upright, while men tend to lounge.



Our work also influences what we need in an armrest. Many computer users type considerably harder than is needed; this is particularly so among those experiencing discomfort². Armrests may help these users type more lightly³.

Armrests must accommodate users' different workstation configurations – including devices such as keyboards that tilt back.

Finally, the overall design of the chair affects how we sit – and support our arms. It should support a variety of postures to promote comfort, work effectiveness, and long-term well being. Chair design affects how armrests are used – and the extent to which the adjustments benefit users.

With this in mind, the following is a review of ergonomic considerations for armrest design and use.

1. Armrests affect more than the arms.

The hand-arm-shoulder-neck system is complex.

For example, neck/shoulder discomfort resulting from inadequate support may cause people to sit in ways that eventually cause discomfort at another site, such as forearms and wrists.

Users may also experience discomfort at a different area than the actual site of injury. This can lead to confusion; for example, users might take steps to alleviate wrist pain – though their discomfort may sometimes result from stress on the neck and shoulders from inadequate arm support.

Damage to a nerve may also lead to a secondary injury to another part of the nerve. The nervous system communicates through nerves that radiate out from the spine. Damage to one area of the nerve (such as at the cervical spine) may contribute to secondary injuries at another site of the nerve (such as at the wrist)⁴.

2. Armrests relieve loads on the neck, shoulders and arms.

Many of today's computer users experience neck/shoulder symptoms. When raising the arms to type, the shoulder girdle tightens and suspends arms. Static work with elevated and unsupported arms increases the load on the neck, shoulder, and back, contributing to neck and shoulder MSD's⁵. Forces magnify when holding one's arms to the side. Working with unsupported arms may impair circulation, restrict the natural range of shoulder motion, degenerate shoulder tendons, and dramatically shorten time to fatigue.

Supporting one's arms can alleviate these static muscle loads - and helps prevent neck, shoulder and arm pain and discomfort.

... And may help promote good postures.



Armrests help support people within their personal vision and reach zone. In fact, achieving a comfortable armrest position to maintain the vision and reach zone is so important that it usually dictates how high users adjust their seat. People will ignore leg

length in adjusting seat height if their vision and reach zone is satisfied. Consequently, at a standard height desk smaller people sit *higher* than tall users.

When foot support is lost, sitting forward on the seat with feet propped on the chair base is a common posture among people using keyboards.

Armrests are particularly critical when the worksurface is much higher than the chair because the higher the keyboards, the more people struggle to find a way to support their arms.

When armrests are not available, users often sit in awkward positions, such as by hunching forward and leaning forearms on the desk. This lack of arm support not only affects posture - but may also exacerbate injury by leaning against sharp worksurface edges.

3. Armrests alleviate stress on the back.

Armrests reduce loads on the spine by about 10% of the user's body weight. This reduced load is approximately equivalent to that associated with using a forward sloping seat.

If designed properly, armrests can help keep users from slumping and facilitate leaning back.

4. And help prevent excessive pressures on the seat...

Armrests help alleviate loads on the soft tissues and the back by supporting some of the weight otherwise supported by the torso.

Armrests that adjust in height, width and pivot provide more surface area to support more of the arms' weight than designs that only adjust in height and pivot, or provide only height and width controls.

5. Armrests alleviate stress on the lower limbs.

When rising from a chair, loads are transferred to the knees and hips, similar to those going up stairs. These loads can be particularly stressful for users with temporary or chronic health concerns⁶.

Armrests facilitate rising from a chair... while cutting the force (hip moment) in half.

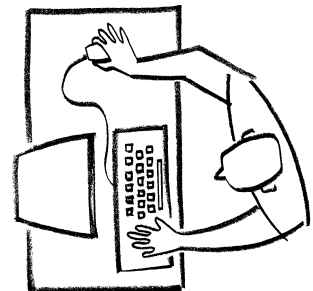
6. Armrests stabilize posture, and help us do our work.

Many computer tasks require working with arms in awkward, fixed positions. Users may experience specific symptoms of discomfort or pain - or there may be a generalized discomfort or muscle fatigue.

MSD symptoms are typically stronger on users' right side. These lateral differences in discomfort have become more pronounced with the introduction of the mouse and other input devices.

Mousing often requires considerable muscle work.

Many users work with arms reaching out, wrists bent more than 15° to the side, and shoulders hunched forward. Data entry on numeric keypads is another example of a task that can be fatiguing. Adjustable armrests can allow users to intermittently support postures and facilitate changes in position.



⁵ Of note, infirmities are not only a function of age. Most of us develop a disability at some time in our lives, resulting from sprained ankles, arthritis, pregnancy, or other health considerations. For such users, ease of rising from a chair takes on particular relevance.

And how should they be designed?

1. Armrests should support asymmetrical work.

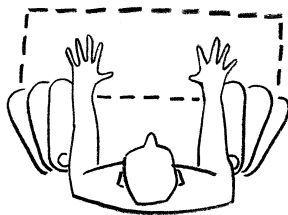
Armrests should be individually adjustable to accommodate uncentered postures such as from mousing, writing, and using calculators.

2. Pivoting armrests.

Benefits of pivoting armrests include:

- a) Independent pivoting action helps accommodate sideways arm postures commonly found among computer users. Mouse users often work with the right arm more bent to the side (abducted).
- b) Specific workstations may interfere with armrests, contributing to poor working postures. For example, narrow diameter corner worksurfaces may obstruct armrests, and force users to work with excessively elevated arms. Adjustments that enable armrests to angle inward can help prevent such problems.
- c) Pivoting armrests allow users to support their arms while working in a wider range of postures.
- d) Computer users' arms hang more naturally near their sides when arm caps adjust for both width and angle. Abduction is reduced if the arm cap can be placed directly under the elbow.

However, it is not enough to provide pivot adjustments.⁷ Armrests that pivot without adjusting in width may not support natural work postures. Because the distance between pivot points is fixed, people that are short (or have narrow shoulders) are forced to hunch and reach to the side (outward rotation and abduction of the shoulders) while using a mouse or working with equipment.⁸



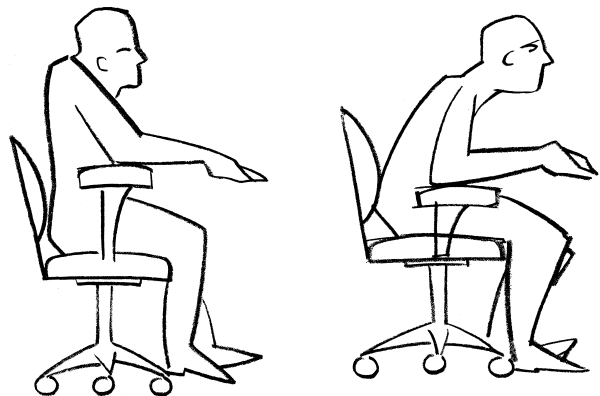
The shape and size of the armrest also affects how they are used. For example, short users may find that pivoting armrests that are too long interfere with work⁹.

3. Armrests should accommodate a broad range of users.

There has been an increasing recognition of the importance of adjustable height armrests for accommodating intensive computer users.

Postures that are symmetrical and supported are generally preferred. Armrests should allow users to sit centered and supported.

Research indicates that armrests that support the elbows are more effective at relieving stress on the back¹⁰. Armrests that adjust horizontally help alleviate muscle loads on the neck/shoulder and back¹¹.



On the other hand, armrests that are inflexible, poorly designed, or that obstruct positioning in front of the worksurface may force the user to hunch or twist. When armrests are too high, users are more likely to hunch shoulders. Armrests that are too low cause slouching and twisting.

Armrest controls ranges must fit different size users:

- Armrest heights should adjust from 7 to 10.75 inches above the seat, in order to fit 5th to 95th percentile females and males.¹²
- Armrest widths should adjust about 4 inches to fit 5th to 95th percentile males and females.

People make fewer errors when their keyboard is at about the right height¹³. It is reasonable that properly designed armrests may increase employee effectiveness and productivity.

4. Armrests should stabilize position, yet promote shifts in posture.

Today's computer users often perform work requiring high precision while using mice and other input devices – for hours at a time. Such precise motions may increase the risk of developing symptoms. Users may benefit from supports that provide postural stability while allowing them to work in a variety of postures.

Many users prefer soft chair armrests to palmrests in order to promote free arm motion; to avoid unnatural hand positions, a palmrest should only be used as a rest, not as a support while keying.

Armrests that are independent of other seat components often provide users with greater control over their working position – because they do not need to reposition their hands when leaning back. This stabilization of arm position may encourage some users to take greater advantage of backrest features.

5. Armrests should allow for (but not encourage) continuous use.

Many ergonomists believe that armrests should be used intermittently. Although there is a vast amount of literature supporting the benefits from using armrests, constant use of these supports may also affect users' posture in unintended ways. For example, continuous arm support may cause users to deviate their wrists while typing.

Ergonomists currently do not fully understand the long-term implications of intermittent versus constant use. Perhaps some people will benefit from working with continuous use – while doing so makes others uncomfortable.

Employees with symptoms may find that continuous use of armrests facilitates recovery – while others may become uncomfortable. It is also possible that some users find that continuous support alleviates neck and shoulder pain – while their wrists become less comfortable.

Certainly, the tradeoffs associated with continuous use are, to some extent, a function of the specific design of the armrest. A well-designed armrest will be more beneficial to more users – and offer less potential for adverse effects.

Regardless of what ergonomists ultimately decide, many users will support their arms continuously while working at the keyboard. And if they can't do so on an armrest, they will find a more hazardous and less acceptable means. Therefore, it is important that the armrest allows users to work with arms constantly supported without introducing unnecessary risk factors.

6. Armrests should not interfere with getting close to the worksurface.

The optimum length of the armrest depends on the specific configuration and placement of the arms on the chair.

However, under all circumstances, the design of the armrest should not interfere with proper seated postures at the work surface. Poorly designed armrests may constrain postures, causing users to hunch forward and work with elevated arms.

7. Armrests should not have sharp edges.

Armrests should be broad and padded, and support the “fleshy” portion of the forearm. These supports should be designed so that they do not impact the highly sensitive ulnar nerve near the elbow (Pheasant, 1997).

8. Armrests should be easy to adjust.

It is now widely recognized that many users do not adjust their chairs¹⁴. We have also learned that adjustability alone is not enough. People must be aware that their chair adjusts. They must also know why it is important to perform the adjustments.

Finally, adjustments must be easy to use. Lueder¹⁵ provided these guidelines for evaluating ease of adjustment:

- Adjustments can be performed from the normal sitting work position.
- Controls are easy to recognize and understand.
- Adjustments offer immediate feedback about the settings.
- Adjustments are logical, consistent, and work as expected.
- Controls require a minimum of motions and effort.

Helander¹⁶ found that the second and third of these principles were particularly important. Helander also reported that a large number of adjustments did not discourage their use.

Training

Training in proper seat adjustment is a central component for ensuring that users are accommodated. Helander¹⁷ noted that training was particularly crucial with poorly designed chairs.

Conclusion

Current research demonstrates that armrests serve an important function in promoting comfort, well being – and in supporting the work process.

Armrests improve posture and promote freedom of movement while stabilizing the way we sit. They also reduce the muscle loads on the neck, shoulders and arms; reduce pressures on the spine; distribute pressures on the seat, support rising and sitting in the chair, and help us do our work.

Evidence suggests adjustable armrests that support task-related arm postures can provide an important means of alleviating stress. Pursuing the evolution of these important adjuncts to working health is a worthwhile endeavor. We have come a long way since the 1950's.

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Note: This is an abbreviated set of references. For a document with a complete list of citations, contact your Steelcase representative or on the Internet at www.humanics-es.com/armrest.htm

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