Laboratory Ergonomics: Risk factors and workbench assessment

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If you work in a laboratory, there are many activities unique to that environment that can increase your risk for Repetitive Strain Injuries (RSI). To better understand the causes, symptoms, and treatment for RSI, please refer to our previous articles on RSI: *Muscle and Tendon Disorders*, *Nerve Disorders and The Tunnel Syndromes*, and *Nerve and Circulation Problems and Related Disorder*.

In this next series of articles, we will briefly discuss the common disorders associated with each type of lab work and then cover the problems and potential solutions for each laboratory activity.

Laboratory RSI

There are several types of RSI commonly found among laboratory personnel.

- **Tendonitis and tenosynovitis (especially DeQuervain's Disease and Trigger Finger).** Use of tools that have handles that are too big or small with sharp or hard edges, opening and closing vials, pipetting, and cover slip applications can cause these disorders if precautions are not taken. [2] *DeQuervain's tenosynovitis* may be precipitated by forceful grasping and turning, particularly of hard objects such as vials. [2] The thumb is used repetitively with a large number of laboratory activities, so it is especially prone to injury. [1] Swelling, pain and tenderness at the base of the thumb are the symptoms of DeQuervain's. *Trigger Finger* is another form of tenosynovitis where the tendon sheath undergoes progressive constriction. Both the tendon and the sheath become inflamed, resulting in pain and difficulty flexing a finger or the thumb.[2] There is resistance to re-extension of the finger or thumb after it has been flexed, producing a snapping that is both felt and heard.
- **Rotator cuff tendonitis.** This is a disorder involving the tendons and muscles of the shoulder. Symptoms include shoulder pain that sometimes radiates down the arm, which is worse with movement. Pain, stiffness, and weakness at night also occur. Rotator cuff injuries are common among workers who perform repetitive tasks with their elbows above mid-torso height. [2]
- **Thoracic Outlet Syndrome (TOS).** This is a disorder where there is a compression of the nerves in the neck extending into the armpit where the major nerves of the arm branch. [2] In the laboratory, holding the head forward, rolling the shoulders and extending the arms while using a microscope or doing hood work increases the risk for TOS.
- **Carpal Tunnel Syndrome (CTS).** If you have numbness or tingling in your first three fingers and/or pain in your wrist, forearm and elbow, you *might* have CTS. Symptoms may wake you at night.[3,4] CTS can be precipitated by resting your wrist on a hard surface or edge, such as the edge of a hood, or while performing surgery or microscope work.

- **Wrist ganglion cysts.** Ganglion cysts are a herniation of the fluid in a tendon sheath due to wear and tear. They pose no problem in and of themselves, but indicate overuse of a tendon.[3,4]
- **Back injuries.** One of the main causes of low back injuries in the lab is awkward lifting. Once back muscles or ligaments are strained from repetitive pulling and lifting, injuries are more likely due to weakening of the back muscles, discs, and ligaments. Reaching overhead to lift material off of shelves and general rearrangement of heavy equipment are often sources of back strain. [2]

Risk Factors:

Above all, ***neutral posture*** is the most important thing to remember when working in the lab (or in any other situation). The rest of "ergonomics" is simply a means to achieve this posture. "Neutral" means that the body is under the least amount of strain and is in a comfortable position. The forces of gravity and the compression of nerves, blood vessels, tendons, and muscles cause permanent damage in our bodies. Neutral posture prevents damage. To achieve neutral posture, please follow these guidelines: [5,6]

- Ears over the shoulders
- Shoulders in line with the hips
- Forearms 90° angle or more from the upper arms
- Wrists straight (not bent, angled, or twisted)
- Shoulders relaxed
- Elbows hanging close to the sides (e.g. Avoid reaching away from the body or working with winged elbows.)

Some of the most common risk factors in the laboratory and potential solutions are listed in the table below. More detail will be provided as we discuss each type of lab activity in the upcoming articles.

Risk Factors [5,7]	Solutions [5.6]
Contact stress (e.g., leaning on elbows on hard work surface)	Use padding and tubing to reduce pressure and force.
Force	Use equipment requiring less force. Clean equipment and make sure valves, knobs, etc. are in good working order. Use a relaxed grip.
Repetition	Change tasks frequently throughout the day. Take short rest breaks every 20 minutes to stretch. It is most important to build stretch breaks into the daily routine, regardless of the work load.
Static Posture	Shift weight often when standing. Alternate methods for holding objects. Vary tasks and activities and take rest breaks every 20 minutes.
Awkward Posture	Maintain neutral posture of body, arms, hands, and neck. Sit close to work. Keep tools and supplies within easy reach. Use proper lifting techniques for large objects.
Vibration	When mixing tubes with a vortex machine, reduce the speed, use an elbow pad (if it is necessary to lean on the surface), use tight-fitting caps to avoid finger hold, install an accessory holder, and keep the machine at the edge of the bench.

Pinch grip (cont.)	Increase the diameter of tools and soften the grip by using rubber or foam tubing. Choose the right tool for the job. Use the index and middle finger to hold instruments such as forceps. Alternate grip. Use thin, flexible gloves that fit properly to reduce pinch and grip forces. Use preprinted computer-generated labels rather than hand-printing.
Bending and twisting	Do not bend or twist wrists. Modify tools and instruments to enable use with straight wrists.

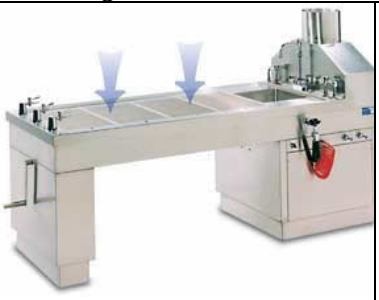
Laboratory Workbenches and Setup

Most lab workbenches are of fixed heights. Working at a bench that is the wrong height for you can expose you to many risk factors for RSI including neck, shoulder, and back strain. Workbenches should be at the following heights based on the guidelines suggested by the National Institute of Occupational Safety and Health (NIOSH).[2,6,7] Note: The elbow height is the distance from the floor to the elbow.

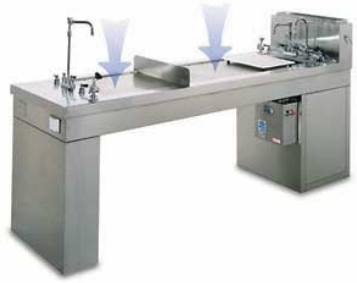
- Precision work - Workbench should be above elbow height
- Light work - Workbench should be just below elbow height
- Heavy work - Workbench should be 4-5 inches below elbow height

It is best to have a workstation evaluation so you know what the correct height for your surfaces should be. If you must work at a bench that is an awkward height, try to adapt to it by standing or sitting, raising or lowering the work with platforms, or pulling out a top drawer and placing a sturdy board on top to create a lower surface.[8] Elevate your chair and use a footrest rather than working at a surface that is too high.

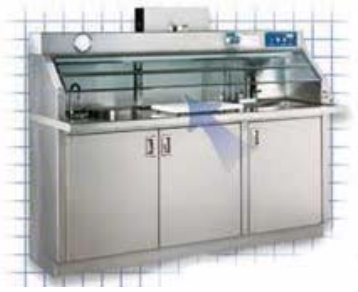
There are greatly improved workbenches now available, so if a lab is to be redesigned or rebuilt, these should be considered. Height adjustable downdraft necropsy tables, backdraft biosafety cabinets and hoods, and "multidraft" tables are now available to accommodate laboratory workers of all heights and to reduce the awkward postures of working under a hood.[10]



Downdraft necropsy table



Downdraft necropsy table



Backdraft BCS

Multidraft Table

Illustrations Courtesy of Scientek Hospital and Laboratory Equipment

Chairs and stools

Use a lab stool with enhanced lumbar support and sit so your back is supported against the backrest.[5] Ensure that sufficient knee and leg space is available to pull up close to the work surface.[2] Create adequate leg space by removing drawers, cabinet doors, and boxes of supplies often stored beneath workbenches.[7]

Avoid using the foot ring on lab chairs and stools. Foot rings place pressure on the back of the thighs, restricting circulation. [8] Instead, use a footstool/footrest in front of you. You will be able to bend forward at the hips, supporting weight on your feet, rather than rounding the neck, back and shoulders. [5]

If you stand at the workbench, always use anti-fatigue matting and supportive shoes.[1,7,8,9]

What's next?

The next articles in this series will cover the following topics on laboratory ergonomics:

- Pipetting
- Microscope
- Laboratory Hoods and Biological Safety Cabinets
- Microtome
- Cell Counters
- Centrifuge Rotors
- Micro-Manipulation and Fine Motor Skills
- Flow Cytometers
- Glove Boxes
- Cryostat Work
- Overhead Lifting

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