Laboratory Ergonomics

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1.0 Purpose of the Guidance

Laboratory workers can be at significant risk for repetitive motion injuries, and musculoskeletal disorders, especially if they are engaged in routine laboratory procedures for prolonged periods. These include procedures such as pipetting, operating microtomes, working on microscopes, using cell counters and video display terminals, standing and working in awkward positions in laboratory hoods/biological safety cabinets.

Repetitive motion injuries and musculoskeletal disorders develop over time, and occur when muscles and joints are stressed, tendons inflamed, nerves are pinched, and the blood flow restricted.

By taking some simple precautions, the risk of developing a repetitive motion injury or musculoskeletal disorder can be greatly reduced. Advice on some routine laboratory tasks can be found below.

2.0 Scope of Guidance

This guidance applies to those individuals who work in laboratories and undertake activities with a number of different items of laboratory equipment.

3.0 Repetitive pipetting

Pipetting is one of the most common tasks performed within a laboratory. It involves several ergonomic stressors – repetitive motion, thumb force, and awkward postures, particularly of the wrists, arms and shoulders. The following are recommendations for the ergonomic use of pipettes:

- Use low profile waste receptacles for used tips. They should be no higher than the tubes being filled.
- Take micro-breaks of 3-5 minutes for every 20-30 minutes of pipetting. Mild hand stretches may be beneficial.
- Clean pipettors on a regularly scheduled basis – this reduces “sticking” and improves quality of work.
- For tasks such as mixing or aliquoting, consider using an electronic pipettor with mixing functions.
- Use a multichannel pipettor for large aliquoting tasks.
- Consider using pipettes with newer trigger mechanisms which require less force to activate, and use the pointer finger to aspirate, and the thumb to dispense.
- Rotate pipetting activities with other laboratory tasks.
- Keep samples and instruments within easy reach.
- Work with arms close to the body.

4.0 Biosafety cabinets and laboratory workbenches

Biosafety cabinets and laboratory workbenches present similar ergonomic hazards which are mostly due to lack of adjustability and leg room.

The following are recommended for control of ergonomic hazards associated with the use of biosafety cabinets and laboratory workbenches:

- Use footrests for individuals whose feet do not rest comfortably on the floor.
- Don't store supplies, refrigerators etc under workbenches or biosafety cabinets, as they reduce leg room.
- Position materials in the cabinet and on the bench top as close as possible to the operator to avoid extended reaching, without compromising containment of the cabinet.
- Take frequent mini breaks.

Should a laboratory worker be spending more than 6 hours at a time working within a cabinet, the following could be considered:

- Use an ergonomically designed chair that provides adequate back support, adjustable seat angle, and height adjustability between 28 and 33 inches.
- Factory-applied moveable armrests may be installed external to the cabinet or edge of the workbench to provide support for the arms and still maintain the required airflow. This reduces contact forces by increasing the surface area that comes into contact with the forearm and therefore reduces the chances of impinging nerves, tendons or blood vessels.
- Use a turntable to store equipment near the worker. This reduces excessive reaching and twisting, which places an increased load on the lower back.

5.0 Micro-manipulation and fine motor skills

Many laboratory procedures require repetitive use of the extensor and flexor muscles of the fingers and wrist. For example, removing caps and screw-off lids from vials, reaching into bins, use of forceps, etc. all require the use of these small muscle groups or result in awkward postures. The following are recommended for control of ergonomic hazards associated with micro-manipulation techniques:

- If feasible for your work, use plastic vials with fewer threads. This will reduce twisting motions during capping and uncapping lids.
- Use small pieces of foam similar to the type used on pencils and pens, to prevent soreness on the fingertips, where fingers and forceps articulate. This will distribute the force over a greater surface area, thus reducing the compressive forces on the soft tissue.
- Practise using the forceps between the 1st and 2nd digits instead of using the thumb and 1st digit. Then try alternating between the two positions to reduce the use of the thumb. The thumb is used repetitively with almost every job task performed in the laboratory.
- Tilt storage bins toward the worker to reduce wrist flexion while reaching for supplies.
- Take frequent mini breaks.

Flow Cytometers

The use of a flow cytometer requires frequent lateral bending, neck and back flexion, and extended arm reaching. This is due to the receiving port being located on the bottom of the flow cytometer. The operator must sit in awkward positions in order to see the controls. The following are recommended for control of ergonomic hazards associated with using a flow cytometer:

- Raise the flow cytometer by placing a block between the flow cytometer and the workbench. When droplet exposure is a concern, a shield is needed to protect your face. Ensure that the shield is also properly positioned.
- Place the top of the monitor so the top of the screen is approximately at eye level.
- Use an electric or hydraulic adjustable table. Each individual will be able to adjust the flow cytometer to a height which is most comfortable.
- Use an ergonomically designed chair.

6.0 Glove Boxes

Working in glove boxes or anaerobic chambers requires extended static loading on the shoulders. Extending the arms for more than a couple of minutes can become very exhausting. In addition to static loading and frequent side reaching, the thick gloves also make the user over compensate on grip strength. Where possible, the following controls are recommended for ergonomic hazards associated with using a glove box:

- Move all needed materials for the experiment from the side chamber to the main chamber at one time to reduce the amount of side reaching.
- Use highly absorbent hand powder for glove comfort.
- Periodically perform other activities to avoid long continuous use of glove boxes.
- Take frequent mini-breaks (3-5 minutes for every 20-30 minutes of glove box work) to perform stretching exercises and relieve static loading from the shoulders.

7.0 Microscopes

Poor posture and awkward positioning are the primary risk factors for full-time microscopists, and can lead to musculoskeletal disorders. Provided here are some basic guidelines, which if followed, may enable you to reduce the incidence of musculoskeletal disorders, by achieving and maintaining a neutral body posture while using a microscope:

- Eyepieces should rest just below the eyes, with the eyes looking downward at an angle 30-45 degrees below the horizontal.
- Interocular distance of binocular eyepieces should be adjusted to ensure that both eyes are focusing comfortably.
- The neck and head should bend as little as possible.
- Beware of posture. Try to maintain the natural curve of the lower back when sitting.
- The arms should be held close to the body, with the wrists straight.
- Clear the laboratory bench leg-wells so that legs and feet are not impeded while sitting at the bench.
- Feet should rest on the floor or a footrest.
- Don't lean forward to look through the microscope. Instead, adjust the position of the chair, workstation or microscope to keep the back straight, head upright and avoid bending the neck. The eyepieces should be in line with, or even extended over, the edge of the bench.
- Avoid contact stress from forearms resting on sharp bench or counter edges by adding padded edge protectors.
- Ensure the microscope optical train is configured properly and the illumination source is aligned and performing at capacity. Excessive microscope illumination can cause an uncomfortably high level of light and contrast, which is easily reduced by proper configuration of the lamp voltage and the condenser aperture.
- Operators who wear eyeglasses can adjust the eyepieces to accommodate near and farsightedness, but those who have more severe conditions should see an optician to determine whether they are suited for extended observation periods using a microscope.
- Check the laboratory environment for excessive glare and reflections from overhead fluorescent lighting, and adjust external and internal microscope light to compensate.
- Take mini-breaks (5-10 minutes for every 50-60 minutes working) are essential to reduce fatigue, especially for operators who work at microscope workstations for 6-8 hour shifts.

Additional recommendations based on time spent per day at the microscope:

1-2 hours/day

- Adequate clearance (a minimum of 2 inches) between the thigh and desk or counter with the leg-well free from obstructions.

2-4 hours/day

- Microscope tilted slightly forward or utilization of wedges, extenders, and/or eye-level adjustments.
- Proper arm support, keeping the limbs close to the body with the forearm parallel to the floor and resting on the bench top. Use armrests for older microscopes having controls located in high positions.
- Padded edges for workstations or countertops to avoid contact stress on arms.

4-6 hours/day

- Adjustable microscope eyepieces should be installed, if possible.
- Electrically powered focus adjustments and objective rotation if more than half the total time on the microscope is spent twisting the coarse and fine knobs while transitioning the magnification factor.

6 hours or more/day

- Adjustable microscope eyepieces and ergonomically positioned microscope controls.
- Electrically powered focus and objective rotation. If configurations permit, powered control of the condenser aperture diaphragm, illumination intensity, and beamsplitters.
- Video monitor or television screen for examination of repetitive specimens (the monitor should be placed in the operator's primary field of view).
- Easily adjustable work surface variables, such as bench height, armrest base angle, observation eye-level, and microscope height (essential in a multi-user workstation environment).

Microscopists can also benefit from general workplace ergonomics. Reduce fatigue by reducing or eliminating highly repetitive tasks and take micro-breaks, 20-180 seconds at 10 to 15 minute work intervals. Use this time to stand and/or stretch, and allow the eyes to focus at a distance. Objects that must be accessed frequently should be kept close enough to avoid having to stretch and strain, usually within a distance of 9-19 inches. Less frequently utilized objects can be kept at a distance of 9-25 inches