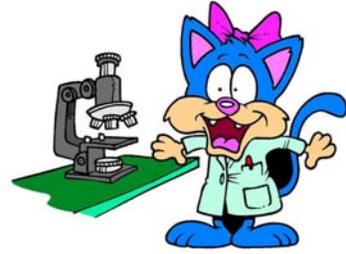


Laboratory Ergonomics: Pipetting, microscope use, and hood work

By Tamara Mitchell
Edited by Sally Longyear



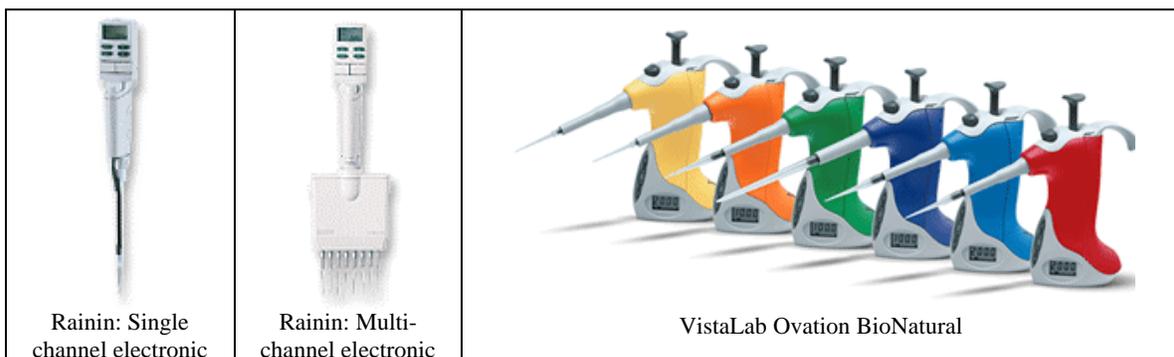
In this second article of our series of Laboratory Ergonomics we discuss three tasks that require frequent awkward posture; the number one reason people experience Repetitive Strain Injury (RSI). Due to its repetitive nature and awkward hand positions, **pipetting** has typically been a source of hand and shoulder problems. **Microscope work** can be a source of eye strain, and neck, lower back, shoulder and arm problems. The forward head and extended arm positions during **hood work** are difficult to avoid, but the strain caused by them can be minimized.

Pipette

The manual plunger-operated pipette has long been at the top of the "bad guys" list. Whenever possible, this type of pipette should be replaced with electronic and multi-channel pipettes that greatly reduce excessive thumb force and repetition.^{all} Otherwise, use as short a pipette as possible, use pipettes where the thumb dispenses and the index finger aspirates, and alternate using the right and left hand to pipette.^{3,4,5} Use thin-walled pipette tips that are easy to eject, or use two hands to eject tips. Use of a pipette for dispensing should be avoided when possible due to its repetitive nature.³

Just as with computer mice, the choice of pipette is highly individual.³ The following factors are important in choosing a pipette that is comfortable for you.

- *Hand size.* This is the most important consideration. Someone with a large hand will likely find a different pipette comfortable to hold than a person with a small hand.³
- *Weight.* A light weight pipette requires less force to hold.^{3,4}
- *Location of controls.* Multi-finger controls help distribute the force among several fingers rather than continuously using the same finger. Some pipettes have a button on the top which may require the thumb to be repeatedly extended out of a relaxed, neutral position.
- *Force.* It is best to use a pipette that requires as little force as possible to control.



General rules of pipette use:

<ul style="list-style-type: none">• Do not twist or rotate your wrist while pipetting.⁴• Hold the pipette with a relaxed grip.⁴• Use minimal pressure while pipetting.⁴• Take rest breaks every 20 minutes for 1-2 minutes.^{4,7,5}• Share tasks with someone else or plan your work day so that other tasks are interspersed frequently.² Pipetting for longer than 2 hours on a continuous basis per day may increase your risk for RSI.¹• Adjust the height and position of sample holders, solution container, and waste receptacle to prevent twisting and bending of the wrist, neck and arms, elevation of the shoulders, and overreaching.^{4,7} Heights should all be approximately the same, and these items should be within easy reach in a logical work order.• Use special tools to open the micro vials, such as Rainin's Jimmy microtube opener or Research Products hand-held opener (\$12.00/25pk).	 <p>Rainin: Jimmy microtube opener (\$40.00/4 pk)</p>
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Microscope

Operating a microscope for long hours will strain the neck, shoulders, eyes, lower back, arms and wrists. Working at a microscope that is not at the correct height and angle requires a hunched position and contact stress on the forearms from the work surface edge.

The percentage of medical problems reported with long-term microscope use by body part is: ⁸

Neck	50-60%
Shoulders	65-70%
Back (Total)	70-80%
Lower Back	65-70%
Lower Arms	65-70%
Wrists	40-60%
Hands and Fingers	40-50%
Legs and Feet	20-35%
Eyestrain	20-50%
Headaches	60-80%

Most new microscopes now incorporate many features that reduce soft tissue problems and other strains. Older microscopes do not account for variability in operator sizes and positions. If a new microscope is not in the budget, there are numerous options for adapting an older microscope to the user. These are generally not expensive and can greatly increase comfort level. Follow the guidelines below:

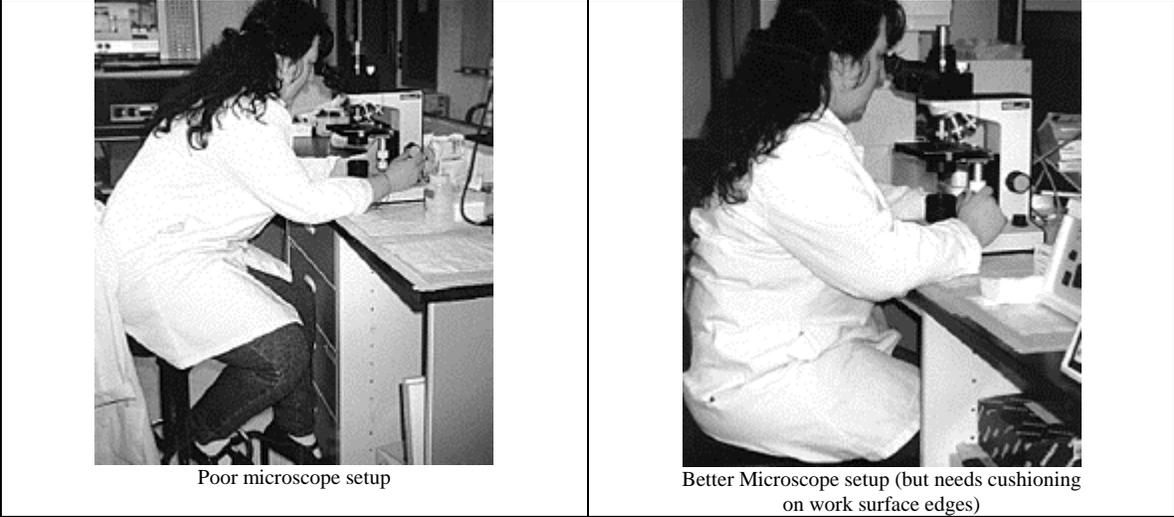
If you work with an electron microscope, there is a specially designed “ergonomic” control package for electron microscopes.

Breaks and work distribution.

Avoid long uninterrupted periods of microscope work by rotating tasks and taking frequent rest breaks.^{all} Every 15 minutes, close your eyes or focus on something distant. Every 30-60 minutes, get up to stretch and move.⁴ Set a timer to remind yourself to move! **This is most important for preventing injuries, as well as improving how you feel at the end of the work day.**

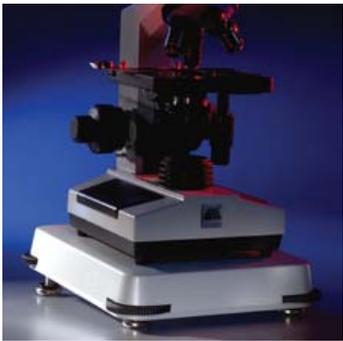
Posture and positioning.

1. Pull the microscope toward the edge of the work surface that has enough space for forearm support. Set it over a space with adequate room for your legs so you can sit directly under the microscope.^{all}



2. Your head should be upright and your line of sight approximately 30-45° below straight ahead vision.⁸ Tilting the head forward causes increased strain on the neck and shoulders. An upright head weighs approximately 10-18 lbs. Tilting the head 15° forward increases the load to approximately 35 lbs!

3. Adjust the microscope height and angle, in addition to bringing it close to the edge of the work surface, to allow the head position to be upright. Use extended eye tubes, optical wedges (positioned between the binocular head and the body of the microscope) and/or variable height and slant adapters to achieve proper neck and head position.^{1,2,7,8} A 2" binder can be used to angle the microscope forward if a more elegant solution is not available.³



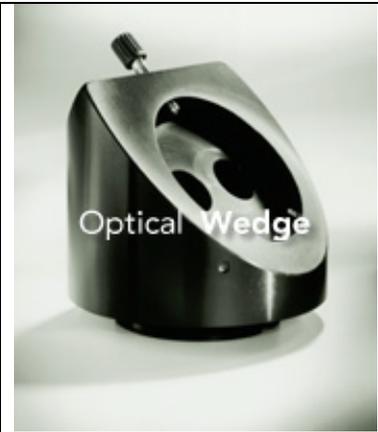
Microscope Positioning Plate (\$89.00); MarketLab
Height and slant adjustment of microscope



Bay Optical



Microscope Height Adaptor



Bay Optical

4. Remove armrests from chairs if they interfere with your arms. Armrests designed specifically for lab work that support your arms in the forward position while you are adjusting the knobs are helpful.^{1,3} Apply padding to the edge of the work surface in the form of foam rolls or padded edge protectors where arms are in contact with surface edges.³



Microscope Arm Rests (\$119.00/pr):
MarketLab

5. There are a lot of new developments in the microscope world which will make the job of researchers easier and less stressful to the body. This microscope (Lynx from Vision Engineering) enables a wide range of head movement and body position that greatly reduces fatigue.



Lynx stereo zoom microscope:
Vision Engineering

6. Tilt storage bins toward you to reduce awkward postures while reaching for supplies.³



Microscope Organization Station (\$139.00):
MarketLab

7. Enlarge small hand tools by placing cylindrical foam around them.³

8. Make simple tool modifications if you are not able to keep your wrists straight.³



Foam tubing: GripWorks.com

Eye strain prevention.

1. Make sure the scope is clean, lighting is adequate, and the microscope lamp and optical pathway are correctly aligned.^{7,8}

2. When possible, use a video display terminal to view the sample; this will also reduce neck strain.² The monitor needs to be placed at eye level, straight ahead and at an easy viewing distance to avoid eye and neck strain. The MiniVid camera (shown to the right) fits into the eye tube of most microscopes and can be used to view or record digital or video images with a TV or other multi-media equipment. It can also be used as a hand-held camera.

The Isis eyepieces from Vision Engineering can fit onto most microscopes and through lenticular array technology allows viewing from a greater distance, healthy head movement and easier use of glasses.⁸



MiniVid Microscope Camera
(\$319.00): Microscopes USA



Isis eyepieces: Vision Engineering

3. Have an eye exam if you are having problems seeing your work and wear glasses if needed, especially if you have astigmatism.^{3,8} Blink often, closing eyelids completely to keep eyes moist.³

4. Focus on a distant object, at least 10 feet away, every 15 minutes to rest your eyes from close-up focusing.³

5. Cup your hands and place them gently over your eyes for a minute to rest them from the light, though don't touch or rub your eyes.³

6. Check the lab environment for excessive glare and reflections from overhead lighting, and adjust internal microscope light to compensate. Excessive microscope illumination can cause a high level of light and contrast, resulting in eye strain. This can be reduced by proper configuration of the lamp voltage and the condenser aperture.⁸

Environmental factors

Temperature, humidity, air currents, ventilation, excessive noise, and ambient lighting levels all affect operator comfort and fatigue.⁸ Temperature should ideally be between 66-73° F. with relative humidity between 40-60%. Low humidity conditions lead to drying of the eyes.⁸

Biosafety Cabinets (BSCs) and Laboratory Hoods

Working within BSC's and fume hoods presents similar hazards as microscope work. Posture is forward, often hunched, and the worker must reach forward.¹ In our last article, we showed some examples of new technology that can eliminate the bent, forward posture of traditional hoods by providing height adjustable tables with downdraft or backdraft rather than the traditional updraft exhausting.

Newer BSC's incorporate the following features:¹

- A perforated front grill reduced by 1-2 inches allows the work platform to be closer to the worker
- Adjustable height
- Non-glare glass on the sash window and/or adjustable plexiglass barriers
- A platform with wells for placement of tall containers to reduce reaching

Your lab is not likely to rush out to buy one of these new tables, but there are things you can do to increase the comfort of working under a traditional hood:

1. Position materials as close as possible to avoid extended reaching without compromising containment of the cabinet (at least 6" back into the lab hood).^{1,2,3,7,4,9}
2. Use a fully adjustable chair that provides adequate back support, adjustable seat angle, and height adjustability between 28" and 33".^{1,2,4,7,9}
3. If allowed, use closed-cell foam padding on the edge of the cabinet which can be decontaminated to reduce damage to nerves, tendons, and blood vessels from resting on the surface edge.^{1,2,4} Or consider attaching arm rests external to the cabinet which can support the arms at the correct height and angle, but not restrict air flow.¹ Where decontamination is a problem, consider the use of bubble wrap, which can be disposed after use and costs very little.
4. For seated work, make sure there is adequate leg space under the cabinets.^{1,3} Raise the cabinet a couple of inches if necessary to create a more comfortable leg and thigh clearance.^{7,9} Use a footrest, not the chair ring, to provide stability in leaning forward from the hips and to reduce pressure on the back of the legs.^{2,7}
5. If standing at the hood/BSC, use anti-fatigue matting and wear supportive shoes.^{1,7,4,9}
6. Use a turntable to store equipment close at hand. This prevents reaching and twisting.¹ Position materials in the cabinet and on the bench top as close as possible to avoid reaching without compromising containment of the cabinet.¹

7. To prevent eyestrain: make sure that lights in hoods/BSC are working properly,^{2,9} keep the viewing window of the hood/BSC clean and the line of sight unobstructed,^{7,9} and use diffused lighting to limit glare.⁴

8. Take frequent mini-breaks to stretch muscles and relieve forearm and wrist pressure.^{1,2,7,4,9}

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<http://www.cdc.gov/od/ohs/Ergonomics/labergo.htm>
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http://www.uos.harvard.edu/ehs/ih_lab_erg.shtml

RESOURCES:

Foam tubing:

GripWorks, Sinclair & Rush, Inc, 123 Manufacturers Dr., Arnold, Missouri 63010. 800-347-4783. <http://www.gripworks.com/foam-grips.htm>

Microscopes, eyepiece options, and adaptors:

Vision Engineering, 745 West Taft Avenue, Orange, CA 92865. 714-974-6966.
<http://www.visioneng.com/index.htm>

Bay Optical Instrument, 2401 - 15th Street, San Francisco, CA 94114. 415-431-8711.
<http://www.bayoptical.com/>

MarketLab, Microscope Positioning Plate, 4282 Brockton, Kentwood, MI 49512, 800-237-3604. <http://www.marketlabinc.com/products/product.cfm/ML8350>

Microscope - electron microscope ergonomic control package:

FEI Company, Tecnai retrofit package, 7451 NW Evergreen Parkway, Hillsboro, OR 97124-5830, 503-640-7500. <http://www.feic.com/tecnai/pdf/030-bs00111-07-02.pdf>

Microscope armrests:

AliMed, Microscope arm support, (\$120-\$180/pr), 800-225-2610.

http://www.alimed.com/product_detail.cfm?VMID=2&FamilySKU=73912

MarketLab, Microscope Arm Rests, ML8888, (\$119/pr), 4282 Brockton, Kentwood, MI 49512, 800-237-3604. <http://www.marketlabinc.com/products/product.cfm/ML8888>

Microscope video camera:

Microscopes USA, <http://www.microscopesusa.com/MiniVID.html>

Microvial openers:

Research Products International Corp., 800-3232-9814.

<http://www.rpicorp.com/index.php?t=labequip&cat=72&id=976>

Rainin, Jimmy Microtube Opener for Pipetteman, 800-472-4646

http://www.rainin.com/products/product_list.asp?class=22

Worksurface edge cushioning:

AliMed, SoftEdge (\$34/6 ft.), 800-225-2610.

http://www.alimed.com/product_detail.cfm?VMID=2&FamilySKU=70459