Pipette use and Ergonomics

Any work environment including the laboratory, can be a source of ergonomic stress. Laboratorians that use pipettes frequently may find not only their health, but their proficiency at risk. Two factors in pipetting which can cause the user physical stress are the design of the pipette and the manner in which it is used. An ergonomically designed pipette should pose few if any difficulties or risks to the user who, trained in body mechanics, knows which positions and postures to avoid. Awkward postures and repetitions are not bad in themselves, but can pose a problem if stresses are cumulative and tasks are not balanced.

Selecting your pipettes and the manner in which they are used is a relatively simple project which requires little more than applying some useful information. The investment of some research and training is far outweighed by the return: improved safety and health in the workplace, improved productivity, reduced absenteeism and turnover, and reduced probability of accidents and errors.  

Potential problems

Manual action pipettes, one of the most commonly used laboratory instruments, can cause muscle strain or tendon swelling, particularly if good body mechanics are not applied while pipetting. Manual pipetting involves several ergonomic stresses of the wrist, arm, and shoulders. The stresses are typically caused by repetition, awkward posture, and the excessive use of thumb force when dispensing a sample. In addition, pipetting is done in a position where the thumb is not stable but nevertheless has to work to stabilize the grip around the pipette and to press down the plunger button of the pipette. Therefore the muscles have to work as both mobilizing and stabilizing structures and are subjected to increased stress. These physical stresses are further aggravated by the mental pressure resulting from the accuracy and timing demanded in many pipetting procedures. Taken together, these factors put laboratory technologists at a great risk of developing a cumulative trauma disorder (CTD): one of a group of health disorders affecting the muscles, tendons, joints, and nerves, which can cause pain and swelling.

Steps that you can take to reduce the risk of developing a cumulative trauma disorder include:

- Rotate pipetting activities.
- Use only the force necessary to operate the pipette; do not use excessive force.
- Choose pipettes requiring less pressure.
- Use shorter pipettes, which allow for decreased arm elevation and thus eliminate the use of awkward postures.
- Consider using electronic pipettes, which are programmable and reduce the need for excessive thumb force and repetition.
- Use low profile waste receptacles for used tips. Receptacles should be no higher than the tops of the tubes being filled.
- Take short pauses of several seconds when you are unable to take a longer break.
- Use adjustable chairs or stools with built-in solid foot rests.
- Keep materials within reach. This allows your arms to remain close to your body which will reduce shoulder strain.
- Use multichannel pipettes for highly repetitive jobs.
- When pipetting in a standing position, anti-fatigue mats offer cushion between you and the floor.
- Align your ears, shoulders and hips to ensure your body is in a neutral position.
- Keep wrist in a neutral position, as if you were shaking hands.
An informed technologist does not have to be a CTD statistic. With CTDs, protection and prevention are the best medicines.

The solutions

The design of a pipette is as important as the manner in which it is used. Pipette manufacturers recognize the benefits of an ergonomically designed pipette, and this is revealed in the designs of pipettes on the market. For example, pipettes with a curved hilt allow a relaxed grip and reduce muscle strain.

Separate buttons for tip ejection, typically allow the operator to use a shorter, less forceful motion for tip ejection than do pipettes with a single “combination” button for both sample dispensing and tip ejection. This can reduce the stress on an operator’s thumb.

Manual action pipettes, however, require the user to relocate the thumb to another button, further stressing the muscles.

Several other features may make pipetting less stressful.

Non-slip, contoured surfaces reduce fatigue by increasing friction, allowing the use of a relaxed grip.

Some plunger buttons can be shaped with sloped or rounded surfaces to better fit the user’s hand. Other pipettes are lighter in weight and require less force to operate the plunger. Consider these features when purchasing and using your pipettes.

Avoiding CTDs is a simple and relatively inexpensive task, the importance of which cannot be overestimated. A healthy technologist will have better attendance, a better attitude, and better accuracy than one who is coping with the effects of CTDs. Pipetting results are only as reliable as the mechanism (operator + environment + pipette) with which they are obtained. A laboratory’s technologists, as well as its pipettes, should be in sound condition, and should be in a comfortable, controlled environment.

References:

1. Ergonomic and epidemiologic evaluation of a biological laboratory. McGlothlin-J; Hales-T
3. Lawrence Berkeley Laboratory, PUB 3000, Chapter 17, Ergonomics.
4. Fitzgerald, NIH, NIEHS Safety Notes, April 1996
6. Clark Rundell, Ph.D. Maine Medical Center Research Institute, interview.

Q: What are some of the more common cumulative trauma disorders, and what are their symptoms?
A: Among the more common forms of CTD are DeQuervain’s disease and carpal tunnel syndrome, in which the median nerve running through the wrist becomes compressed. Symptoms of carpal tunnel syndrome include pain, numbness, or tingling in the first three fingers and the base of the thumb. DeQuervain’s disease affects the tendons on the side of the wrist and at the base of the thumb. Symptoms include pain and difficulty in movement.

Other CTDs include epicondylitis, commonly referred to as “tennis elbow,” which is an inflammation of the tendons within the elbow. Symptoms include swelling, pain, and weakness. Tendinitis is an inflammation of the tendon in the wrist and hand which can cause swelling and pain. “Trigger finger” results when a tendon sheath in the finger swells and becomes locked. The condition is referred to as “trigger finger” because attempts to move the finger result in a snapping and jerking movement.

Q: How do I determine my risk of developing a CTD?
A: “Yes” answers to any of the following indicate that CTD risk factors are present at your job:

- Are there frequent, repetitive motions?
- Does your working position require bending of the neck, shoulder, wrist, or finger joints?
- Are there forceful or quick, sudden motions?
- Do you work across the midline of your body or out to the side?

Q: What should I do if I think I have a CTD?
A: Talk to your supervisor, request referral to health and safety professional at work, or see your doctor. Remedies, such as acetaminophen or ibuprofen, are often helpful. However, as with any health concern, consider seeing your physician, who can accurately assess your condition and recommend an appropriate course of action, which might include physical therapy to help heal strained muscles.

Q: Are there any additional safety considerations, not necessarily mechanical or ergonomic in nature, that I should keep in mind when working with pipettes?
A: Pipetting should never be done by mouth, even if extension tubes are used, in the event that liquids or vapors are drawn into the body through the mouth or nose.

Broken glass pipettes can also pose a danger to users. Unusable broken glassware or pipettes should be collected in a suitable sharps container which can be sealed for disposal when full.