

Pipette use and **ergonomics**

“Ergonomic disorders are the fastest growing category of work-related illness...There is no question that workplace injuries are a major factor in bottom line profitability across the world...”¹

Darcor, *The Cost of CTDs*

Any work environment, including the laboratory,

can be a source of ergonomic stress. 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.³

Potential problems

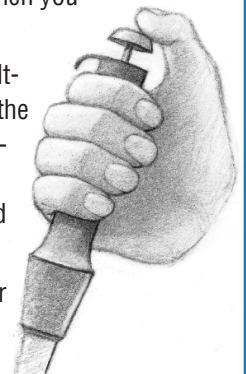
Manual action pipettes, one of the most commonly used laboratory instruments, can cause muscle strain or tendon swelling, particularly if good body mechanics are not applied while pipetting. Manual pipetting involves several ergonomic stresses of the wrist, arm, and

shoulders. The stresses are typically caused by repetition, awkward posture, and the excessive use of thumb force⁴ 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 button [plunger] of the pipette. Therefore the muscles have to work as both mobilizing and stabilizing structures” and

are subjected to increased stress.⁵ These physical stresses are further aggravated by the mental pressure resulting from the accuracy, precision, and timing demanded in many pipetting procedures.² Taken together, these factors put laboratory technicians at a great risk of developing a CTD, or a cumulative trauma disorder: one of a group of health disorders affecting the muscles, tendons, joints, and nerves, which can cause pain

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

- Rotate pipetting tasks among several people.¹
- Use only the force necessary to operate the pipette; do not use excessive force.¹
- Choose pipettes requiring the least pressure.¹
- Use shorter pipettes, which allow for decreased arm elevation and thus eliminate the use of awkward postures.¹
- Consider using electronic pipettes, which are programmable and reduce the need for excessive thumb force and repetition.² Electronic pipettes, however, are sometimes designed with right-handed persons in mind and may be difficult for a left-handed technician to use.⁶
- Use low profile waste receptacles for used tips. Receptacles should be no higher than the tops of the tubes being filled.¹
- Take short pauses of several seconds when you are unable to take a longer break.¹
- Use adjustable chairs or stools with built-in solid foot rests. Work with arms close to the body to reduce strain on shoulders. Multipipettes, which are considerably stiffer than automatic or manual action pipettes, should be used on a limited basis.¹
- Choose a pipette that fits your hand. Your hand should cover more than half, but not the entire, circumference of the pipette.¹



and swelling.³ An informed technician 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 hold, reducing muscle strain.

Separate buttons for tip ejection, depending upon the tension in the spring within the pipette, usually 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.

A separate ejector, however, requires an additional movement to a button which may not be ergonomically placed. On electronic pipettes, the tip ejector is located on the far side of the pipette, allowing the user to simply exert a light squeeze with the index finger in order to eject the pipette tip. 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 minimize fatigue by increasing

friction, allowing the use of a relaxed grip. Plunger buttons are sometimes sloped to better fit the user's hand. Keep these features and the list of guidelines above in mind when purchasing and using your pipettes.

Avoiding CTDs is a simple and relatively inexpensive task, the importance of which cannot be overestimated. A healthy technician will have better attendance, a better attitude, and better accuracy and precision 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 technicians, as well as its pipettes, should be in sound condition, and should be in a comfortable, controlled environment.

References:

¹ Darcor. Ergonomics. *The Cost of CTDs*, www.darcor.com.

² Dr. Putz Anderson. Fisher Scientific, *Lab Ergonomics*, 1996.

³ Lawrence Berkeley Laboratory, PUB 3000, Chapter 17, Ergonomics.

⁴ Fitzgerald, NIH, *NIEHS Safety Notes*, April 1996

⁵ Kerstin Fredriksson. "Laboratory Work with Automatic Pipettes: A Study on How Pipetting Affects the Thumb", *Ergonomics 1995*, vol 38, no 5, Pharmacia.

⁶ Clark Rundell, Ph.D. Maine Medical Center Research Institute, interview.

⁷ University of Utah Research Foundation, Ergoweb, 1994-1996.

⁸ Time-Life, *Medical Reference Handbook*, 1996.

⁹ University of Illinois, Lab Safety Exam, 1997. (www.eecs.vic.edu)

Questions & Answers

What are some of the more common cumulative trauma disorders, and what are their symptoms?

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.³ 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.³

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.³

How do I determine my risk of developing a CTD?

"Yes" answers to any of the following indicate that CTD risk factors are present at your job⁶:

- 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?

What else can I do to relieve some of the discomfort caused by CTDs?

Analgesics, such as acetaminophen or ibuprofen, are often helpful.⁷ 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, and painkillers such as analgesics.

Are there any additional safety considerations, not necessarily mechanical or ergonomic in nature, that I should keep in mind when working with pipettes?

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.⁸

Broken glass pipettes can also pose a danger to users. Unusable broken glassware or pipettes should be collected in a labelled cardboard box which can be sealed for disposal when full.⁹

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