Reducing the Risk of Musculoskeletal Injury in Healthcare Laboratory Technologists Performing Pipetting Tasks

Background
Musculoskeletal injury (MSI) and associated time loss is a significant and growing problem among laboratory technologists involved in pipetting work. To address this problem the British Columbia Institute of Technology (BCIT), in partnership with OHSAH, has undertaken a study to evaluate the effectiveness of ergonomic workstation modifications on reducing the risk of MSI.

Technologists often work in awkward postures due to the length of the pipettes and the height of a typical workstation. The technologist’s head and arms are often held in a forward position with shoulders rounded. Typically, a technologist will work with his/her arms unsupported and raised to just below shoulder height. Due to the lack of adjustability of most workstations, it is difficult to accommodate for differences in the height or arm length of the technologists.

Typical symptoms associated with pipetting tasks include: thumb, forearm, elbow, and shoulder pain, as well as finger pain, numbness, and tingling.

A review of the literature indicates that several pipette manufacturers are working on new pipette designs. However, no formal studies have considered the effect of redesigning the pipetting workstation.

Project Objectives
1. To conduct an ergonomic risk assessment of existing pipetting procedures and workstation designs.
2. To evaluate the impact of an ergonomic pipetting workstation design on reducing the risk for MSIs.
3. To develop design criteria to control risks associated with pipetting work, based on the evaluation results.

Note that the scope of this project is limited to redesign of the pipetting workstation; no attempt will be made to redesign the pipettes.
Methods

This study focuses on workstation adaptations that are expected to minimize the risk of MSI in laboratory technologists who perform pipetting tasks. The study will involve an intervention group (receiving the modified workstation) who will evaluate customized, ergonomic workstations and a control group who will continue to work at the existing workstations without any ergonomic modifications. The study is divided into four phases.

Phase I: Pre-Intervention Assessments

The first phase of the study, which has already been completed, involved a risk assessment of laboratory technologists and their existing workstations. Various assessment tools were used including a pain/discomfort questionnaire, a background questionnaire (containing questions on demographics, length of time spent pipetting, other regular work tasks, and leisure activities), and a design input questionnaire. The purpose of this phase was to establish baseline data on the level of pain and discomfort experienced by laboratory technologists and to obtain and review feedback on the existing workstations and pipetting procedures.

Phase II: Design and Living Lab Evaluations

An adjustable, ergonomic pipetting workstation was developed during the second phase of the study in the Dr. Tong Louie Living Lab at BCIT. This new workstation design was based on the ergonomic assessment conducted in Phase I of this project, input from laboratory technologists, and recommendations from the literature.

Participants in the intervention group will be asked to perform pipetting tasks at a typical pipetting workstation in the Living Lab. A biomechanical assessment including measurements of joint angles, joint torques (forces acting around joints), postural information, and work envelope data will be conducted. This information will be used as a baseline for comparison with information collected in Phase III. Participants in the intervention group will also provide feedback on the ergonomic workstation but no formal biomechanical assessment will be conducted at this stage.

Phase III: Implementation & On-Site Evaluations

Results from the Living Lab assessments will be used to design ergonomic workstations for each laboratory technologist in the intervention group to implement in his/her respective laboratory. Laboratory technologists in the control group will continue to work at their existing workstations without any ergonomic modifications.

After the new workstations have been in use for six months, laboratory technologists in the intervention group will be observed using the ergonomic workstation at the Living Lab. Joint angles, joint torques, postural information, and work envelope data will be compared with baseline data collected for the typical workstation in Phase II. Participants in both groups will be asked to complete pain/discomfort questionnaires. After the ergonomic workstations have been in place for one year, participants in both groups will be asked to complete the pain/discomfort questionnaires.

Phase IV: Reporting and Information Dissemination

The results of this study will be analyzed to determine if the recommended ergonomic adaptations result in a reduced risk of MSI for the technologists in the intervention group. Design criteria and best-practice guidelines for pipetting workstations will be reviewed and compiled.

Results

Demographics

Fifteen laboratory technologists who normally perform pipetting tasks were selected as participants for the study (n=8 intervention technologists; n=7 control technologists). The technologists involved in the study represent 6 different healthcare sites, including hospital laboratories and privately funded research laboratories. The group includes males and females with a height range of 59.4” to 77” (151 to 196 cm), and an age range of 24 to 56 years. Experience with pipetting varies between 2 and 37 years.

Approximately eighty percent of the laboratory technologists surveyed reported neck and right shoulder pain.
Phase 1: Pre-intervention Assessments

Pain Index Results
Pain/discomfort questionnaires (based on the Standardized Nordic Questionnaires) revealed that all technologists experienced some level of pain. Eighty percent of participants reported neck pain, and a similar number reported pain in the right shoulder. Sixty-seven percent reported lower back pain and 60% reported upper back pain.

In response to questions on hand pain (based on Robens Institute Ergonomics Evaluation), 73% reported pain in the right wrist and 60% reported pain in the right thumb. All participants hold the pipette in their right hand.

Task/Workstation Assessments
Existing workstations and pipetting procedures were assessed by photographing and videotaping laboratory technologists performing typical activities. From the videotapes, task analyses and process flow charts were compiled. Drawings were made of all workstations and relevant equipment.

Tasks often associated with pipetting include set-up, labeling, lid/cap removal, vortex mixing, and clean-up. Other tasks typically performed at a pipetting workstation include microscope, computer, and administrative work.

Two workstation scenarios were noted:
1. Laboratory technologists rotate between workstations based on a predetermined schedule. For example, a dedicated pipetting workstation is used by a number of laboratory technologists throughout the day.
2. Each laboratory technologist has his/her own workstation and performs a variety of laboratory tasks at the same workstation.

A review of existing workstations showed that the majority of laboratories spent little time addressing ergonomic principles in the setup of their workstations. Workstations at the intervention and control sites did not accommodate the different heights of the laboratory technologists. They also did not account for the varied types of tasks being performed at the workstations.

To determine which workstation features were most valuable, participants were asked to rate the importance of and their satisfaction with these features. The most valuable features were found to be:
- The height of the primary work counter
- Adjustability of the workstation
- Height adjustability of the seat pan and back of the chair
- Proper task lighting
- Overall comfort of the workstation

This implies that these features should be addressed in any new design.

A review of existing workstations showed that the majority of laboratories spent little time addressing ergonomic principles in the setup of their workstations.

Phase II: Design and Living Lab Evaluations

Results from the assessment of existing pipetting workstations, questionnaire results, and recommendations from the literature were used to establish design criteria for an ergonomic workstation.

Design Criteria for Pipetting Workstation
An ergonomic pipetting workstation was designed using the following design criteria:
- Workstation with height adjustability, modular shelving, reduced reaching distances, rounded edges, and low-gloss work surface
- Computer station, monitor support stand, keyboard tray
- Chairs with adequate height, backrest, seat pan, and armrest adjustability
- Task lighting
- Footrest

The new workstation consists of:
- An automated height adjustment mechanism to reduce awkward shoulder and neck postures
New laboratory workstation for pipetting tasks

- A table cutout to reduce reaching distances
- Floating arm supports to reduce static (stationary) shoulder posture
- Plinths (wooden blocks) of different heights to accommodate variable height test tubes/pipettes; this will help to reduce the need to raise the arm while using the floating arm supports
- An infrequent reach zone which alerts technologists to the workstation areas to avoid placing frequently used items thereby minimizing awkward reaching
- Turntables to reduce awkward reaching
- A central waste receptacle to reduce awkward reaching
- A footrest to reduce pressure on the underside of the thighs
- Rounded countertop edges to reduce contact stress on forearms
- A cap-removal device to reduce pinch grip

Next Steps

Evaluation of the ergonomic workstation is currently underway in the Living Lab (Phase II). Once this evaluation is complete, the ergonomic modifications will be finalized for the implementation and on-site evaluation of the workstations (Phase III). The workstations will be implemented in the intervention worksites in July 2003.

OHSAH anticipates that this study will help define effective strategies for reducing the risk of MSI among laboratory technologists. An important consideration will be to keep modifications at a reasonable cost and to include as many commercially available parts as possible. Implementing and sustaining workstations at other healthcare facilities will be both practical and affordable.

References