An Update on Ergonomic Issues in Sonography

REPORT

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July 2000

EHS Employee Health and Safety Services

Introduction:

Since the fall of 1996, Employee Health and Safety Services (EHS) at Healthcare Benefit Trust (HBT) has participated in a timely and revealing ultrasound project. The project was initiated as a result of numerous requests for assistance from member facilities, the significant concerns expressed by sonographers and the observations made by HBT ergonomists. The British Columbia Ultrasonographer's Association (BCUS), the Health Sciences Association (HSA), Simon Fraser University – School of Kinesiology (SFU) and Healthcare Benefit Trust Work Health Foundation collaborated on this study. The objectives of the project were threefold:

1. Quantify physical and psychosocial stressors and symptoms related to ultrasound tasks.
2. Identify potential solutions related to changes in work practices and redesign of ultrasound instruments and tasks.
3. Determine the efficiency of proposed solutions.

The project consisted of two phases: a survey of sonographers and a clinical study of ultrasound tasks. Initially, the survey phase of the project was to focus solely on BC sonographers, however, due to increasing interest expressed by US and Canadian sonographer associations, the project was expanded to include a survey of their national constituents. More recently, the survey instrument has been shared with interested groups in Australia, New Zealand, China, Israel and Italy. A multidisciplinary group consisting of sonographers, employers, ergonomists, and representatives from unions and professional associations designed the survey. The survey consisted of 125 questions divided into five sections:
a) demographic and work experience variables
b) self reports of musculoskeletal symptoms,
c) work scheduling and work tasks
d) work equipment and
e) work environment characteristics.

Highlights of the Survey:

The survey was distributed to members of the British Columbia Ultrasonographers (BCUS) (n=232), to members of the Canadian Society of Diagnostic Medical Sonographers (CSDMS) (n=1095) and with sponsorship from the Society of Diagnostic Medical Sonographers (SDMS) the same survey was distributed to a random sample of the American Registry of Diagnostic Medical Sonographers (n=3000). An excellent response rate was achieved from the BCUS (n=211) and a moderate response from the CSDMS (n=427) and the American Registry of Diagnostic Medical Sonographers (n=983). These responses indicate that the findings provide a representative description of the prevalence of musculoskeletal pain and discomfort and associated risk factors among sonographers.

The results of the survey clearly indicated the high prevalence of musculoskeletal symptoms among sonographers. Because of the remarkable similarity of the responses to individual questions, it was decided to combine the data from the three survey groups in this report (n = 1621). (Individual reports from each of the surveys can be obtained through Healthcare Benefit Trust.)

Figure 1 is an illustration of the anatomical sites of discomfort reported by sonographers showing that higher numbers of respondents experienced discomfort in the shoulder, neck, low back, wrist and hand/fingers.

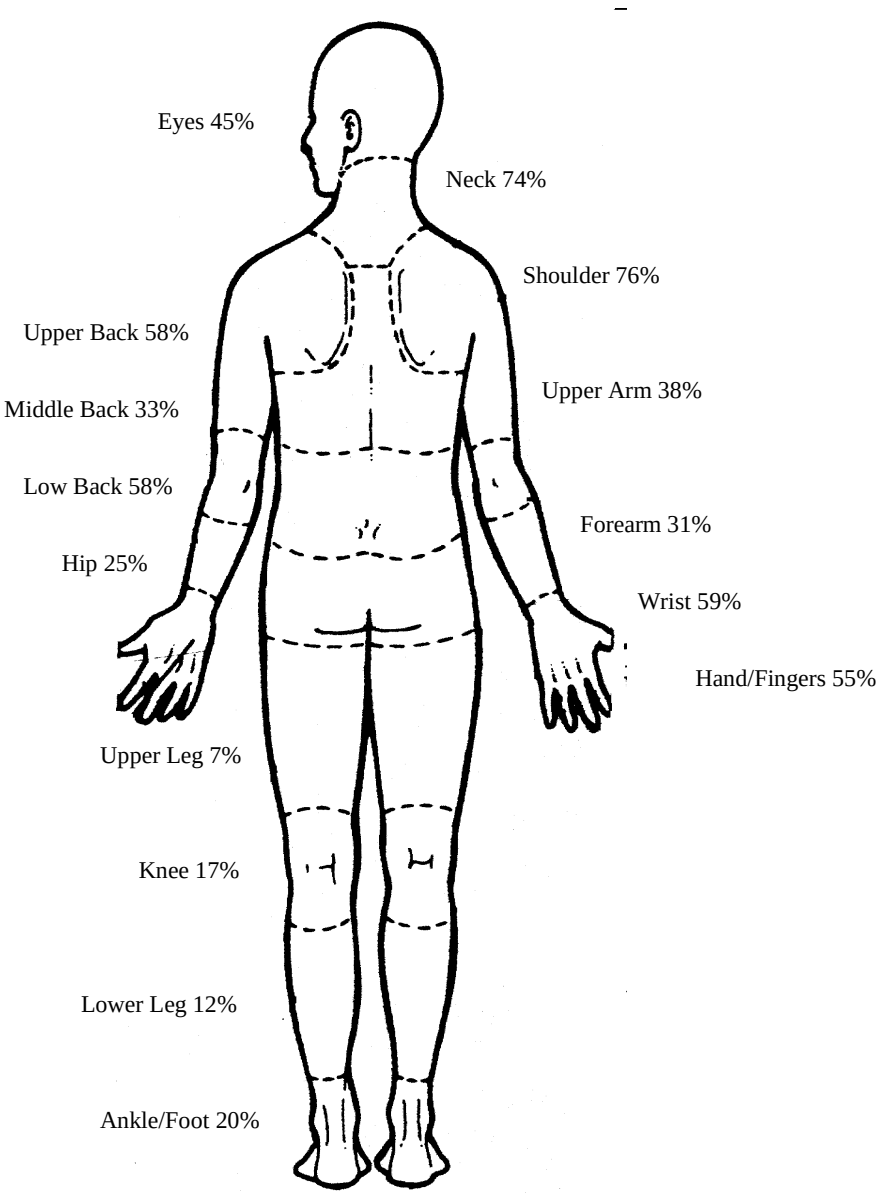


Figure 1. Anatomical sites of discomfort in sonographers

Figure 2 illustrates that experiencing pain and discomfort has a range of functional consequences that impact on both home and work life.

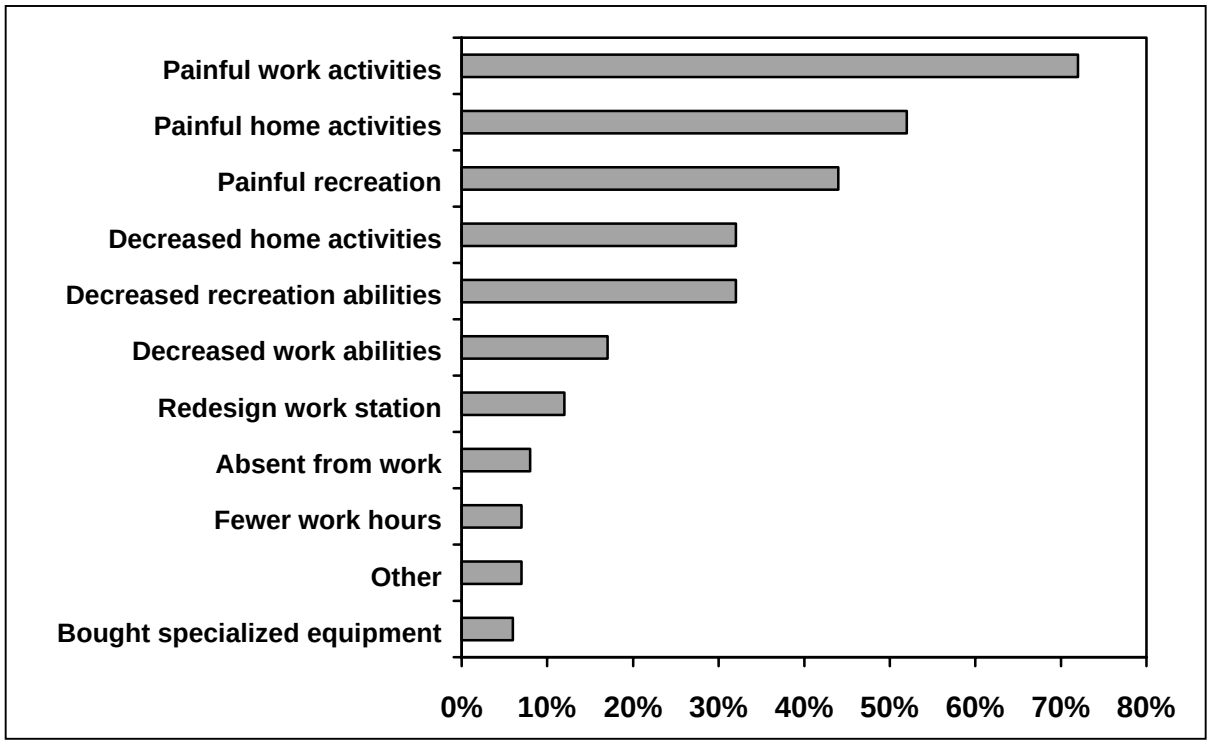


Figure 2: Percentage of Sonographers Reporting Consequences of Pain and Discomfort

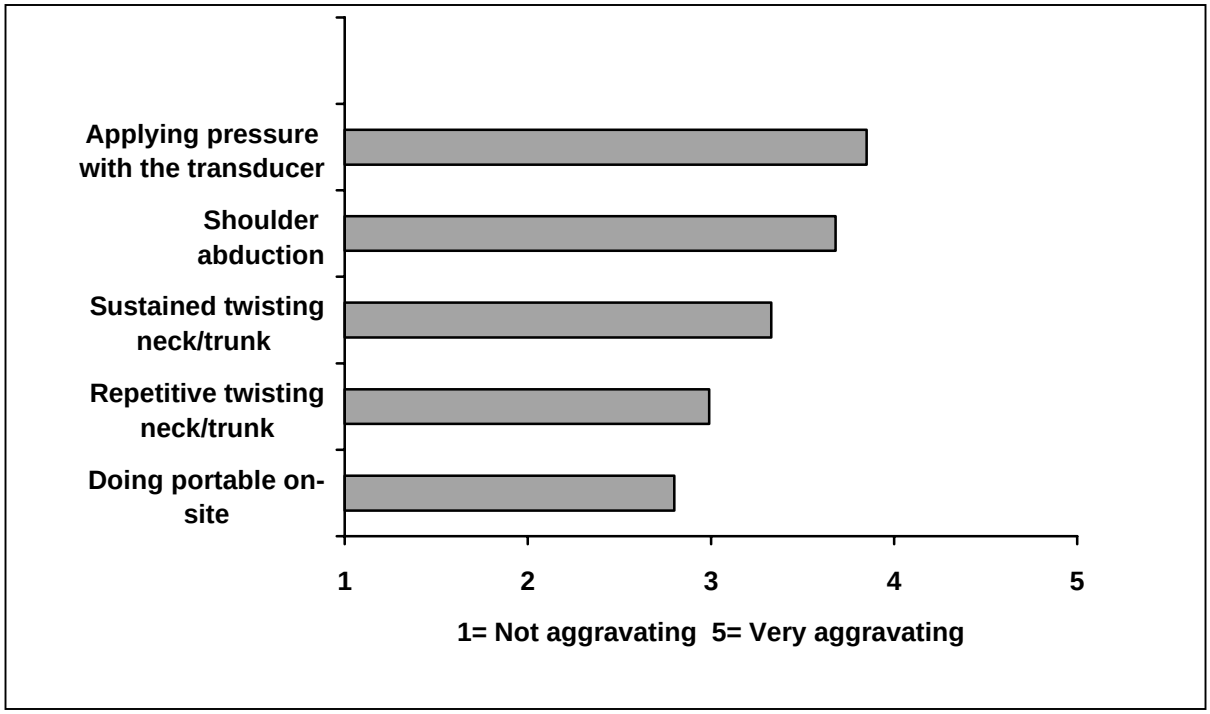


Figure 3: Tasks that Aggravate Musculoskeletal Symptoms (Mean Scores on a 5 Point Scale)

As illustrated in Figure 3, the tasks reported to aggravate musculoskeletal symptoms the most were applying sustained pressure on the transducer; abduction of the shoulder; sustained twisting of the neck and trunk; and repetitive twisting of the neck and trunk. Paper work, computer work, film development and changing cassettes were rated low on the aggravating scale.

Overall, respondents had positive perceptions of co-worker support and work clarity within their work environment. Lower ratings, which may indicate potential areas of concern, were provided for performance of repetitive tasks and planning overtime or extra work.

Several studies undertaken in the same period identified nine major factors of interest. Smith et al. (1997) found a positive relationship between musculoskeletal pain and ultrasonographer height (<63inches), between frequency of scans (100 or more scans per month), between scan time (average scan time of 25 minutes or more per patient) and between use of manually propelled machines. Magnavita et al. (1999) showed that discomfort from the transducer design was the best predictor of hand-wrist complaints, whereas a comfortable chair and correct position of the body protected the sonographer from the onset of neck and back discomfort. Finally, Mirk et al. (1999) showed that muscular efforts such as gripping the transducer, applying sustained pressure and scanning with a flexed or hyperextended wrist were significantly correlated with increasing severity of symptoms in the hand, wrist and forearm area.

Clinical Findings:

The clinical study portion of the project was carried out by Dr. Ted Milner of the School of Kinesiology at Simon Fraser University (SFU) with the co-operation of four Lower Mainland Hospitals (Royal Columbian Hospital, Vancouver General Hospital, Lion's Gate Hospital and Children's and Women's Centre of British Columbia) Several measurement instruments, to be used onsite, were developed to measure applied forces, electromyographical activity and postures. Twenty-seven sonographers participated in the clinical study. A further laboratory study was conducted with ten sonographers. Several task scenarios were evaluated:

- abdominal scanning while sitting and standing
- placement of the monitor directly in front of the sonographer and at eye level
- detaching the console and placing it close to the sonographer
- adjusting the console to allow an elbow angle of 90 or 110 degrees
- raising the height of the seat to a half seated/half standing position
- supporting the elbow with a counterweighted sling
- scanning with a transducer that had been modified to accommodate a palmar grip rather than a finger grip and
- clamping the transducer to an adjustable frame which was attached to the bed.

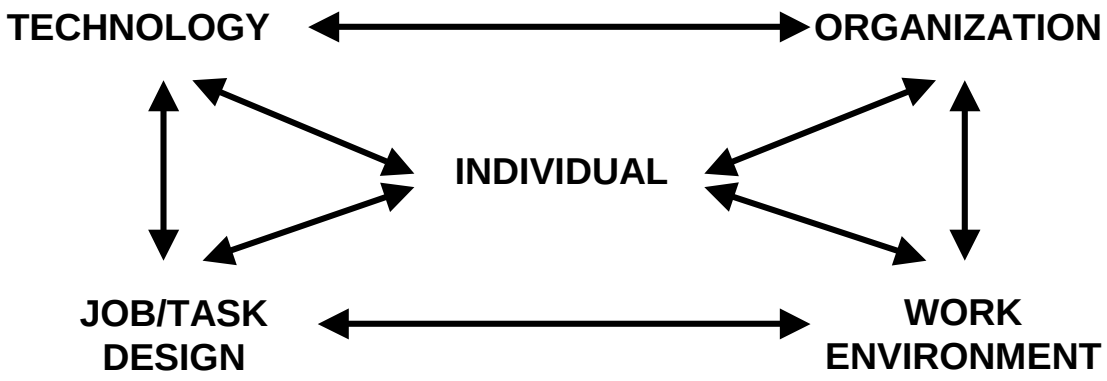
Initial findings from the laboratory study have indicated that scanning while standing resulted in less muscle activity in the neck and trunk muscles and lower muscle activity was noted when the console was at a height that required the elbow to be at 90 degrees. Elbow support reduced muscle activity in the neck, shoulder and trunk muscles, particularly during cardiac scans.

From the clinical study, common risk factors have now been identified and SFU and British Columbia Institute for Technology have initiated a follow up intervention study. The intervention study will assess the use of an adjustable ultrasound workstation that can be linked to any existing ultrasound unit. Prototypes will be tested with a group of sonographers at BC Women's and Children's Hospital during the next year. Other initiatives are underway to work with manufacturers to redesign the transducer head in order to improve the grip and to reduce the muscle forces required. The potential for robotic assistance with specific types of scans is also being explored.

Various initiatives undertaken at individual sites have shown the motivation within Sonography departments to mitigate risks present in sonography tasks. These include height adjustable examination tables and chairs, user trials of new equipment to ensure that the equipment provides more options for the users (some are now available with height adjustable keyboards), and comprehensive stretching programs and task rotation within groups of workers.

Multifactorial Nature of Ergonomic Issues Surrounding Sonography Tasks:

Observations and assessment of sonography tasks clearly indicate that several ergonomic risk factors contribute to the musculoskeletal discomfort/pain experienced by sonographers. Any work system is comprised of a combination of components, each with a number of inherent risk factors which can contribute to the development of illness and injury. The main categories of influence are shown below:



(Smith & Sainfort, 1989)

If these risk factors can be identified and their influences simultaneously reduced or eliminated, the components of the work system can be balanced, resulting in more comfortable work tasks and fewer symptoms. When assessing for ergonomic problems in sonography it is important that the influence of each of these components be considered and the impact of controls considered at each of these levels. Recommendations to reduce risk should encompass engineering controls (equipment and workstation design and layout), administrative controls (work organization and work practices) and individual controls (risk identification and control, training and education).

Recommendations for the Future:

Although the engineering changes being investigated by SFU and BCIT offer exciting possibilities for the future tasks of sonographers, much of the information obtained in the last few years can be applied immediately by sonographers and sonography departments. In general, risk of injury can be minimized by careful use of the following principles:

- Decreasing the duration of static posture
- Decreasing hand-grip pressure
- Minimizing awkward postures
- Increasing tissue tolerances through exercise and adequate rest

It is recognized that there may be limitations to what can be achieved at this point, but here are a few ideas to consider.

➪ Use whatever adjustability you have in your present workstation to achieve an upright posture with your arms as close as possible to your body and with your head and trunk upright.

This may require adjusting the bed and chair height and/or moving the bed to a more central position and/or correctly positioning the patient so that you can reduce some of the reaches. We know that time is a precious commodity and taking the time to make adjustments is difficult, but safety should not be compromised. Optimal productivity and quality is not achieved by symptomatic or injured workers.

How can posture be improved?

Consider the Figures 4, 5, 6 and 7 below to see the impact on neck, shoulder and back postures with and without adjustments to a workstation. As you can see from Figures 5 and 7, postures of the neck, shoulder and back are improved with correct adjustment of the bed and chair.

➪ Think of ways to allow you to vary your posture throughout the day. Varying posture and muscular effort appears to have a significant effect on reducing musculoskeletal discomfort. Deviations from a good working posture appear to be a high predictor of discomfort. Although achieving a good posture is not always easy even small changes can have a positive effect.

➪ Reduce reaches to and over the patient. This may mean making fine adjustments to the patient's position to allow them to get as close to the edge of the bed as is safe. Some new bed designs have an additional shelf that can be raised and the patient can then be positioned closer to the sonographer. Support cushions of different sizes and shapes can be constructed of foam and positioned around the patient.

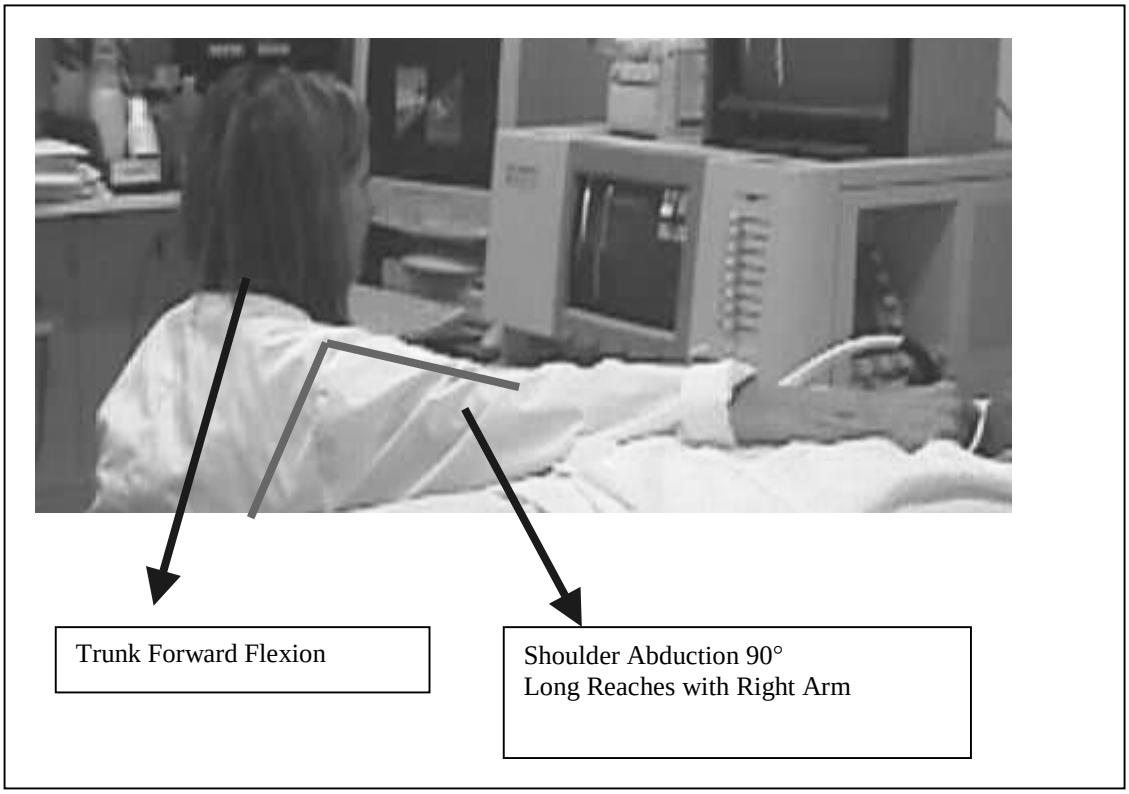


Figure 4: Sitting Work Posture Chair Height Adjustable, Bed Height Non-Adjustable

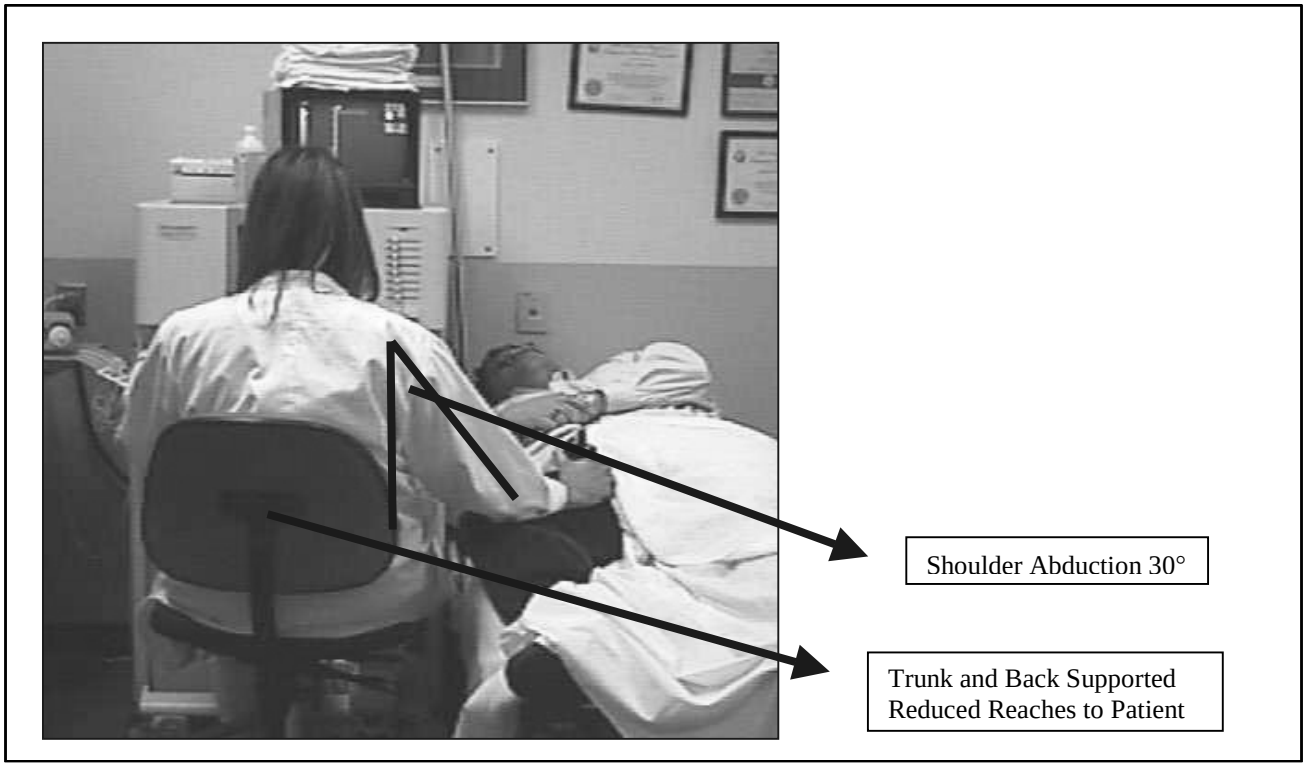


Figure 5: Sitting Work Posture, Bed and Chair Height Adjustable

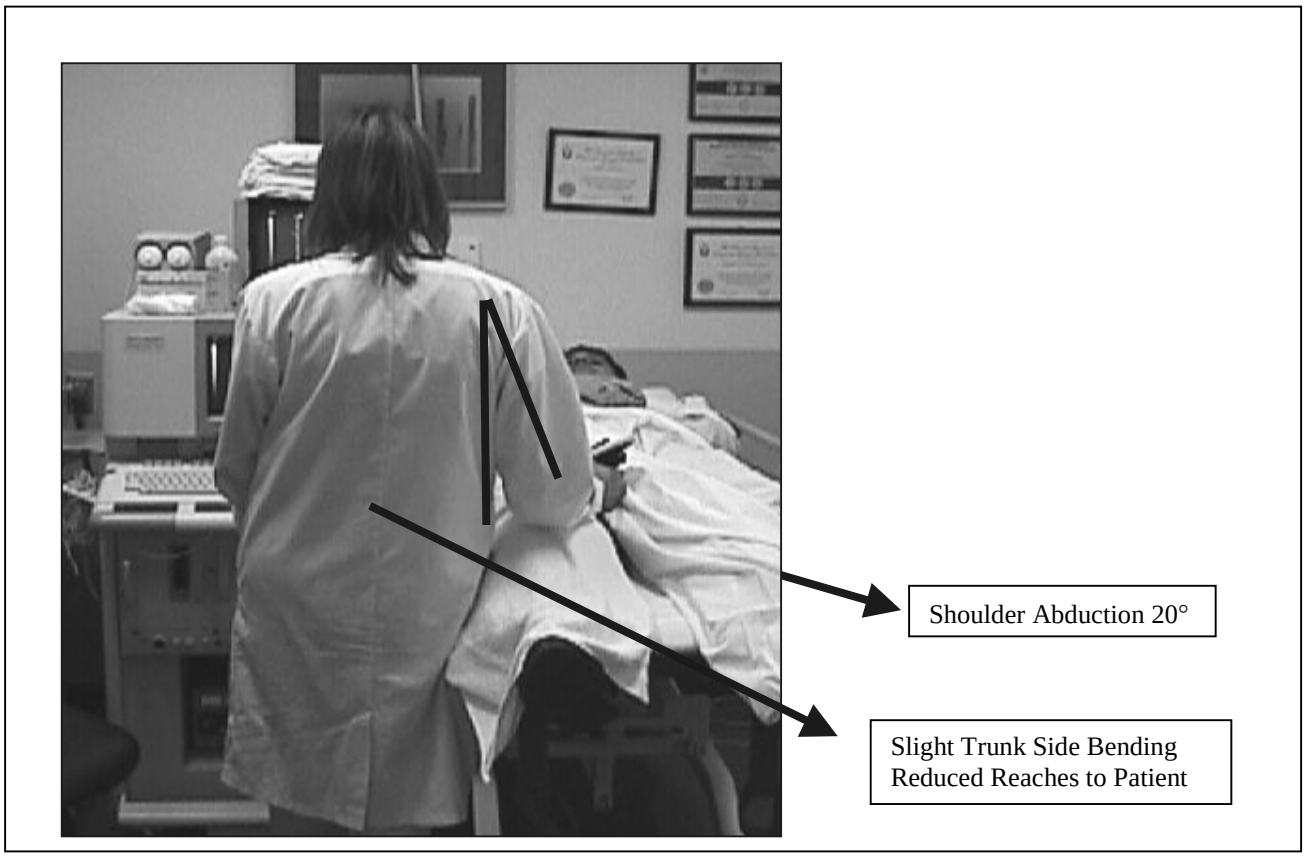


Figure 6: Standing Work Posture, Bed Height Non-Adjustable

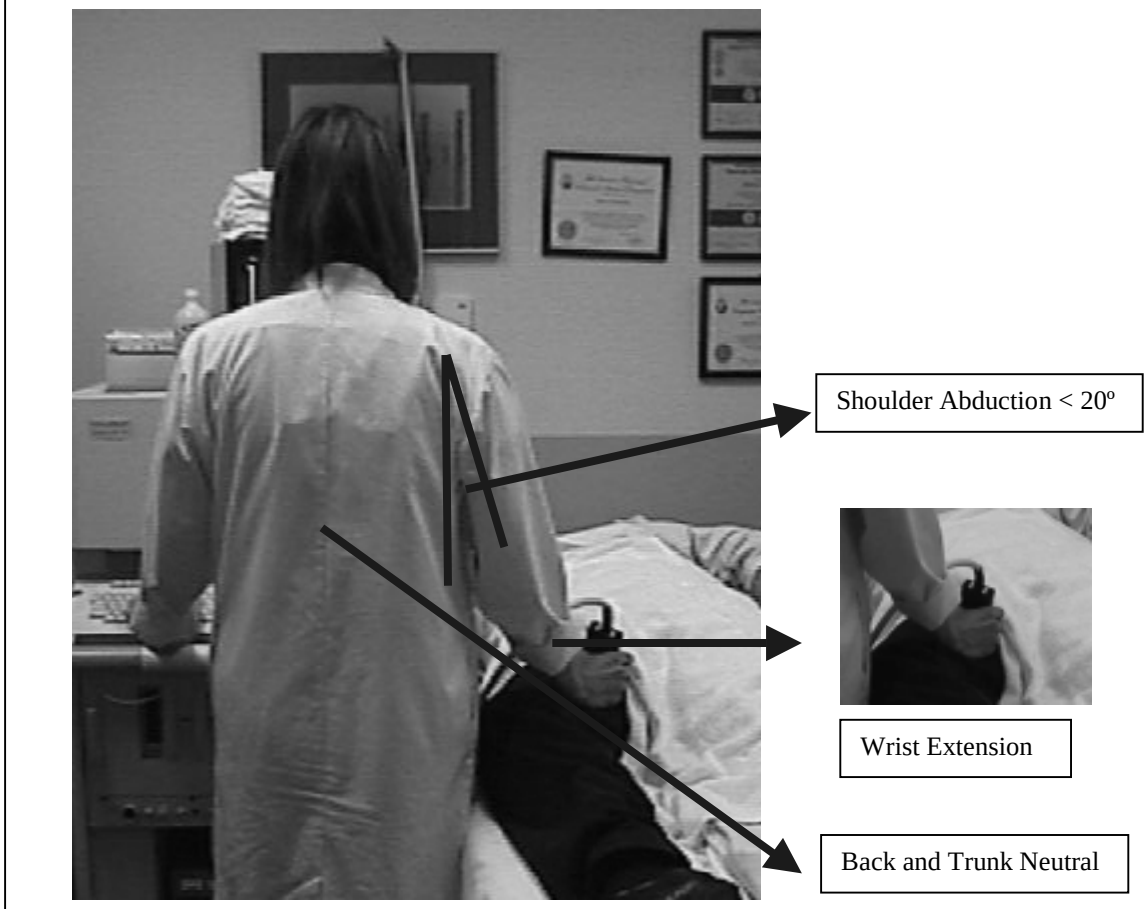


Figure 7: Standing Work Posture, Bed Height Adjustable

➪ A posture enhancing adjustable chair, with footrest, should be considered. Details on features for a good chair can be obtained from the EHS department at HBT. It is important that the chair has sufficient height adjustment to allow the sonographer to sit comfortably, that it rotates freely from the patient to the ultrasound machine, and that it accommodates the placement of the feet on the footrest.

➪ A height adjustable bed is recommended with controls easily accessible and easy to operate with sufficient space under the bed for the sonographer's knees. These beds require regular maintenance to ensure that this adjustability remains a working feature for the sonographers. A standing working posture can then be chosen for some tasks, either to vary the muscle work load or to accommodate a bed height that is non-adjustable. Figures 4 and 6 illustrate how a bed that is non-height adjustable negatively impacts on the posture of the sonographer as compared to a bed that is height adjustable (Figures 5 and 7).

➪ Plan for the ideal set-up that will allow adjustability in the chair/bed/keyboard and the monitor. If you are considering purchasing new equipment in the near future, consider adjustability in these individual components. Always trial new equipment prior to purchasing. “Guidelines to include Ergonomics in Equipment Purchasing” can be obtained from HBT. Always remember to ask your colleagues in other facilities if they have knowledge of, or have purchased new equipment that has improved user comfort. Try to obtain some expert assistance such as from your health and safety advisor or an ergonomist.

➪ If possible, position the keyboard so that the arm is in a relaxed position with the upper arm close to your side (minimal flexion and abduction) and the forearm at a 90-degree angle. Adjust your chair to allow you to achieve this position.

➪ Stand to do some of the scanning. This will reduce low back compression and alternate stresses. As can be seen from Figures 4, 6, and 7, it is important to adjust the bed height correctly so you do not increase musculoskeletal hazards. Consider a sit-stand stool, which will support your body weight but allow your trunk to move freely. Information on sit-stand stools can be obtained from the EHS department at HBT.

➪ Position your monitor to suit you and consider a second monitor for the patient. The second monitor should be placed on a swing arm and should be of high resolution. It could then be used for the patient on an as-needed basis or by the sonographer to reduce twisting, flexion and rotation of the head and neck. The monitor needs to have high resolution for the level of accuracy required during scanning.

➪ Alternate the scanning hand to reduce the stress imposed on the musculoskeletal system by scanning with only one hand. This may require moving the equipment over to the other side of the bed or rotating the bed so that the feet are near the machine. Having ultrasound rooms set up for left and/or right handed use only could also be considered. It is likely that you will be a little slower initially when using the non-dominant hand, but a reduction in discomfort should outweigh the disadvantages.

➪ Whenever possible, rotate between scan types or ask the scheduler to book different scan types back to back. This provides more variety in the tasks and can reduce musculoskeletal stresses.

➪ Include small stretching exercises regularly throughout the work period and let the muscles completely relax (mini breaks). Research indicates that allowing the muscles to be completely silent for as few as 2-3 seconds can have dramatic effects (micro breaks).

Burnaby General Hospital has just completed a pilot study introducing stretching exercises to sonographers. For more details on this study and current work being completed on equipment purchasing for sonographers at the Simon Fraser Health Region, please contact Waqar Muqhal, Bodyworks Program Coordinator (604-520-4742).

➪ Develop alternative procedures for conducting ultrasound examinations that emphasize the comfort of the sonographer without compromising the quality of services performed. This may involve brainstorming with your colleagues or observing and working with each other to establish methods for minimizing stress. If you find a good solution, whether at an individual or group level, pass this information along to other workers involved in sonography tasks. Sharing these workable (effective) solutions within the industry is essential.

➪ Finally, be aware of your posture every time you scan. Think of ways to reduce the load on your body. Awareness of how to achieve an optimal posture and how to reduce musculoskeletal stress is vital to your healthy survival as a sonographer.

An injury prevention guide for sonographers, titled "Guide for Reducing Risk of Musculoskeletal Injury in Diagnostic Medical Ultrasound", will be available in the near future on the Occupational Safety and Health Association for Healthcare web site: www.ohsah.bc.ca **.**

A further source of information for sonographers is the Society for Diagnostic Medical Sonographers web site: www.sdms.org (click on “work zone”)

Below is a brief Musculoskeletal Checklist to allow you to assess your work posture and work practices.

1. Is the patient close enough to me? Is my arm and elbow tucked in closely to my body in a comfortable position?

2. Did I adjust my chair or examination bed according to the body habitus of my patient in relationship to my height?

3. Is my posture a comfortable and correct one so as not to cause undue stress on my body?

4. Am I working with my wrist and neck in a straight and supported position?

5. Is the monitor and keyboard positioned so that I can easily see and reach them?

6. Am I supporting my limbs properly throughout the entire examination?

7. When I stand, am I carrying my body weight equally on both feet?

8. Did I take a micro break? I.e. consciously releasing tension on the scanning hand for a few seconds?

9. Did I take a mini-break? I.e. removing the probe from the scanning hand, stretching the hand, arm and shoulders and glancing periodically away from the monitor to release eye tension?

10. Am I aware of any unusual symptoms, such as numbness, swelling or pain?

(Gregory, 1998)

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Any questions? Please call us at HBT. (604-736-2087 or within BC at 1-888-736-2087)

We would like to acknowledge the following individuals for their participation in the Steering Committee and continuing contributions to the project.

Joan Baker**,** Society of Diagnostic Medical Sonographers
Jonathan Berkowitz, Berkowitz & Associates
Vickie Lessoway, British Columbia Diagnostic Medical Sonographers
Ted Milner, Simon Fraser University
Rachel Notley, Health Sciences Association