

Workplace Health and Safety Bulletin



Musculoskeletal Injuries – Part 6 Reducing Ergonomic Hazards

This is the last in a six-part series of Safety Bulletins dealing with musculoskeletal injuries

Musculoskeletal injuries, or MSIs, are referred to by a variety of different names. These include repetitive strain injuries (RSIs), repetitive motion injuries, cumulative trauma disorders (CTDs), work-related upper limb disorders (WRULDs), and others. In each case, the name is used to describe injuries of the bones, joints, ligaments, tendons, muscles, and other soft tissues.

There is strong scientific evidence that the greater the intensity, duration, and frequency of exposure to physical risk factors at work, the greater the risk of having an MSI. There is also strong evidence that reductions in exposure will reduce the development of MSIs. In particular, applying the principles and tools of ergonomics to known risk factors can effectively reduce the hazards to workers and thereby prevent MSIs.

The purpose of performing a workplace hazard assessment is to identify specific workplace hazards related to MSIs and to then reduce worker exposure. Part 5 of this series presents a hazard assessment checklist that employers and workers can use to assess those hazards. The hazard assessment checklist recommended for use was introduced in May, 2000 by the State of Washington, Department of Labour and Industries, as part of that state's ergonomics legislation (WAC 296-62-051, Ergonomics).

If worker exposure to one or more of the risk factors highlighted in the assessment checklist exceeds the limits, then an ergonomic hazard is considered to be present and the employer needs to take action. Each identified hazard should be reduced below the levels stated or to the degree technologically and economically feasible. The methods used to reduce the hazard(s) should not rely primarily on changes in worker behaviour.

Government of Alberta ■
Employment and Immigration

Principles of hazard reduction or elimination

In reviewing the ergonomics literature, certain principles or themes for the reduction or elimination of MSI hazards are repeated continually. Summarized in the guidance documents supporting Washington's ergonomics legislation and paraphrased below, they are the basis for the control methods listed in Table 1.

- (1) Adapt the workstation and work equipment to take into account the dimensions of the worker and the type of work being performed. Preferred body positions include an erect upper body, body weight appropriately supported, elbows at the side of the body, and forearms approximately horizontal.
- (2) Provide sufficient room for body movements, especially those of the head, arms, hands, legs, and feet.
- (3) Provide variety in tasks and movements to avoid static muscle tension caused by body positions held fixed for long periods of time.
- (4) Design work tasks so that machinery can perform or assist in the performance of highly repetitive tasks. Leave workers with the remaining tasks but make sure that the tasks incorporate variety.
- (5) Put controls within easy reach of the worker. Grips and handles should be suited to the hand.
- (6) Loads should be kept as close to the body as possible and awkward body positions avoided.
- (7) The strength demands of the job or task should match the physical capabilities and work capacity of the worker.
- (8) Use mechanical assist devices if strength demands exceed the capacity of the worker to perform the work without injury.
- (9) Larger muscle groups should be used for producing higher forces, smaller muscle groups for precision work.
- (10) Do not combine requirements for great accuracy and strength on the same job at the same time.

- (11) Avoid extreme body positions when exerting high force.
- (12) Design tasks to permit gripping with the fingers and palm instead of pinching.
- (13) Reduce worker exposure to hand-arm vibration when using power tools by reducing the tool's vibration intensity, reducing the length of time that the worker is exposed to vibration, or isolating the worker from the vibration.
- (14) Provide workers with adjustable equipment, furnishings, workstations, and tools.

Suggested methods of reducing ergonomic hazards

Table 1 of this Safety Bulletin, a companion to the hazard assessment checklist of Part 5 of this series, was prepared by the Department of Labor and Industries as a resource of ideas to employers trying to control the ergonomic hazards highlighted by the assessment. Other equally effective approaches may exist and should be used when appropriate. A number of these approaches have already been presented as “Potential solutions” in Parts 3 and 4 of this series. Readers are encouraged to review those Parts for additional information.

A companion series of Safety Bulletins specific to the lifting and handling of loads is also available. Part 3 of that series includes additional ideas specific to reducing the ergonomic hazards associated with heavy, frequent, or awkward lifting.



Table 1 Suggested methods of reducing ergonomic hazards

Ergonomic Hazard	Reduction Methods
AWKWARD BODY POSITIONS	
Working with hand(s) above the head or the elbow(s) above the shoulder(s), more than 4 hours total per day	<ul style="list-style-type: none">• Raise the worker up with elevated work platforms or ladders• Make tools longer with articulating arms or extension handles• Bring the work down and tilt it on its side for better access• Provide adjustability where possible for multiple users• Design reach distances for the shortest worker• Provide arm supports• Use sloping platforms with overhead conveyers to adjust for variable worker heights
Repetitively raising the hand(s) above the head or the elbow(s) above the shoulder(s) more than once per minute, more than 4 hours total per day	<ul style="list-style-type: none">• Limit overhead storage to infrequently used items• Raise the worker up with elevated work platforms or ladders• Make tools longer with articulating arms or extension handles• Bring the work down and tilt it on its side for better access• Provide adjustability where possible for multiple users• Design reach distances for the shortest worker
Working with the neck bent more than 45° (without support or the ability to vary posture), more than 4 hours total per day	<ul style="list-style-type: none">• Raise and tilt objects being viewed to keep neck more upright• Use magnifiers when working on objects with the hands in order to keep the arms and shoulders down• Support the head with a chin/forehead cradle• Use monitor arms or stackers to raise up monitors• Use video or mirror systems to view objects or locations that are difficult to see (dental/medical/surgical tasks, forklifts)
Working with the back bent forward (without support or the ability to vary posture) more than 30° for more than 4 hours per day, or more than 45° for more than 2 hours per day	<ul style="list-style-type: none">• Raise and tilt the work to provide better access• Use a sit/stand stool to lower the worker• Make tools longer with articulating arms or extension handles• Alternate between bending, sitting, kneeling, and squatting• Use a chest pad to support the weight of the upper body• Locate objects well within arms' reach• Use body carts for ground level work



Squatting more than 4 hours total per day	<ul style="list-style-type: none">• Raise the work to provide better access• Make tools longer with articulating arms or extension handles• Alternate between bending, sitting, kneeling and squatting• Use body carts for ground level work• Use short portable stools for ground level work
Kneeling more than 4 hours total per day	<ul style="list-style-type: none">• Wear knee pads• Raise the work to provide better access• Make tools longer with articulating arms or extension handles• Alternate between bending, sitting, kneeling, and squatting

HIGH HAND FORCE	
Pinching an unsupported object(s) weighing 900 grams or more (2 lbs) per hand or pinching with a force of 180 Newtons or more (4 lbs) per hand, combined with highly repetitive motions for more than 3 hours total per day	<ul style="list-style-type: none">• Redesign hand-tool interface for use of a power grip• Reduce weight of tool or object• Use clamps, vices, jigs, or fixtures to eliminate forceful pressing or pinching• Use fasteners requiring minimal pinch force e.g. plastic rather than metal• Use fasteners that can be inserted by or with a tool
Pinching an unsupported object(s) weighing 900 grams or more (2 lbs) per hand or pinching with a force of 180 Newtons or more (4 lbs) per hand, combined with wrists bent in flexion 30° or more, or in extension 45° or more, for more than 3 hours total per day	<ul style="list-style-type: none">• Redesign hand-tool interface for use of a power grip• Redesign hand-object interface to reduce slipperiness• Reduce weight of tool or object• Change tool, work surface orientation, or worker location to reduce bent wrist postures



Pinching an unsupported object(s) weighing 900 grams or more (2 lbs) per hand or pinching with a force of 180 Newtons or more (4 lbs) per hand for more than 4 hours total per day	<ul style="list-style-type: none"> • Redesign hand-tool interface for use of a power grip • Reduce weight of tool or object • Rotate jobs between workers • Use clamps, vices, jigs, or fixtures to eliminate forceful pressing or pinching • Use fasteners requiring minimal pinch force e.g. plastic rather than metal • Use fasteners that can be inserted by or with a tool
Gripping an unsupported object(s) weighing 4.5 kg or more (10 lbs) per hand or gripping with a force of 340 Newtons (10 lbs) per hand, combined with highly repetitive motions for more than 3 hours total per day	<ul style="list-style-type: none"> • Reduce weight of tool or object • Use balancers, adjustable fixtures, articulating arms to hold handled items, or minimize weight held in the hand • Use two hands rather than one • Alternate between hands • Sharpen cutting tools to reduce force requirements during use • Rotate workers between tasks
Gripping an unsupported object(s) weighing 4.5 kg or more (10 lbs) per hand or gripping with a force of 340 Newtons (10 lbs) per hand, combined with wrists bent in flexion 30° or more, or in extension 45° or more, or in ulnar deviation 30° or more, for more than 3 hours total per day	<ul style="list-style-type: none"> • Reduce weight of tool or object. • Change tool, work surface orientation, or worker location to reduce bent wrist postures. • Use balancers, adjustable fixtures, articulating arms to hold handled items or minimize weight held in the hand • Use two hands rather than one • Alternate between hands • Sharpen cutting tools to reduce force requirements during use
Gripping an unsupported object(s) weighing 4.5 kg or more (10 lbs) per hand or gripping with a force of 340 Newtons (10 lbs) per hand, more than 4 hours total per day	<ul style="list-style-type: none"> • Reduce weight of tool or object • Rotate jobs between workers • Use balancers, adjustable fixtures, articulating arms to hold handled items, or minimize weight held in the hand • Use two hands rather than one • Alternate between hands • Sharpen cutting tools to reduce force requirements during use • Preventive maintenance of tools to reduce high hand forces • Use bench-mounted adapters to provide more leverage

HIGHLY REPETITIVE MOTIONS	
Using the same motion with little or no variation every few seconds (excluding keying activities) more than 6 hours total per day	<ul style="list-style-type: none"> • Rotate jobs with other workers, varying the types of motion • Use job enlargement, increase the number of tasks performed by the worker, vary the types of movement • Reduce the speed of the motions if possible • Use mechanical assists • Use multifunction tools
Using the same motion with little or no variation every few seconds (excluding keying activities) combined with wrists bent in flexion 30° or more, or in extension 45° or more, or in ulnar deviation 30° or more, and high, forceful exertions with the hand(s), more than 2 hours total per day	<ul style="list-style-type: none"> • Re-orient or move objects into positions where bent wrists are eliminated • Rotate jobs with other workers, varying the types of motion • Use tools (with power grip) if exertions are required • Provide clamps, vices, jigs, or fixtures to hold parts, reducing forceful grasping and allowing the use of two hands • Use mechanical assists • Use multifunction tools
Intensive keying for more than 7 hours total per day, or combined with awkward postures for more than 4 hours total per day	<ul style="list-style-type: none"> • Enlarge the job to include tasks other than keying • Provide equipment to reduce awkward postures such as wrist rests, arm rests, adjustable keyboard shelves • Rearrange workstation to eliminate awkward postures e.g. raise monitor, lower keyboard, bring mouse closer to keyboard • Utilize voice-recognition software • Utilize software macros that automate repetitive keystrokes • Schedule breaks



REPEATED IMPACT

Using the hand (heel/base of palm) as a hammer more than once per minute more than 2 hours total per day

- Use rubber mallets, bean bags, or other padded tools to strike with instead of the palm
- Press objects into place using levers, or hydraulic or pneumatic tools
- Redesign assembly processes to avoid the need to pound parts in by hand
- Use viscoelastic padded palm pads to reduce impact
- Cover sharp or hard objects with pads
- Use different types of palm button guards such as light sensors for manual activation of equipment

Using the knee as a hammer more than once per minute more than 2 hours total per day

- Use tools that don't require knee kicks, such as power stretchers for carpet laying, or long handled Mallets
- Press objects into place using levers, or hydraulic or pneumatic tools
- Relocate knee switches so that the thigh or the foot presses them
- Redesign processes to avoid the need to pound parts in by knee



HEAVY, FREQUENT or AWKWARD LIFTING

Heavy lifting	<ul style="list-style-type: none">• Reduce weight of load• Increase weight of load so that it requires mechanical assist• Reduce the capacity of the container• Use slides or gravity chutes to eliminate lifting• Use mechanical assist devices such as overhead hoists, manipulators, vacuum lifts, pneumatic balancers, forklifts• Use telescoping extendible conveyors with powered belts that reach deep into trailers• Reduce the horizontal distance of the load away from the body by reducing the size of the packaging• Reduce the horizontal distance of the load away from the body by removing barriers and obstacles that make access to the object difficult• Team lift the object with two or more workers• Improve layout of work process so the need to move materials is minimized• Provide handholds which increase lifting capability up to 15%
Frequent lifting	<ul style="list-style-type: none">• Use mechanical assist devices such as overhead hoists, manipulators, vacuum lifts, pneumatic balancers, forklifts• Reorganize work method to eliminate repeated handling of the same object• Rotate workers to jobs with light or no manual handling• Use slides or gravity chutes to eliminate lifting• Use mobile storage racks to avoid unnecessary loading and unloading
Awkward lifting	<ul style="list-style-type: none">• Redesign workstation layout to eliminate trunk twisting by locating objects within arm's reach• Design workstation with adjustable heights to eliminate bent forward posture when lifting• Eliminate the use of deep shelves that require a worker to bend and reach for objects.• Store objects at 30" off the floor – lifting should be performed between mid-thigh and shoulder height• Provide sturdy walk-up ladder with handrails to access stored parts on high shelves/racks• Provide rigid containers to better control the load


HAND-ARM VIBRATION


Hand-arm vibration


- Select power tools with lower vibration levels
- Provide regular maintenance to eliminate vibrations caused by imbalanced mechanical parts e.g. grinding wheels
- Increased tool weight could reduce vibration transmitted to the hands, though caution should be taken not to introduce other risk factors
- Using balancers, isolators, damping materials, articulating arms, vertical suspension, and counterweighting to reduce grip requirements and provide an alternative transmission route for vibrational energy
- Use battery-operated rather than air-powered tools where possible
- Isolate vibration between source and hand by providing handles with a well designed mass-spring system or anti-vibration gloves
- Tools should have a high power-to-weight ratio, have low torque with a cutoff rather than a slip-clutch mechanism, and have handles with a non-slip surface to reduce the need to grip tightly
- Reduce vibration exposure time


Other Safety Bulletins in this series


This six-part series of Safety Bulletins consists of the following titles:


 http://employment.alberta.ca/documents/WHS/WHS-PUB_erg017.pdf
MSI – Part 1 – Alberta Injury Statistics and Costs – ERG017

 http://employment.alberta.ca/documents/WHS/WHS-PUB_erg018.pdf
MSI – Part 2 – Symptoms and Types of Injuries – ERG018


 http://employment.alberta.ca/documents/WHS/WHS-PUB_erg019.pdf
MSI – Part 3 – Biomechanical Risk Factors – ERG019


 http://employment.alberta.ca/documents/WHS/WHS-PUB_erg020.pdf
MSI – Part 4 – Workplace Risk Factors – ERG020


 http://employment.alberta.ca/documents/WHS/WHS-PUB_erg021.pdf
MSI – Part 5 – Assessing Ergonomic Hazards – ERG021

 http://employment.alberta.ca/documents/WHS/WHS-PUB_erg022.pdf
MSI – Part 6 – Reducing Ergonomic Hazards – ERG022

A companion series specific to the lifting and handling of loads is also available. It consists of the following titles.

 http://employment.alberta.ca/documents/WHS/WHS-PUB_bcl001.pdf
Lifting and Handling Loads – Part 1 – Reviewing Issues – BCL001

 http://employment.alberta.ca/documents/WHS/WHS-PUB_bcl002.pdf
Part 2 – Assessing Ergonomic Hazards – BCL002

 http://employment.alberta.ca/documents/WHS/WHS-PUB_bcl003.pdf
Part 3 – Reducing Ergonomic Hazards - BCL003

Each of these Bulletins is available through Workplace Health and Safety regional offices or the Department's Internet web site. Refer to the end of this Safety Bulletin for specific details.

References

Note: Each of the Department of Labor and Industries references are available at the following Internet web address:


www.lni.wa.gov/wisha/regs/ergo2000


Department of Labor and Industries, State of Washington. *WAC 296-62-051, Ergonomics*. May 5, 2000.

Department of Labor and Industries, State of Washington. *Concise Explanatory Statement (RCW 34.05.325.6a) WAC 296-62-051, Ergonomics*. May 5, 2000

Contact us:

Province-Wide Contact Centre

 Edmonton & surrounding area:
780-415-8690

 Throughout Alberta:
1-866-415-8690



Deaf or hearing impaired
▪ In Edmonton: **780-427-9999**
or
▪ **1-800-232-7215**
throughout Alberta

Web Site



www.worksafe.alberta.ca

Getting copies of OHS Act, Regulation & Code:

Queen's Printer



www.qp.gov.ab.ca

Workplace Health and Safety



<http://employment.alberta.ca/whs-ohs>



Edmonton 780-427-4952

Call any Government of Alberta office toll-free
Dial 310-0000, then the area code and telephone number you want to reach

© 2010-2011, Government of Alberta, Employment and Immigration

This material may be used, reproduced, stored or transmitted for non-commercial purposes. The source of this material must be acknowledged when publishing or issuing it to others. This material is not to be used, reproduced, stored or transmitted for commercial purposes without written permission from the Government of Alberta, Employment and Immigration. This material is to be used for information purposes only. No warranty express or implied is given as to the accuracy or the timeliness of the material presented. In case of any inconsistency between this document and the Occupational Health and Safety Legislation, the legislation will always prevail.