Self Help Manual for Prevention of MSIs

Body Manual

Industrial Musculoskeletal Injury Reduction Program

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The body manual was developed to guide sawmill workers through a program to prevent problems with their bodies. Preventative exercises have been carefully chosen by professionals who work in an exercise therapy role.

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INTRODUCTION

Resetting the Injury Clock

Musculoskeletal injuries (MSIs) occur when physical demands exceed the capabilities of the body. There are two ways to decrease the risk of injury to the body. 1) decrease work demands by changing the job through engineering or administrative methods; and 2) increase capabilities of the body. It is important to address the work demands of the job with physical changes to the work environment. The focus of the Body Manual however, is on increasing the capabilities of the body. Please keep this in mind when you use this document.

There are pros and cons to having musculoskeletal injuries occur slowly. One negative aspect is that injuries are not recognised early unlike, for example, when skiers “blow out” their knees and seek immediate treatment. With slowly progressing injuries, problems may go unchecked for longer periods. The signs and symptoms of MSIs may gradually progress over months or years until a worker is partially disabled. Injuries that go untreated for long periods may become chronic and more difficult to treat. If MSIs progress for too long, the body may not be able to fully recuperate.

A positive aspect of MSIs progressing slowly is that damage can be reversed quickly if caught early. This is referred to as “resetting the injury clock”. If you reset the injury clock soon enough and often enough, serious MSIs can be avoided.

Preventative exercises are used to reset the injury clock. Like a machine, the body requires regular maintenance to ensure that it works properly. Professional athletes use exercises to keep strong and facilitate recovery from fatigue. This practice helps aging athletes maintain a high caliber of play and enjoy longer careers and healthier lives.

The Body Manuals describe how slowly progressing injuries occur for each major body part, outline information on how to avoid harmful stress, and show preventive exercises to reset the injury clock.

With simple maintenance, the body can remain healthy and continue to perform at an optimum level - enhancing life both on and off the job.
Consult a healthcare professional before beginning a new exercise program or if you have any questions regarding this manual.
Loading the Neck Muscles

Most workers have experienced neck discomfort at some point. Typically workers who experience neck discomfort believe that it is a part of the job that simply has to be endured.

Neck discomfort, if treated early, is easy to correct and even easier to prevent. With simple exercises, the injury clock can be reset and workers can carry on with their daily activities, pain free.

Neck and upper back muscles must support the weight of the head when looking down. An average head weighs 12 lbs. The more the neck bends forward, the more muscle force required to support the head, and the faster the postural muscles fatigue.

Every joint in the body is comprised of levers and pulleys. The principle of torque can be applied to the body to determine how hard your muscles have to work to counter-balance loads, and how much joint compression is produced as a result of these loads.

Teeter-Totter Principle

The more the head bends forward, the greater the load on muscles, the greater the joint compression, and the greater the risk of injury.
NECK PROBLEMS

Stretched - Weakened Muscles

Each joint has positions, which are optimal for force generation and strength. A muscle has an optimum length for active tension. When body positions make this length longer or shorter, greater force must be exerted for the same tension to be produced. The body also has positions where it is weak and more prone to injury. When muscles are outside of their optimal positions, the amount of force that they can generate decreases significantly.

Example - Grip Strength Test

Try this. Grip two fingers with the wrist straight, and squeeze as hard as you can. Now repeat with a bent wrist. Do you feel a difference in strength between the two positions?

Strong

Weaker

The more the wrist is bent, the weaker the grip. Similarly, the farther the head is bent forward, the weaker the neck and upper back muscles become and the greater the risk of injury.
Adaptive Changes to Work

The body has a great ability to adapt to its environment. For example, it can produce more sweat to deal with a hot climate, and it can adapt to physically demanding work by becoming stronger. However, some adaptive changes are not positive. Workers who continually work with their neck bent forward may start to develop problems as a result of postural changes. As the body becomes increasingly misaligned, the loading of the muscles and joints increases significantly. As well, the postural muscles in the neck and upper back that are under constant tension soon become stretched-weakened and lose the ability to maintain erect posture. As a result, spinal alignment gets progressively worse with time. If caught early, these changes are reversible.

**Posture Check**

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<td><img src="image" alt="Good Posture" /></td>
<td><img src="image" alt="Bad Posture" /></td>
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Place feet 6 inches away from wall and keep low back flat against the wall. Someone with good alignment should be able to press their forearms, hands, and back of the head flat against the wall. If you do have posture problems, this test can also be used as a corrective exercise.
During motor vehicle accidents, the amount of force that is transmitted through the body and especially the neck is massive. Because of the large forces, soft tissues in the neck (muscles, tendons, and ligaments) can easily be damaged. This injury is referred to as whiplash.

The body is similar to a machine in the sense that it has load limits which are referred to as tissue tolerances. If the load on the tissues exceeds these tolerances, an injury will occur.

**Whiplash Injury**

Impact forces in accidents can significantly load soft tissue in the neck. Loads that exceed tissue tolerances will result in a whiplash type of injury.
Wearing Out the Neck

Workers who continuously turn their head can also experience neck problems. Muscles are required to turn the head to the side. The more the head is turned, the greater the load on the muscles. For forklift drivers, turning the head continuously to one side can result in a muscle imbalance in the neck causing pain. This imbalance can eventually lead to uneven wearing of the spine.

This sort of injury develops over a period of time. Because the progression of the injury is slow, workers often let the damage accumulate to the point that the problem becomes irreversible. If possible, movements should be performed in both directions (looking over both shoulders). The exercises on page 11 can help minimise muscle imbalance.

Overuse Injury

Injury also occurs when repetitive loading reduces tissue tolerance to the point of failure

Repetitive twisting of the neck can cause neck problems.
Neck Problems

Neck Tension Syndrome

Workers such as graders who continuously look down can also develop neck problems. The neck and upper back muscles support the head when bent forward. With the head bent forward for long periods, the muscles gradually fatigue, and tissue tolerances decrease. If the fatigue is significant, this continuous load can result in neck tension syndrome.

If a muscle is constantly turned on (static contraction), blood is squeezed out of the muscle. Think of muscles as being small motors. Motors require oxygen to allow for the combustion of fuel. Without oxygen, motors die out. Without blood, which carries oxygen, muscles soon die out as well.

For a muscle to work properly it requires blood to be circulated. Dynamic contractions, where the muscle turns on then off, increase blood circulation and allow the muscle to breathe and stay healthy.

Overuse Injury

Injury also occurs when … constant loading reduces tissue tolerance to the point of failure

Constantly having neck and upper back muscles turned on can cause neck tension syndrome. Getting in the habit of turning muscles on and off while working can prevent injuries.
NECK PROBLEMS

How to Prevent Neck Problems

Use the information below as your guide to keep your neck healthy.

To avoid injury, decrease work demands and increase worker capacity

Decrease Demands
- Reduce loading on neck muscles by keeping the head more upright.
- Reduce the amount of turning of the head.
- Train yourself to look up periodically and relax neck muscles to change work from static to dynamic.

Increase Capacity
- Exercise to improve endurance of neck muscles.
- Exercise to improve posture and to reduce loading on the neck.
- Perform contraction and relaxation exercises to improve blood circulation in oxygen deprived muscles.
NECK PROBLEMS

Exercises to Keep Your Neck Healthy

Follow the instructions on this worksheet to reduce the risk of neck discomfort. Exercises should be done daily. Start out slowly and gradually increase exercise intensity. Purchase light resistance tubing and cut into six-foot lengths.

External Shoulder Rotations
With your elbows bent at 90 degrees and thumbs together, pull your hands apart and let the thumbs rotate outwards. As your posture muscles get stronger, finish higher. Do 3 sets 10 times.

Chin Tucks
With your head upright, tuck chin in. You should feel a gentle stretch, in the back of the neck. This exercise can be done lying down initially. Hold for 30 seconds and then relax. Repeat 5 times.

Isometric Neck Extensions
Apply light resistance to the back of the head with the hands. As neck muscles get stronger more resistance can be applied. Hold for 10 seconds and then relax. Repeat 5 times.

Upper Trapezius Stretch
Turn head to the side slightly and reach for the ground. The opposite arm can be used to increase the stretch. Concentrate on relaxing neck muscles during stretching. Hold for 30 seconds and then relax. Repeat 5 times on each side.
Consult a healthcare professional before beginning a new exercise program or if you have any questions regarding this manual.
Sports like baseball are known for being extremely stressful on the shoulder joint, and on the rotator cuff muscles and tendons. When you hear “rotator cuff injury”, typically one thinks of a career ending injury. In the past that may have been the case. Today, however, with better understanding of the cause of these injuries and better medical management, athletes are capable of recapturing pre-injury performance levels. These same principles that have worked so effectively in the sporting environment are also effective in preventing shoulder injuries in the workplace.
SHOULDER PROBLEMS

Stability vs. Mobility

The shoulder is a ball and socket joint. However, it might be more accurate to say that the socket is more of a depression. Unlike the hip, which is a true ball and socket joint, the shoulder must rely on muscles to keep the shoulder in place.

When one thinks of shoulder muscles, usually the large deltoids and trapezius come to mind. However, there is another group of muscles that are responsible for providing stability to the shoulder joint. They are the small rotator cuff muscles and their tendons which lie underneath the deltoids. Because of the large forces that can be generated at the shoulder, it is very easy to damage the rotator cuff muscles and tendons.

Built for mobility
Built for stability

Less contact surface between the ball and socket in the shoulders allows for greater range of movement, but sacrifices stability. In comparison, the hip is designed to provide more stability, which reduces range of movement.
SHOULDER PROBLEMS

Loading the Shoulder Joint

The shoulder has positions where it is stronger and more resistant to injury.

The amount of force that the rotator cuff muscles must generate to stabilize the shoulder depends directly on how close loads are to the shoulder joint. When loads are farther away from the shoulder, there is more loading on the muscles and their tendons. If this loading exceeds the muscles and tendons capabilities, or tissue tolerances, an injury will occur.

Teeter-Totter Principle

Effort = Force x Distance
Double the Distance, Double the Effort
Your muscles must work twice as hard!

Muscles must work harder to counterbalance loads that are held farther away from the body. Risk of injury also increases with loads held away from the body.
Millwrights, who have to reach into confined spaces with tools (e.g., impact guns), are at risk of shoulder injuries. Holding onto heavy tools requires the small rotator cuff muscles to work extremely hard to stabilize the shoulder. The combination of reaching some distance from the body and applying force produces loads on the shoulder joint, which can exceed the tissue tolerances. The resulting injury is a rotator cuff strain.

**Overexertion Injury**

The shoulder joint allows for mobility or stability but not both. If you try to apply a lot of force in an awkward position the result may be an injury.
Shoulder Impingement

Workers that continuously reach above shoulder height can also develop rotator cuff problems. When reaching above shoulder height, some of the rotator cuff muscles are pressed up against the roof of the shoulder complex (this is referred to as impingement). Repeated rubbing against bones and ligaments causes the rotator cuff tendons to fray. Another structure in the shoulder, a bursa sac (like a water balloon), helps to reduce the amount of friction but can also swell and become damaged.

These injuries develop over a period of time. When the accumulation of damage weakens the tissue significantly, even a small load can result in an injury.

Overuse Injury

Injury also occurs when … repetitive loading reduces tissue tolerance to the point of failure

Repetitive reaching above shoulder height can cause impingement problems.
The body has a great ability to adapt to its environment. For instance, the body can become stronger to meet the demands placed on it. However, there is a negative consequence to adaptive change in the workplace. The spine has a memory, and will structurally change over the years in response to stress.

Workers that are required to look down may start to develop changes in posture. As a consequence, workers may develop shoulder problems. Impingement usually occurs when the arms are lifted above shoulder height. However, with postural changes this impingement can occur at lower levels. Consequently, workers such as hula saw operators, who work below shoulder height, can start to develop rotator cuff impingement problems.

**For Example:**

*Shoulder impingement while working at shoulder height.*

*Shoulder impingement while working at mid chest height due to poor posture.*

In combination with appropriate working heights, improving posture can help reduce impingement and reduce the risk of injury.
Employees such as Trades/Maintenance workers, who work with their arms away from their body, can also develop shoulder problems. The shoulder and neck muscles contract to begin raising the arms. With the arms away from the body for long periods, the shoulder and neck muscles gradually fatigue and tissue tolerances decrease. Even small loads can result in large moments and faster fatigue.

If a muscle is constantly working without producing motion (referred to as a static contraction), blood is squeezed out of the muscle. Muscles are like small motors. Motors require oxygen to allow for the combustion of fuel. Without oxygen, motors die out. Without blood, which carries oxygen, muscles temporarily cease to function effectively and cause pain.

For a muscle to work properly it requires blood to be circulated. Dynamic contractions, in which the muscle turns on then off, increase blood circulation allowing the muscle to breathe and stay healthy. By simply changing the type of muscle contraction, muscle fatigue can be relieved.

**Overuse Injury**

Injury also occurs when …
*constant loading reduces tissue tolerance to the point of failure*

Constantly having shoulder muscles turned on can cause a rotator cuff strain. Getting in the habit of varying which muscles are used while working can prevent injuries.
How to Prevent Shoulder Problems

Use the information below as your guide to keep your shoulders healthy.

To avoid injury, decrease work demands and increase worker capacity

**Decrease Demands**
- Reduce torque on the shoulder by reducing extended and overhead reaches.
- Avoid repetitive overhead lifting if possible.
- Train yourself to relax shoulder muscles and to change work from static to dynamic.

**Increase Capacity**
- Exercise to condition rotator cuff muscles and tendons.
- Exercise to improve posture in order to reduce impingement.
- Stretch to help relax rotator cuff muscles.
Exercises to Keep Your Shoulder Healthy

Follow the instructions on this worksheet to reduce the risk of shoulder discomfort. Exercises should be done daily. Purchase light resistance tubing and cut into six-foot lengths.

**External Shoulder Rotations**
With your elbows bent at 90 degrees and thumbs together, pull your hands apart and let the thumbs rotate outwards. As your posture muscles get stronger, finish higher. 
**Do 3 sets 10 times.**

**Internal Shoulder Rotations**
With your elbows bent at 90 degrees and pressed in to your side, pull tubing towards your body. Stay within pain free ranges of motion. As your shoulder strengthens, increase the range. 
**Do 3 sets 10 times with each arm.**

**Shoulder Depression**
Squeeze shoulders together and then down. Make small circles with your hand. Avoid slouching when pressing down. 
**Do 10 circles one way then switch directions. Repeat with opposite arm.**

**Shoulder Stretch**
Gently pull elbow towards opposite shoulder. Stretch to the point of mild tingling and not beyond. When the tingling subsides deepen the stretch. Repeat until full range of motion is achieved.
Body Manual

Industrial Musculoskeletal Injury Reduction Program

Elbow

Consult a healthcare professional before beginning a new exercise program or if you have any questions regarding this manual.

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Tennis Elbow and Golfer’s Elbow

Epicondylitis is a common problem in the sawmill industry. Epicondylitis is inflammation of the tendons that insert into the elbow. This condition produces pain at the elbow. Typically, elbow pain increases with activity and subsides with rest.

Two more common names for this condition are tennis elbow and golfer’s elbow. Sports are not the only cause of these conditions. In fact, most cases are caused by occupational stress rather than sports. Regardless of whether the problem is sports-related or work-related, the condition can be prevented.

Injury Location
ELBOW PROBLEMS

To help understand how people develop epicondylitis, imagine the muscles and tendons in the forearm as being similar to a cable used to lift. Cables have load limits that should not be exceeded. If these load limits are exceeded, the cable will be damaged.

The muscles and tendons in the forearm are similar to a cable in the sense they have load limits. These limits are referred to as tissue tolerances, and if they are exceeded, injuries can result. Most elbow and forearm problems are not the result of a single injury event (e.g., gripping something that is too heavy). Generally these problems develop from either repetitive loading (e.g., flipping boards too frequently), or from constant loading (e.g., gripping controls for too long). Injuries result when repetitive and/or constant loading reduces tissue tolerance to the point of failure.

Exceeding Load Limits

Injury occurs when …
loading exceeds tissue tolerance
How Gripping Affects Tissue Tolerances

Part 1: Weight

Muscles used for gripping are found in the forearm. Tendons connect both ends of the muscle to the bone. The weak link in the muscle-tendon-bone structure is the tendon-bone junction. Usually, the tendon-bone junction at the elbow is the area damaged. This area is damaged by tension generated through the forearm muscles that attach to the bone above the elbow joint.

The heavier the object being gripped, the greater the tension generated by the muscles, and the greater the tension at the tendon-bone junction. Increased tension developed during gripping accelerates tissue fatigue and lowers tissue tolerances. With sufficient rest, the body can quickly repair itself and reset its tissue tolerances. However, without sufficient rest, the tissues gradually break down to the point where even light gripping becomes a problem.
How Gripping Affects Tissue Tolerances

Part 2: Gripping Width

How objects are gripped also determines the amount of tension generated by muscles and transmitted to the tendon-bone junction. The width of an object affects how much muscle tension needs to be generated. There is an optimal grip width at which the forearm muscles work most efficiently. Outside this grip width, the muscles have to work harder to generate the same tension. Consequently, objects that are too large or too small can increase the tension generated by muscles and transmitted to the tendon-bone junction. If the tension is high enough and the rest period is too short, tissue fatigue will occur and the tissue tolerance will decline.

- **Narrow grip**
- **Optimal grip**
- **Wide grip**
How Gripping Affects Tissue Tolerances

Part 3: Wrist Posture and Resistance

Another factor that affects the amount of tension generated by muscles and transmitted to the tendon-bone junction is the posture of the wrist while gripping. There is an optimal wrist position where the forearm muscles are most efficient at generating tension. This position occurs when the wrist is in 30 degrees of wrist extension (see middle picture below). Deviating from this position by bending the wrist forward or backward causes the forearm muscles to work harder just to generate equivalent tension. Consequently, gripping objects with the wrist bent increases the tension generated by muscles and transmitted to the tendon-bone junction. The greater the resistance, the quicker the tissue fatigues, and the greater the risk of injury.

Workers who have to continuously grip controls can develop problems even with light gripping if their wrist posture is not kept in the optimum position.
ELBOW PROBLEMS

Tissue Fatigue from Over-Gripping

The body sends messages from the brain to the muscles to tell them to contract. Feedback from the muscles is sent back to instruct the brain that the message was carried-out. If this feedback is distorted or interfered with, then the brain loses its ability to determine the appropriate level of muscle contraction to carryout the job. Usually the body is fairly energy efficient, and uses only enough muscle activation to complete a task. However, improperly fitting gloves, cold temperatures, and even vibration can distort feedback, resulting in over-gripping. This over-gripping quickly reduces tissue tolerances and increases the risk of developing epicondylitis and other injuries.

Gloves can decrease sensation and cause over-gripping.
ELBOW PROBLEMS

How to Prevent Elbow Problems

Use the information below as your guide to keep your elbows healthy.

To avoid injury, decrease work demands and increase worker capacity

Decrease Demands
- If possible, reduce loading by adopting optimal grip width with the wrist in a good position.
- Use two hands instead of one to handle heavy boards or tools.
- Minimize vibration and cold temperatures and purchase appropriately sized gloves.

Increase Capacity
- Exercise to improve the strength of forearm muscles and tendons.
- Stretch to help relax forearm muscles.

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Exercises to Keep Your Elbow Healthy

Follow the instructions on this worksheet to reduce the risk of elbow discomfort. Exercises should be done daily.

**Wrist Curls**
Slowly curl wrist with palm up until wrist is straight. Don’t grip the weight too tightly, as you will reduce blood flow to the forearm. Just hold the weight tightly enough so that it doesn’t drop and gradually increase your grip as the weight becomes heavier. As strength improves use a heavier weight. Soup cans can be used as weights. **Do 3 sets 10 times on each side.**

**Wrist Extensions**
Slowly curl wrist with palm down until wrist is straight. Remember not to grip the weight too tightly. Progressively increase resistance by using a heavier weight as your condition improves. **Do 3 sets 10 times on each side.**

**Wrist Flexor and Extensor Stretch**
With your arm extended and fingers pointing up, gently pull hand towards your body. Stretch to the point of mild tingling and not beyond. When the tingling subsides deepen the stretch and repeat until full range of motion is achieved. Over-stretching and tissue tearing are common with this problem so be careful. **Repeat with fingers pointing down.**

**Wrist Rotations**
Grab a bottle or a stick and slowly rotate the wrist back and forth. Increase the weight as strength improves. **Do 3 sets 10 times on each side.**
Consult a healthcare professional before beginning a new exercise program or if you have any questions regarding this manual.
**Introduction**

Wrist problems are common among sawmill workers. The type of work found in the sawmill industry places the worker at risk of developing wrist problems, for example tendonitis.

The tendons run through tendon sheaths that act as guides. Tendonitis is caused by friction between the tendon and its sheath, where the tendon and sheath run over a thick band found at the wrist. Over a period of time, this tendon and tendon sheath becomes irritated and painful.

Two things affect tendon friction: wrist angle and gripping force.

*Muscles used for gripping are found in the forearm.*

*These muscles attach at the elbow, run down the forearm and turn into tendons.*

*These tendons pass under a thick band found at the wrist and attach to bones in the hand.*
Wrist Problems

Wrist Angles and Gripping Force

Friction between the tendon, tendon sheath, and the thick wrist band is one cause of wrist problems. The more the wrist bends, the more friction there will be between the tendon and the sheath.

When the wrist is straight, there is little or no friction. However, activities that require extreme wrist postures increase friction significantly. Over time, damage from friction can weaken the tissue to the point of injury.

Tendon friction increases significantly when the wrist is bent.

Another cause of tendon friction is tension produced from gripping.

The heavier the object being gripped, the greater the tension generated by the muscles. Tension in the muscle is passed through to tendons and can increase friction at the wrist.

In combination with extreme wrist postures, repeated or continuous gripping can gradually weaken tendon tissue to the point of injury.
To help understand how people develop wrist problems, imagine the muscles and tendons in the forearm as being similar to a cable used to lift. Cables have load limits that should not be exceeded. If these load limits are exceeded, the cable will be damaged.

The muscles and tendons in the forearm are similar to a cable in the sense that they have load limits. These limits are referred to as tissue tolerances, if they are exceeded, injuries can result. Most workplace wrist problems are not from a single injury event (e.g., gripping something that is too heavy). Generally problems develop from repetitive loading (e.g., flipping boards too frequently) or from constant loading (e.g., holding controls with awkward wrist postures for too long). Injuries result when repetitive and/or constant loading reduces tissue tolerance to the point of failure.

**Injury occurs when … loading exceeds tissue tolerance**
How to Prevent Wrist Problems

Use the information below as your guide to keep your wrists healthy.

To avoid injury, decrease work demands and increase worker capacity.

Decrease Demands
- If possible, reduce tendon friction by gripping with the wrist straight.
- If possible, reduce gripping force by using two hands instead of one to handle heavy boards or tools.

Increase Capacity
- Exercise to improve strength of forearm muscles and tendons.
- Stretch to help relax forearm muscles.
Exercises to Keep Your Wrist Healthy

Follow the instructions on this worksheet to reduce the risk of wrist discomfort. Exercises should be done daily. These exercises are appropriate for people without discomfort. If you have wrist discomfort/injury consult your health care professional.

**Wrist Curls**
Starting with the weight in fingers, slowly close the hand and lift weight. As condition improves use heavier weight. *Note: Soup cans can be used as weights.*
Do 3 sets 10 times on each side.

**Wrist Extensions**
Slowly lift weight until wrist is straight. As condition improves use heavier weight.
Do 3 sets 10 times on each side.

**Wrist Flexor and Extensor Stretch**
With your arm extended and fingers pointing up, gently pull hand towards your body. Stretch to the point of mild tingling and not beyond. When the tingling subsides deepen the stretch and repeat until full range of motion is achieved. Over-stretching and tissue tearing are common with this problem so be careful.
Repeat with fingers pointing down.
Consult a healthcare professional before beginning a new exercise program or if you have any questions regarding this manual.
Are Back Programs Effective?

When will you learn to lift with your legs and not your back?

Back programs have been around for some time. Unfortunately, the success of these programs has been limited. Why are these programs not effective in dealing with back injuries?

Recent research suggests that some concepts that are the foundation for many back programs are incorrect.

This manual will answer questions like *is it important to have strong stomach muscles to prevent back injuries, or for that matter, is it important to have strong back muscles to prevent injuries?* You may be surprised to learn that many of the ideas you were once taught about back exercises may actually be doing more harm than good.
BACK PROBLEMS

Is it the Weight of the Load that Causes Most Back Injuries?

Your body is similar to a lifting machine in the sense that it has load limits. If you exceed these load limits you risk damaging the equipment. These load limits are referred to as tissue tolerances for the body. An injury occurs when a load exceeds tissue tolerances.

- Most injuries to the back are not from a single overload event.
- Only approximately 20% are due to excessive force (e.g., lifting something that is too heavy).
- Most back injuries are from repetitive and/or constant loading that gradually weakens tissues to the point of failure.

Hum, I don't understand. He lifted with a straight back and bent knees.

Most back injuries are caused from repeated or constant loading - not necessarily from the weight of the load.
How Should You Lift?

- Researchers use spines from cadavers and representative animal samples to better understand what the spine’s tolerance levels are, and to better understand how spinal tissue fails.
- Testing has shown that the position of the spine affects its ability to endure loading.

The spine can tolerate more loading when in a 3-curve position.

*Lift with a 3-curve spinal alignment*
Is Having a Flexible Spine Important for Preventing Back Injuries?

Research has shown that increased spine flexibility does not prevent low back injuries. Excessive spinal flexibility allows workers to compromise their back more by adopting weaker positions. *For rehabilitation purposes, it may be important to stretch tight back muscles. It is important that range of motion exercises be done in non-weight bearing positions.*

However, **hip and leg flexibility are very important** in preventing lower back injuries. Flexible hip and leg muscles allow workers to maintain a 3-point curve while lifting.

In the picture, the worker is lowering a board onto a new stack. The muscles in the back of the legs, known as the *hamstrings*, pull on the pelvis causing the back to bend. The lower the stack the more the back bends.

For most people, lifting or lowering anything below the height of the knees can increase the risk of injury.

*Hip and leg flexibility are important to reduce the risk of low back injury.*
Do you Need A Strong Back to Avoid Injury?

Generally, people who are stronger have higher tissue tolerances. But strong workers can get injured just as easily if they have poor work techniques or body mechanics.

- People with back problems often initiate lifting by flexing their backs
- Well coordinated athletes initiate lifting by bending at the hips

Muscle control is important to reduce the risk of low back injury.

Are Abdominal Exercises Effective for Preventing and Managing Low Back Injuries?

Commonly, people with back injuries are prescribed abdominal strengthening exercises. It was thought that strong abdominals helped prevent low back injuries. Recent studies have shown that abdominal muscles provide minimal support for the spine. Another muscle known as quadratus lumborum acts as a primary stabiliser of the spine. Consequently, strengthening and conditioning of the quadratus lumborum will help workers maintain their spine in the 3-curve position.

This exercise challenges the primary stabiliser of the spine (quadratus lumborum) while minimising harmful loading on the spine.

Abdominal exercises alone will not prevent or manage low back injuries.
More and more research suggests that cardiovascular conditioning plays a major role in maintaining a healthy spine. While at work, poor muscular endurance causes workers to rely on passive tissues like ligaments to support the spine instead of using active tissue like muscles. Unlike muscles that can become stronger with activity, ligaments stretch throughout the shift and become weaker.

Muscle endurance is important!
Heavy machinery in sawmills produces vibration. This vibration can be very harmful to the body, especially at certain frequencies. The Tacoma Narrows Bridge collapse helps to explain how small levels of vibration can cause major damage.

**Tacoma Bridge Collapse**

A light steady breeze was able to destroy the bridge structure. The bridge acted like a big spring. Springs oscillate (move back and forth) at specific speeds or frequencies. This speed is referred to as the natural frequency.

When the wind blew at the bridge’s natural frequency, the bridge’s oscillations grew.

The size of these oscillations continued to grow. Eventually, the size of these oscillations was large enough to destroy the heavy structure of the bridge.

Consequently, it is not the size of the wind storm but the speed of the wind storm that caused the bridge to come down.

Vibration found in sawmills can have the same effect on the human body. Even minor levels of vibration can be hazardous to workers if the vibration frequencies match the body’s natural frequencies.
Exercises to Keep Your Back Healthy

General instructions

- Start out slow and gradually increase intensity.
- Exercise should not cause pain that lingers.
- Be patient. Results may take as long as 3 months.
- Be consistent and exercise every day.

Follow the instructions on this worksheet to improve cardiovascular conditioning. Stay within your target heart rate.

Any good back program should incorporate a walking or running component. For treatment purposes, walking is an excellent method for accelerating the healing process. Since the discs found in the back are avascular (have no blood vessels), they have a difficult time receiving nutrients. Similar to a sponge, nutrients are “milked” into the disc during walking from the loading and unloading of the spine.

When starting a walking/running program, begin slowly and maintain a proper intensity.

Start exercising at 70% maximal heart rate for 20-30 minutes. Adjust your speed to keep your heart rate in this target zone (see chart to find your target heart rate).

<table>
<thead>
<tr>
<th>Age (yrs)</th>
<th>Target Heart Rate (bpm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>140</td>
</tr>
<tr>
<td>30</td>
<td>133</td>
</tr>
<tr>
<td>40</td>
<td>126</td>
</tr>
<tr>
<td>50</td>
<td>116</td>
</tr>
<tr>
<td>60</td>
<td>108</td>
</tr>
</tbody>
</table>

Walk 20-30 minutes a day. Stay in your target zone.

How to measure your Heart Rate:

Place two fingers next to your Adam’s apple. Count the number of beats in 15 seconds. Multiply that number by 4 to find your heart rate.
Follow the instructions on this worksheet to check your **posture and muscle control**.

**Posture Check**
– Spinal Alignment

<table>
<thead>
<tr>
<th>Good</th>
<th>Bad</th>
</tr>
</thead>
</table>

Place feet 6 inches away from wall, and press hands, forearms, and back of the head against wall. Keep low back flat against the wall. **Hold for 15 sec. Repeat 5 times.**

**Muscle Control Check** - Erector Spinae Muscle

<table>
<thead>
<tr>
<th>Good</th>
<th>Bad</th>
</tr>
</thead>
</table>

Use a straight bar (e.g., mop), hold it against your back and squat. Keep weight on the heels. **Repeat 10 times.**
# Back Problems

Follow the instructions on this worksheet to improve flexibility and range of motion. Remember to breathe. Do not over-stretch. If any of the stretches produce discomfort stop immediately and move on to another stretch.

<table>
<thead>
<tr>
<th>Hip Extensors – Gluteal (Hip) Stretch</th>
<th>Trunk Twisting - Spine Range of Motion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lying on back with one leg crossed over, pull leg towards chest. (Can be done against wall)</td>
<td>Lying on side, bring knees up to chest. Breath in and as you exhale roll shoulders back.</td>
</tr>
<tr>
<td><strong>Hold 30 sec. Repeat 5 times each side.</strong></td>
<td><strong>Only roll over as far as comfortable. Hold 30 sec. Repeat 5 times each side.</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hip Adductors – Groin Stretch</th>
<th>Squats (Easy) - Hip &amp; Leg Strengthening</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lying on back with knees bent, lower one leg to the ground, then start to lower other leg till you feel a pull in the groin.</td>
<td>With feet shoulder width apart, bend at hips and knees. Keep back straight and keep knees behind toes. To make squats harder, put weights in hands.</td>
</tr>
<tr>
<td><strong>Hold 30 sec. Repeat: 5 times each side.</strong></td>
<td><strong>Repeat 10 times.</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hip Flexors – Quadriceps Stretch</th>
<th>Lunges (Hard) - Hip &amp; Leg Strengthening</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standing on one leg, pull on foot gently. Tighten stomach during stretch.</td>
<td>With hands on waist, step forward and touch knee to the ground. Keep front knee behind toes. To make lunges harder, put weights in hands.</td>
</tr>
<tr>
<td><strong>Hold 30 sec. Repeat 5 times each side.</strong></td>
<td><strong>Repeat 10 times each side.</strong></td>
</tr>
</tbody>
</table>

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## BACK PROBLEMS

Follow the instructions on this worksheet to improve **muscle control and endurance for the spine**. Remember to keep the 3-curve alignment in the back. Each exercise has an easy, medium, and hard level. Start with the easy level and slowly progress.

<table>
<thead>
<tr>
<th>Exercise (Easy)</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Side Lying Leg Lifts</td>
<td>Quadratus Lumborum Strengthening</td>
<td>Raise bent leg 1 foot off the ground. Hold 10 sec. Repeat 10 times each side.</td>
</tr>
<tr>
<td>Irish Setter</td>
<td>Thoracic Strengthening</td>
<td>On all fours, raise arm straight ahead. Avoid arching the neck and lower back. Hold 10 sec. Repeat 10 times each side.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Exercise (Medium)</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Side Lying Leg Lifts</td>
<td>Quadratus Lumborum Strengthening</td>
<td>Raise straight leg 1 foot off the ground. Hold 10 sec. Repeat 10 times each side.</td>
</tr>
<tr>
<td>Irish Setter</td>
<td>Lumbar Strengthening</td>
<td>On all fours, lift bent leg. Use buttock muscles to lift leg. Avoid arching lower back. Hold 10 sec. Repeat 10 times each side.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Exercise (Hard)</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Side Lying Leg Lifts</td>
<td>Quadratus Lumborum Strengthening</td>
<td>Raise both legs off ground. Hold 10 sec. Repeat 10 times each side.</td>
</tr>
<tr>
<td>Irish Setter</td>
<td>Spine Strengthening</td>
<td>On all fours, lift opposite leg and arm. Avoid arching neck and back. Hold 10 sec. Repeat 10 times each side.</td>
</tr>
</tbody>
</table>
Knee

Consult a healthcare professional before beginning a new exercise program or if you have any questions regarding this manual.
**How Knees Wear Out**

Mention knee injury and one typically thinks of a skier “blowing out” their knee or a football player collapsing from a “chop block”. This type of injury is an acute injury where a single event causes the damage. There is, however, another type of injury that is perhaps more common in industry. This type of injury is a chronic injury in which an accumulation of stress causes tissue to wear out.

Studies have shown that patellofemoral syndrome accounts for up to 50% of these overuse injuries. Patellofemoral syndrome is caused by irritation of the contact surface between the patella (knee cap) and the femur (thigh bone). Over a period of time, the contact surface can wear and become rough, increasing knee pain.

Two things can affect the amount of stress between the knee cap and thigh bone: knee angle and muscle imbalance. The more the knee bends, the more stress there will be between the knee cap and thigh bone. When the leg is straight, there is little or no contact stress. However, activities that require deep knee bends place a significant amount of stress on the knee and can lead to premature wear. This wear can then lead to a second cause of increased stress, muscle imbalance.

*Contact stress increases significantly when the knee is bent past 90 degrees or when kneeling on hard surfaces.*
Muscle Imbalance

Trades like Millwrights and Welders that require kneeling for prolonged periods expose their knees to a lot of “wear and tear”. This wear and tear can produce inflammation around the knee cap which can lead to a condition known as bursitis. Also, wear and tear may produce inflammation inside the knee which can change the mechanics of movement.

Even minor knee inflammation causes the inner quadriceps muscle (vastus medialis oblique) to shut off. To compensate, the outer quadriceps muscle has to work harder. Over time, the outer muscle gets overdeveloped and the inner muscle wastes away. Because of this muscle imbalance around the knee, the patella tracks more to the outside. This increases the contact stress between the knee cap and the thigh bone, and can lead to premature erosion.

Muscle Balance

Muscle Imbalance

The vicious cycle of patellofemoral syndrome

Damage to the knee results in changes in knee mechanics, which in turn increases contact stress. Increased contact stress results in more damage. Consequently, if problems go unchecked, permanent damage can occur.

Patella Tracking

Healthy patella that fits symmetrically in the femoral groove.

Femur and patella with premature wear.

“‘The key with preventing these injuries is to develop muscle balance around the knee to ensure that the knee cap tracks properly.’”
The dilemma with preventing knee problems is that you need to develop muscle balance to help the knee cap track properly. However, if you overdo it or move improperly you can damage the knee. Consequently, it is important to know how much stress your knee can handle. There is a very fine line between preventing and causing a knee problem. In order to establish baselines for exercise you need to understand the concept of tissue tolerances.

Your body is similar to a machine in the sense that it has load limits. If you exceed these limits known as tissue tolerances, you can damage the structure being loaded and create an injury. However, unlike a machine, your body can adapt to stress and become stronger. This is the basic foundation for strength conditioning and rehabilitation programs.

By controlling the stress and gradually increasing activities, tissue can become stronger. However, you have to be careful not to reverse the process by overdoing it.
How to Prevent Knee Problems

Use the information below as your guide to keep your knees healthy.

To avoid injury, decrease work demands and increase worker capacity.

**Decrease Demands**
- Reduce harmful deep knee bends (keep knee angle at 90 degrees or less).
- Avoid kneeling on hard surfaces. Use kneepads or foam insert coveralls.
- Avoid playing stressful sports like basketball, volleyball, squash, and downhill skiing if you have knee pain.

**Increase Capacity**
- Exercise to improve knee cap tracking.
- Consult your doctor about the use of knee supports and orthotics to help the knee cap track properly.
Exercises to Keep Your Knees Healthy

Follow the instructions on this worksheet to **reduce the risk of knee discomfort.** Exercises should be done daily.

**Leg Extensions**
Place a soft ball or a rolled up towel between knees. Turn toes out slightly and gently squeeze knees together as you straighten legs. **Repeat 10 times.**

**Step Downs**
Slowly step down keeping weight on the back foot. Keep knee cap over 2nd toe and try to minimize wobbling. Choose a small step and progress in height as knee strengthens. **Repeat 10 times on each side.**

**Hip Abductor Stretch**
Cross one leg in front of the other and lean to the side. Gently stretch the outside muscles of the leg. Use a wall if needed to help your balance. **Hold for 15 seconds. Repeat 5 times on each side.**

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Consult a healthcare professional before beginning a new exercise program or if you have any questions regarding this manual.
Feet may be the most abused part of the body. Day in and day out the feet are subjected to stresses. If these stresses are too long or rest too short, debilitating foot problems can occur.

Most foot problems in industry are not due to a single injury event like jumping from a height. Generally, foot problems develop from repetitive loading (e.g., walking too much) or constant loads (e.g., standing too long) without time to recover. Just like a new shoe, your foot can gradually wear out.
Foot Problems

Faulty Feet

Good - Proper Alignment

Bad – Pronation

Poor foot alignment accelerates tissue fatigue. With good alignment, bones support the load transferred through the foot. With bad alignment, soft tissues like ligaments and tendons support loads. When soft tissue is loaded, it stretches and deforms. If soft tissue is stretched excessively it becomes permanently deformed and loses its ability to creep back to its original shape.

Due to an inability of soft tissue to withstand excessive or constant strain, people with pronation problems are at a higher risk of developing a foot injury. The poorer the alignment of the foot, the greater the risk of injury.
What is Plantar Fasciitis?

Plantar fasciitis is one of the more common foot problems found in industry. Typically, plantar fasciitis begins with a dull occasional pain in the heel and can progress to a sharp constant pain. The pain is worse in the morning or at the beginning of a shift.

The fascia is a tough fibrous band found on the bottom of the foot. It starts at the base of the heel and travels down the foot out towards the toes. Plantar fasciitis occurs when the fascia and the underlying musculature are strained or torn. Along with the damage comes inflammation. Heel spurs can develop where the underlying muscles attach at the heel. Because it is difficult to rest the foot, damaged tissue has difficulty healing properly. With every step, the fascia can be further damaged causing the problem to progress quickly.

**Good Alignment**

With good alignment, stress to the foot is distributed evenly.

**Poor Alignment**

With poor alignment, there is more stress to the inside. More stress results in the fascia stretching and causes the foot’s natural arch to drop.
FOOT PROBLEMS

How to Prevent Foot Problems

Use the information below as your guide to keep your feet healthy.

To avoid injury, decrease work demands and increase worker capacity.

Decrease Demands

- Reduce prolonged standing by using sit/stand stools.
- Remove/reduce harmful vibrations.
- Place anti-fatigue mats down on hard surfaces where workers stand all day.

Increase Capacity

- Purchase shoes that provide good support.
- Replace shoes when they wear out.
- Exercise to increase tissue tolerances.
FOOT PROBLEMS

The Right Shoes

Purchasing the right shoe that provides adequate support is an important first step in avoiding foot problems. A good shoe will help maintain proper foot alignment and reduce excessive wear and tear.

A good shoe will provide ...

**Good Arch Support**

People with narrow feet may need custom fitted shoes or else risk swimming around in their shoes.

**Good Heel Support**

A strong heel counter helps keep your foot aligned. When a shoe wears out, pronation problems can be noticed.

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Buy durable shoes with a lot of support. Avoid buying light-weight work boots. Typically, the lighter the shoe, the less support it offers. Replace shoes on a regular basis.

**Invest in good shoes and allow your shoe to wear out, not your feet.**

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Exercises to Keep Your Feet Healthy

Follow the instructions on this worksheet to reduce the risk of foot discomfort. Exercises should be done daily.

**Toe Curls**
Place a towel down on a slippery surface and pull the towel in with the toes. To make it harder, place a weight on the end of the towel.
*(Repeat 10 times on each side)*

**Toe Grabs**
Place feet together. Rotate knees outwards while using muscles in the feet to grab the ground.
*(Hold for 10 secs. Repeat 10 times)*

**Ball Rolling**
Roll a ball back and forth under the foot. Use gentle pressure.
*(Continue for 2 minutes)*

**Heel Cord Stretch**
With your back leg straight, press your heel into the ground.
*(Hold 30 secs. Repeat 5 times on each side)*
Repeat stretch with back leg bent.