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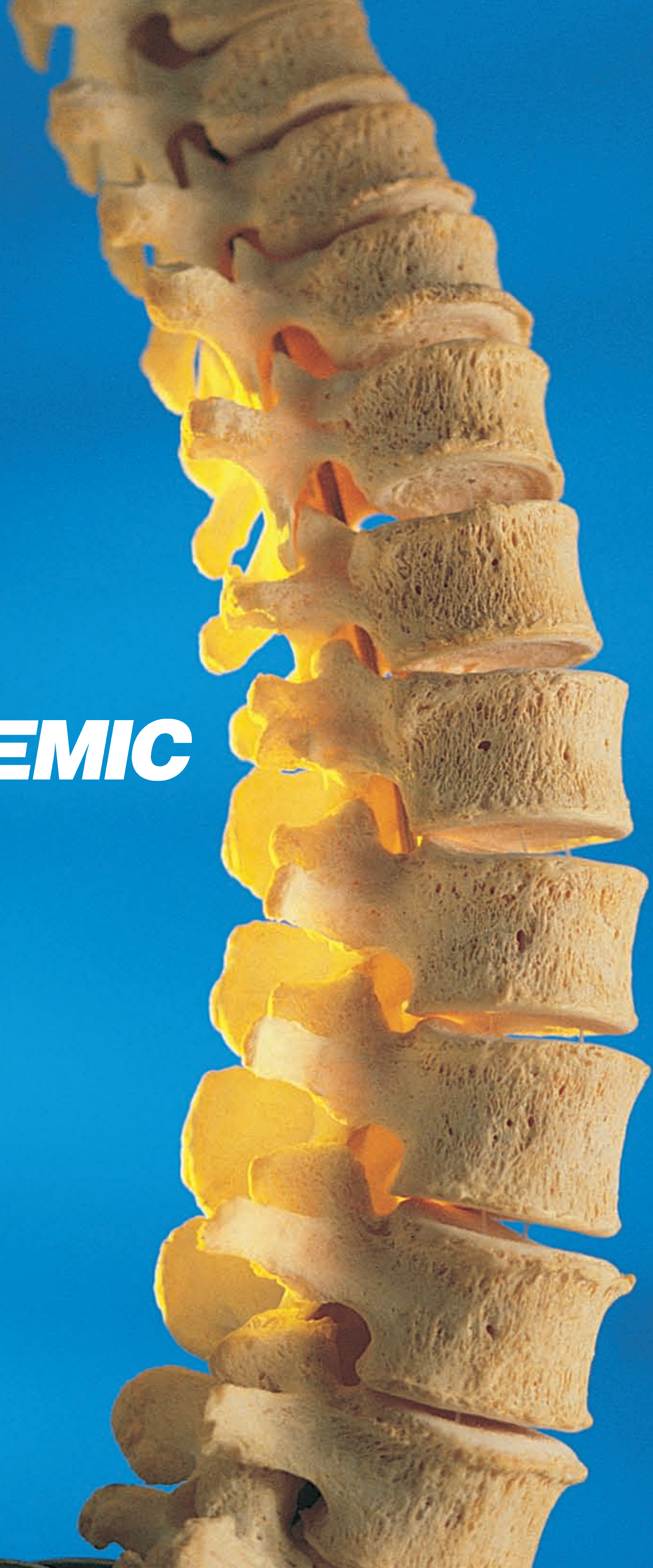


BACK INJURY PREVENTION

Back Injury Prevention

MEMIC

Contents

Approximately one-third of the workforce in the United States is required to exert nearly maximum strength in the performance of their daily jobs. Gross manual activities, even if performed intermittently during the workday, are still a part of the job for a large number of people, which places them at risk of incurring low back pain or injury. According to U.S. Bureau of Labor statistics, more than one million workers suffer back injuries each year, accounting for one out of every five workplace injuries or illnesses.

The numbers for MEMIC policyholders reflect similar findings—an analysis of the most recently available data on workplace injuries/claims shows that 20% of all claims are related to the back.

This 20% of back-related injuries/claims accounts, in turn, for 33% of all claims dollars spent by MEMIC and its policyholders. MEMIC has spent more than seventy million dollars on back injury claims alone, never mind taking into account the suffering undergone by the employees who sustain these injuries and by their family members. Studies show that 68% of all low back pain is related to manual material handling, which includes the lifting, lowering, carrying, or pushing and pulling of objects. Understanding the basic anatomy of the back, becoming familiar with the factors involved in manual material handling, and learning the proper techniques of manual material handling are steps on the way to maintaining a healthy back.

Introduction

This booklet discusses back injuries and highlights the steps you and your company can take to reduce the risk of developing one of these debilitating injuries.

Most people associate back injuries with one single incident, such as a slip/trip/fall or lifting a heavy object. In reality a large majority of back injuries are caused by the accumulation of risk factors performed over an extended period of time.

Some of the risk factors that lead to back injuries include:

- ✔ Poor posture
- ✔ Excessive body weight
- ✔ Improper body mechanics
- ✔ Excessive lifting
- ✔ Repetitive bending

There are preventive measures you can take to reduce the chances of sustaining a back injury. The first step is an understanding of how your back works and how an injury can occur.

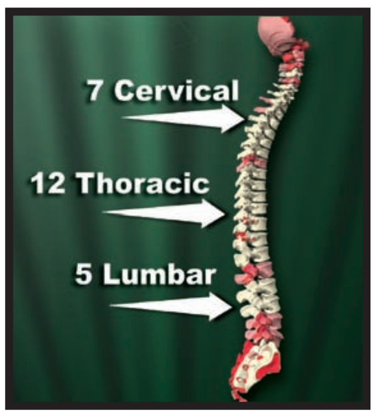
The Spine

The spine, or backbone, forms the major part of the skeleton and is one of its primary support structures.

Functions
The spine has three main functions:

- ✔ Flexibility and stability
- ✔ Spinal cord protection
- ✔ Shock absorption

Flexibility and Stability. The spine is composed of 24 movable bones called vertebrae. These vertebrae overlap each other to allow flexible movement of the back. Bones form a system of levers which have to sustain the weight of our body, and they provide a mechanism for force exertion.

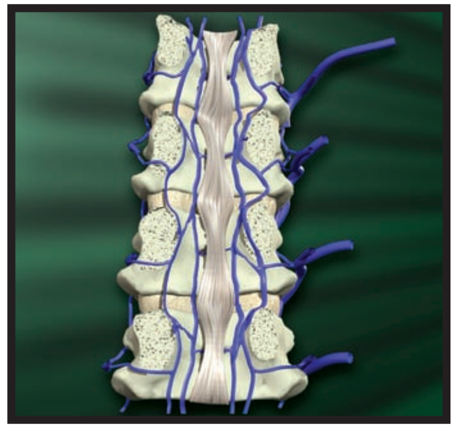


There are three continuous curves in the spine:

1) an inward curve in the cervical (neck) region,
2) an outward curve in the thoracic (upper back) region, and
3) a second inward curve in the lumbar (lower back) region.

This is what we refer to as the neutral posture of the spine.

It is this natural inward curve of the lower back that must be maintained during lifting, pulling, pushing, sitting, and walking.



Strong inelastic ligaments connect each vertebra, providing stability to the spine. Ligaments are strong ropelike fibers that connect one bone to another to form a joint. Their function is to bind the bones together and limit the range of joint motion. When a joint is twisted past its normal range, some fibers may be torn or ripped loose from a bone. This is referred to as a sprain. Ligaments that are injured generally take weeks or even months to heal because of their poor blood supply.

Spinal Cord Protection. The second function of the spine is to protect the spinal cord. The spinal cord is a cylindrical, elongated bundle of nerves that is contained within the vertebral canal. There are 31 pairs of spinal nerves, each made up of thousands of nerve fibers that carry electrical current via microvolts from the brain to various structures within the body. The spinal cord is a delicate and intricate system that receives bony protection from the vertebra within the spine.

Shock Absorption. The third function of the spine is to absorb shock. Whole body shock is created whenever we walk, run, or perform strenuous physical activity. The primary shock absorbers are the three natural curves of the spine, although the discs that separate each vertebral body act as cushions.

Spinal Discs

Between each vertebral body lies a disc that acts as a cushion for the spine. Spinal discs are made up of cartilage-like material running in bands, which are crisscrossed and firmly attached to the bones. These bands encompass a core or nucleus. The nucleus is composed of a gelatin-type substance which is free-floating and is the actual shock absorber of the disc. The front wall of the disc (toward the abdomen) is thick, offering a good deal of protection for the nucleus. However, the back wall of the disc (toward the buttocks) is thin. Also running outside the back wall of the discs are the spinal nerves, which branch off the spinal cord. These nerves are in very close proximity to the thinner back wall of the disc. When we bend from the waist, the front heads of the vertebral bodies put pressure on the front wall of the disc, forcing the nucleus toward the thinner back wall. Discs themselves do not slip from between the bone, but can become damaged when there is excessive wear and tear placed on them.

It is common for us not to think about how much stress we place on our back during everyday activities. In fact, most of us only consider the external forces involved in lifting an object and don't take into consideration the weight of our own body. In fact, quite often the forces required to lift and support our body's weight far exceed any external forces exerted. (For an example, see the discussions about bending under "Muscles" on page 12.)

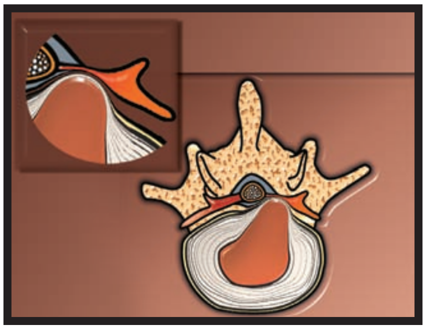
Most back injuries sustained are sprains and strains occurring to the muscles and connective tissue of the back. Studies show that the majority of these injuries heal in 6 to 12 weeks. However, the most severe back injuries are disc-related.

Disc Injuries

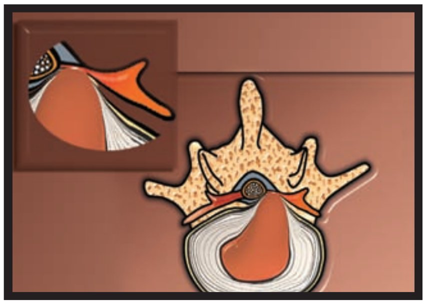
There are three common grades of disc injuries:

- ✔ Bulging disc
- ✔ Herniated disc
- ✔ Ruptured disc

Bulging Disc. A bulge in a disc occurs when there is a mild or slight bulge within the disc wall. Studies have indicated that 40 percent of Americans have a disc bulge, yet do not have symptoms because the bulge is not compressing a nerve which can cause pain or numbness in the back or legs.

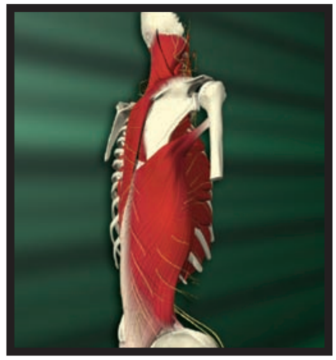


Herniated Disc. A disc bulge that is large enough to come in contact with spinal nerves as they branch off the spinal cord is called a herniation. Herniations are caused by repeated lifts with a rounded back and by twisting during a lift. This places a great deal of pressure on the nucleus, or jelly-like center, of each disc.



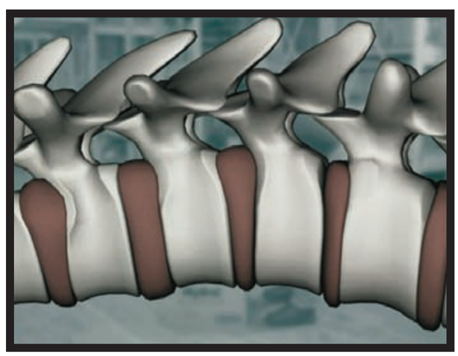
Ruptured Disc. If the pressure becomes so intense that it causes the disc material to break through the disc wall, it is called a rupture. A disc rupture is usually quite serious, as it places a great deal of pressure on the spinal nerve roots and could possibly result in permanent damage to those nerves if steps are not taken to remove this pressure. Disc ruptures in the lower back can cause continuous pain and numbness in the buttocks, groin, and legs, and generally require surgery. If the disc rupture occurs in the cervical spine or neck, the symptoms will be experienced in the arms or hands.

Muscles



Muscles support the back and are responsible for doing most of the work we perform. The small deep muscles of the back allow the torso to twist or rotate, while the outer longer muscles allow the back to bend forward, backward, and from side to side. Proper care of these postural muscles is the key to a healthy back. If you are overweight and your abdominal muscles are weak, additional stress is placed on your back. Muscles are composed of thousands of tiny fibers that run in the same direction. Muscles are red because they are filled with many blood vessels that supply oxygen and nutrients and carry away carbon dioxide as well as other waste metabolic materials. Basically muscles do two things. They contract and relax. When you contract a muscle it tightens and shortens. Oftentimes when one muscle contracts, another opposing muscle relaxes. Muscles generate energy and forces responsible for handling internal and external loads. Blood flow is critical to the effective use of muscles. When a muscle is static (held in steady state of contraction), blood flow required for fuel is severely restricted. thereby increasing fatigue and risk of injury.

Another good reason to maintain good posture is to protect the discs while lifting. Lifting with the legs, raising the chest, and tilting the pelvis while lifting evenly distribute the forces within the disc, thereby reducing stress placed on the back.



When lifting improperly by bending at the waist, as mentioned earlier, the heads of the vertebral bodies force the nucleus of the disc toward the thinner back wall. This action weakens the disc and increases the risk of injury.

Most of us heard of someone injuring their back while bending over to pick up a piece of paper or a pen. Bending over incorrectly to pick up a light object puts nearly twice as much strain on your back as lifting a 40-pound object using the proper technique.

To understand this better, let's look at how the muscles in our back function when we are bending forward from the waist. Muscles are strongest when they begin to contract. When you bend forward from the waist, your back muscles are stretched out, which means that more force needs to be exerted not only to pick up the object you are lifting but also to lift your own body weight. In fact the heaviest thing most of us lift on a daily basis is our own body weight. Our torso makes up 60% to 65% of our body weight. For example a 170-pound person bending over from the waist 10 times a day can place up to an additional 11,700 pounds of force on the back. Remember, when you bend from the waist to pick up any object, the muscles and connective tissue in the back must work to support torso weight as well as exert the force required to pick up the external object.

The cumulative repetitive stress we place on the muscles and ligaments of our back leads to a high number of sprain and strain injuries.

When proper lifting techniques are employed, the force exertion required to lift the torso is minimized because the torso is in line with the hips. In this scenario, the large powerful leg muscles lift the weight of the torso, rather then the muscles and connective tissue of the back performing this function. When using the proper technique, the forces generated to lift the torso are minimized and the effort required to lift the object is optimized.

Lifting

NIOSH Lifting Equation

The National Institute of Occupational Safety and Health (NIOSH) has developed a formula (the revised NIOSH Lifting Equation) to calculate how much weight a person can lift in a given situation. The NIOSH Lifting Equation (Waters et al., 1993) provides an empirical method for computing the recommended weight limit for manual lifting tasks. The revised equation provides methods for evaluating asymmetrical lifting tasks and less-than-optimal hand-to-object coupling. The equation allows for the evaluation of a greater range of work durations and lifting frequencies. The equation also accommodates the analysis of multiple lifting tasks. The Lifting Index—the ratio of load lifted to the recommended weight limit—provides a simple means for comparing different lifting tasks.

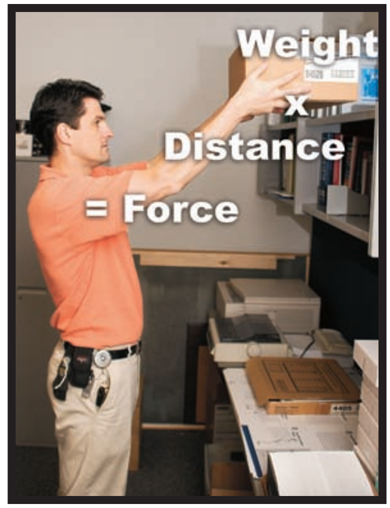
			Object Weight (lbs)		Hand Location (in.)				Asymmetry (degrees)		Period (hours)	Freq (l/min)	Handle
					Origin		Destination						
Task No.	RWL	LI	L(avg)	L(max)	H	V	H	V	Orig	Dest	P	F	C
1	12.5	1.0	12	12	18	68	28	20	0	0	1	2.4	FAIR
2	23.8	0.5	12	12	12	4	16	20	0	0	1	2.4	FAIR
3	21.2	0.6	12	12	16	52	16	20	0	0	1	2.4	FAIR
4	21.2	0.6	12	12	16	52	16	20	0	0	1	2.4	FAIR
5	21.2	0.6	12	12	16	52	16	20	0	0	1	2.4	FAIR
6	23.8	0.5	12	12	16	36	16	20	0	0	1	2.4	FAIR
7	23.8	0.5	12	12	16	36	16	20	0	0	1	2.4	FAIR
8	23.8	0.5	12	12	18	20	20	22	0	0	8	0.1	FAIR
9	25.5	0.5	12	12	16	20	16	20	0	0	1	2.4	FAIR
10	25.5	0.5	12	12	16	20	16	20	0	0	1	2.4	FAIR

According to the equation, it is safe for 99% of the male population and 75% of the female population to safely lift 51 pounds if all of the factors below are adhered to:

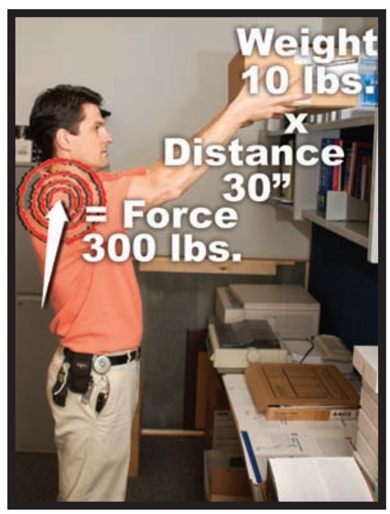
- ✔ The object is only 10 inches away from the body at the start of the lift.
- ✔ The object is 30 inches off the floor.
- ✔ The object does not have to be lifted or lowered more than 10 inches.
- ✔ No twisting occurs during the lift.
- ✔ There are good handholds for the lift.
- ✔ The lift is performed no more than 12 times in one hour over an eight-hour day.

Now let's look at all of these factors in greater detail.

Distance of Load from Body. The first factor is distance of the load from the body at the start of the lift. Additional force is required the farther an object is away from the body during a lift—weight times distance equals force.



In order to lift any mass, gravity must first be overcome. Gravity is a strong downward force (-9.8M/S squared) that we are constantly subjected to but rarely consider. If you perform a lift with your arms outstretched in front of the torso, you are not only lifting the weight of the external load (the object), you are also lifting the weight of the body part (arm weight = 10 pounds) as well as overcoming the downward force of gravity.

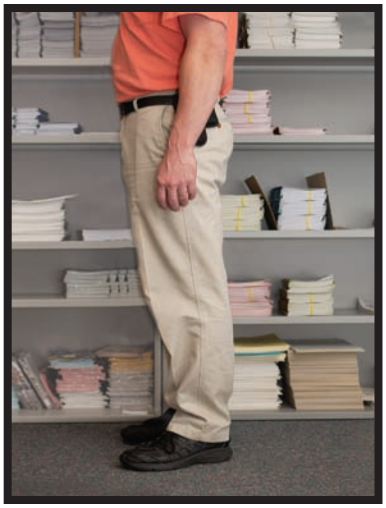


Biomechanical analysis reveals that lifting a 10-pound object at full arm extension can require upwards of 300 pounds of force.

Our bodies and limbs are levers. When we lift an object with our arms extended, the amount of force exerted by our muscles at the fulcrum must be greater than the weight multiplied by the distance from the fulcrum to the load in order to keep the object stationary. In order to lift the object, the force generated needs to be more than the other factors combined. To reduce the negative effects of lifting, get the object as close to the body as possible before lifting. This can be done by changing the grip point, by sliding the object before lifting it, by walking to the item instead of reaching, or by tilting the item toward you. Look for ways to reduce the negative effect of lifting away from the body.

Next let's consider the height of the hands at the start of the lift.

Height of Hands. The ideal height of the hands at the start of a lift is 30 inches. General ergonomic principles recommend that all lifts start at or slightly higher than standing-knuckle height, which will reduce a forward trunk posture at the initial point of the lift.



If the lift started at 12 inches, most likely it is a forward bend that would be performed. When lifting with a bent back, not only must the back lift the weight of the object but also the weight of the torso, which is generally calculated at 60 to 65% of the person's body weight.

A biomechanical analysis reveals that a 170-pound person lifting a 20-pound weight 30 inches from the torso with a forward back posture generates over 1100 pounds of compressive force in the lower back. Compressive forces on the lower back should not exceed 770 pounds, as identified in the NIOSH Lifting Equation. Therefore, lifting a 20-pound object 30 inches from the torso places employees at a significant risk of developing a low back injury.

Look for ways to get objects that require a manual lift up off the floor. Keep in mind that the ideal lifting height of the hands at the start of the lift is 30 inches.

Oftentimes initial lifting height can be improved by using empty pallets, by working directly off of forklifts, queue tables, or carts, etc. A good ergonomic principle to employ is: once an object is at a good working height, keep it at that height. Don't lift an object to a bench, work on it, and then place it back on the floor for the next person to lift onto a bench. Not only does this practice significantly increase the risk of injury, but it also is inefficient. Another general principle in ergonomics is: eliminate unnecessary effort. Bending over to pick something off the floor is unnecessary effort.

Distances to Be Lifted (or Lowered). Now let's consider the distance the object is actually lifted or lowered. The further the vertical distance, the greater the force. When lifting objects above shoulder height, stress is placed on the shoulders and upper back. The shoulder is a complex joint that is unstable when exposed to high forces due to the varied range of motion it is capable of assuming. Working with the arms outstretched over the shoulder increases the force required to perform a task as well as pinching nerves, tendons and blood vessels that run through the shoulder joint down to the arms and hands.

When lowering objects below mid-thigh level, you most probably are bending from the waist. Identify methods you can take to decrease the overall travel distance of the load.

The Twisting Factor. The next multiplier used in the NIOSH Lifting Equation is twisting. When twisting is performed during a lift torsion, compressive forces are placed on the disc. This action dramatically increases risk of injury. Some of the most severe back injuries have occurred from bending and twisting simultaneously during a lift because of the high internal disc forces generated.

It is generally recommended that we pivot instead of twisting when performing lifting tasks. However, human nature needs to be taken into consideration. Most of us will exert no more effort than necessary to perform a work task, especially if the job is performed on a frequent basis. We need to realize that it takes less effort to twist than to pivot. Therefore, do not expect employees to pivot instead of twisting to perform a poorly designed job task. You are fighting Mother Nature and will more than likely fail. Instead, design the task so as to eliminate the twist, either by reorienting the objects closer or by increasing the distance between lift and release points, which requires workers to take one or two steps.

Coupling. The next muliplier used in the NIOSH Lifting Equation is coupling. How you grasp the item to lift it is also a key factor. For example, if an object is lifted using a pinch-type grasp, it will take up to 6 times more hand force to perform. Also, wearing heavy work gloves increases force requirements, as that makes us lose up to 40% of our overall grip strength. Whenever possible, use a good power-type grasp. When picking up an item, keep the wrist in a good neutral posture. This will dramatically reduce the amount of force required to make the lift.

Frequency. The last multiplier used in the NIOSH Lifting Equation is frequency, which takes into consideration not only the lifts per minute but also the overall length, or duration, of a lifting task. Frequent lifts require higher energy demands and thereby increase fatigue. Risk of overexertion injuries are high in jobs that require frequent lifting over an extended period of time. Frequent lifting tasks may also tempt workers to take shortcuts.

Elimination of Unnecessary Lifts

In many companies the number of times an object is lifted is higher than would be necessary if good product flow guidelines were followed. Every time an object is lifted, the risk of injury is increased. Analyze each lift performed throughout a process and ask: Does this lift need to be performed? Does it need to be performed here? If so, why? By whom? Frame your questions in terms of each specific activity and the factors involved in performing it and of the potential hazards incident to its performance. Then determine what action you can take to control the perceived risks.

Below is a standard product flow diagram that can assist you in looking at and analyzing each lifting task. The goal is to eliminate unnecessary lifts, which will significantly reduce risk of injury as well as increase overall efficiency.

	ANALYSIS of MAT. HANDLING															
	ACTIVITY					FACTS				HAZARDS						
METHOD ▯ present or ▯ proposed	OPERATION	TRANSPORT	INSPECTION	DELAY	STORAGE	DISTANCE M	TIME MIN.	SIZE MxMxM	FREQ. per shift	FALLING MAT.	SHARP EDGES	PINCH POINTS	BENT BACK	HAZARD RATING Hi Med Low No	COMMENTS	CONTROL ACTION Elimnate Combine Redesign Simplify Pers. Protect
1	○	⇨	□	D	▽											
2	○	⇨	□	D	▽											
3	○	⇨	□	D	▽											
4	○	⇨	□	D	▽											
5	○	⇨	□	D	▽											
6	○	⇨	□	D	▽											
7	○	⇨	□	D	▽											
8	○	⇨	□	D	▽											
9	○	⇨	□	D	▽											
10	○	⇨	□	D	▽											

Lifting Techniques

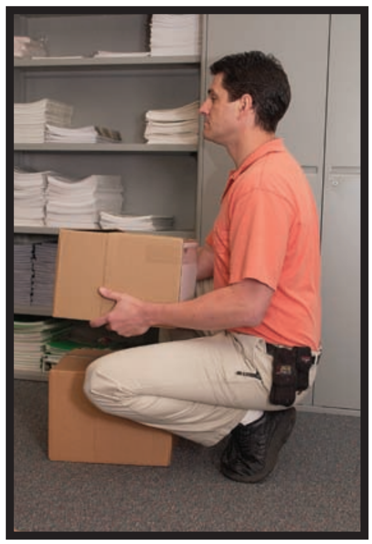
Check the load you are going to be lifting for weight by rocking it back and forth. Is it too heavy for a one person lift? If so, get help.

Ask yourself: Can the lift be performed mechanically?

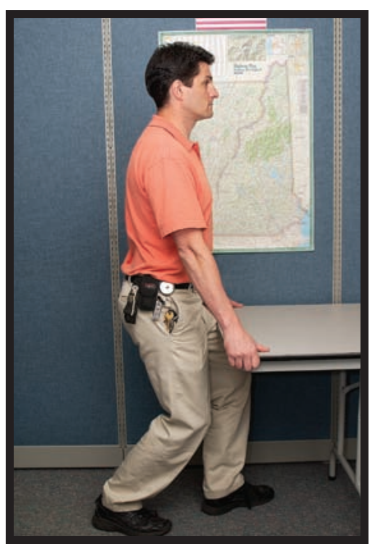
Always think before you lift. Visualize the lift in your mind. Figure out where you are going to grab the object. Identify where you are lifting it to. Think about the posture you are going to use and asking for assistance if you need help.

Here are five good lifts you can use.

Diagonal Lift. Squat with weight in front, and keep looking forward with feet spread apart and one foot ahead of the other. Lead with your head and neck, and keep the back upright throughout the lift. Keep weight close to the body. If you have to turn, move your feet. Never twist when lifting a load.



Power Lift. Use this technique when lifting heavy objects. Perform a partial squat with weight in front. Keep looking forward with feet positioned one foot in front or parallel to each other. Keep back straight and level with the head and neck.



Three-Point Lift. This technique is good for lifting bags of product or heavier items. With one leg kneeling, lift the item and place it on your stationary leg. Hug item to the body and stand up, keeping the back straight and leading with your head and neck.

Golfer's Lift. This lift should only be used for picking up light objects. With one leg stretched out behind the torso, support upper body on top of box or other container and retrieve the item.

Partial-Squat Lift. This is best for lifting with one hand and is often used with suitcases, buckets etc. With this lift, keep the torso in an upright position. Squat and lift the item using the strong leg muscles. Instead of carrying one extremely heavy load, try to decrease the weight and make additional trips. This will take a little extra time, but the load on your back will be decreased.

Pushing and Pulling

Another aspect of manual material handling is pushing and pulling. It is generally better to push an object than to pull it, because pushing allows you to also incorporate your body weight. When pushing an object, the location of your hands is critical to reduce the force required. If your hands are too high, or too low, the ability to generate required forces is hindered. Remember, put yourself at a biomechanical advantage.

When pulling an object, take short steady steps as you walk backwards. And don't put yourself at risk of slipping by bending your body away from the load!

When pulling an object, it is natural to twist the torso in order to see where you are walking. This places torsion forces on the disc increasing the risk of injury.

Slips, Trips, and Falls

Slip, trip and fall injuries are usually the result of poor housekeeping. Make sure a good traction surface exists for walking. When walking on a slippery surface or uneven ground, we generally tense our bodies up. This reduces the natural shock absorption of our bodies and can lead to a more severe injury should we fall. This stress is significantly amplified if working off the ground.

Inspect the pathways you will be traveling before performing a lift and/or carry action. Make sure the pathway is free of obstacles and slip hazards. Also make sure any doors you will be going through are open.

Remembering the risk factors discussed earlier that also contribute to back injuries, let's look at the importance of exercise in maintaining a healthy back. A regimen of exercise is extremely important for all of us, but especially so for those who perform difficult physical tasks throughout the work shift.

It only makes sense to adopt a lifestyle that promotes health and exercise. Consider the key role that excessive body weight plays in the health of the back—for every 10 pounds we are overweight, an extra 100 pounds of additional force is placed on out backs.

Even though our bodies do get used to the strenuous job tasks we perform, it is still necessary to challenge our bodies with a regular routine of walking, jogging, running, biking, aerobics, or some other form of physical activity.

It also makes sense to start a daily stretching program in the workplace. Stretching plays a key role in maintaining a healthy back. Exercises stretch what is tight and strengthen what is weak. Forty percent of all strain and sprain injuries occur during the first hour of the shift, when the muscles are cold and inelastic. Because it is so important to warm up your muscles before the start of the work shift, a daily stretching program for employees is highly recommended.

Remember, we tend to use the least amount of energy possible to perform frequent work tasks. Although a poor lifting technique requires less energy, it significantly increases the compressive forces on the back. The most successful method that companies can use to reduce and/or eliminate back injuries is to engineer the risk out. Training in proper lifting techniques alone will not compensate for poor job design. Companies that rely solely on training to reduce or eliminate back injuries will have limited success, at best.

Preventing back injuries is a twofold responsibility involving both the employee and the employer. Employees can reduce risk by taking care of their backs (posture, exercise, and diet). Companies can reduce risk by using engineering controls, by implementing stretching programs, and by providing training in proper manual material handling techniques. Use the ideas presented in this booklet to help you protect your back. Remember it’s the only one you will ever have.

Notes

Notes

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