SPINAL CORD MEDICINE

CONSUMER GUIDE: UPPER LIMB FUNCTION

Preservation of Upper Limb Function: What You Should Know

A Guide for People with Spinal Cord Injury

consortium for SPINAL CORD MEDICINE
CLINICAL PRACTICE GUIDELINES
Administrative and financial support provided by Paralyzed Veterans of America

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This guide has been prepared based on scientific and professional information found in *Preservation of Upper Limb Function Following Spinal Cord Injury: A Clinical Practice Guideline for Health-Care Professionals* published in 2005. Users of this guide should periodically review this material to ensure that the advice herein is consistent with current reasonable clinical practice.

Preservation of Upper Limb Function: What You Should Know

A Guide for People with Spinal Cord Injury

Consortium for Spinal Cord Medicine
and Paralyzed Veterans of America

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Introduction

Wheelchair users work continually with their hands, fingers, wrists, elbows, arms, and shoulders. Each and every day they have to push a wheelchair, reach for and lift things, transfer themselves from one place to another, and relieve pressure on their skin and buttocks. Thinking about what they do and how they do it can help lessen the amount of strain on the upper limbs.

The risk of painful and disabling injuries is great—one half of all wheelchair users will at some time experience severe pain in the hands, wrists, elbows, or shoulders. This guide, one of a series of consumer guides produced by the Consortium for Spinal Cord Medicine, will help you understand your risks for pain and injury and tell you how people with spinal cord injuries and others who use wheelchairs can protect their arms.

You will find information on how to select and set up equipment that will meet your needs as well as tips on how to arrange your environment so that your day-to-day activities put less stress on your arms. A section on fitness describes both stretching and strengthening exercises that will keep your arms and shoulders strong and healthy.

Forming good habits that minimize the risk for injury is the key to protecting and preserving mobility and function. This guide can help you do that. Keep it handy for reference or occasional review.

Important: As you read this consumer guide, please keep in mind that all recommendations, exercises, transfer procedures, and other suggestions regarding positioning and wheelchair use should be discussed with your personal doctor and your health-care team **before** trying anything new or different. Do not try any of the exercises described in this guide without professional assistance. Please keep your health-care team well informed of anything you find in this document that you would like to try or about which you have questions.

Areas at Risk

Individuals using wheelchairs face increased vulnerability to hand, finger, wrist, elbow, and shoulder injuries. You should be alert for pain or symptoms that indicate stress injury to your arms.

Hands and Fingers — Hands and fingers are vulnerable structures for wheelchair users, especially individuals who propel a manual wheelchair. They can frequently get pinched or cut up while propelling through narrow areas, applying brakes, and maneuvering the chair (for example, loading your chair in and out of your car is a particularly dangerous time for the hands and fingers). In addition, the skin on the hands and fingers can often become dry and rough from the friction of the handrims when slowing down or stopping the wheelchair.

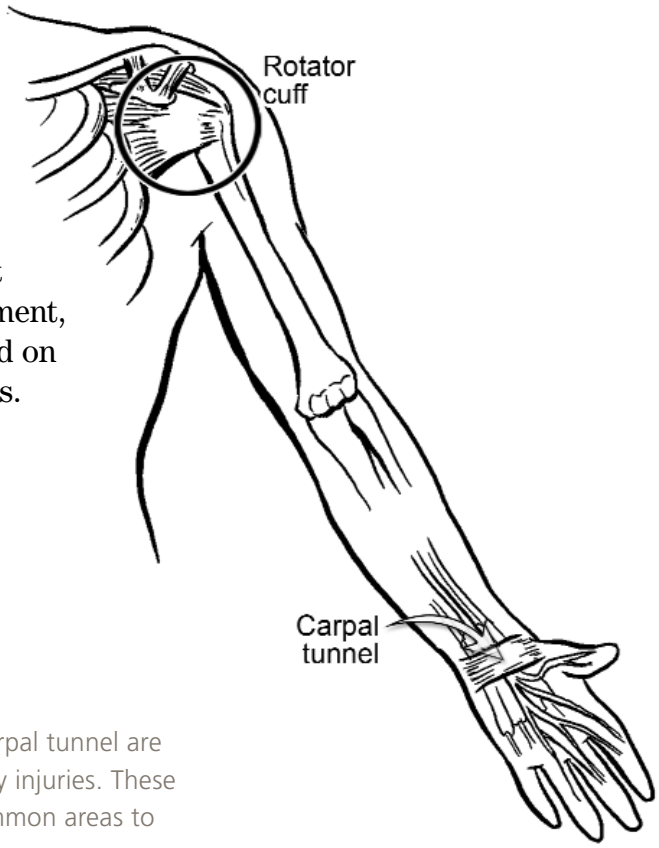
Wrists — Any repetitive task, such as factory assembly line work, can cause damage to the median nerve where it passes through the carpal tunnel in the wrist. No work is more repetitive than pushing the rim of a wheelchair. About half of the people with a spinal cord injury who use a manual wheelchair eventually develop carpal tunnel syndrome, or CTS. It is a painful and, for someone who uses a chair, disabling condition.

1a. The median nerve travels through a small area of the wrist called the carpel tunnel. As a result of repetition of movement (such as wheelchair propulsion), the nerve can become inflamed and compressed, leading to pain in the hand and wrist.

Elbows — All of the force you apply with your hands is transmitted through your elbows. Both the repeated impact of pushing the chair and the heavy loads carried by the elbows when transferring can cause damage. About one in four SCI wheelchair users develop elbow pain.

Shoulders — The wonderful range of motion of the human shoulder is possible because it is held together by ligaments and muscles and not limited by rigid bones—but that flexibility comes at a price. Those ligaments and muscles can stretch and tear if too much force is applied in the wrong direction.

About half of the people with spinal cord injury eventually experience arm pain, but with a little knowledge and care, you can stay pain free. You will have the best chance of keeping your arms working and free of pain if you get the right equipment for your particular needs, set yourself up in a convenient and well-designed environment, and form good habits based on sound ergonomic principles.



1b. The rotator cuff and the carpal tunnel are frequent sites of upper extremity injuries. These two areas are the two most common areas to develop upper extremity pain.

Good Equipment

You have to have the right tools for the job. Exactly what tools you need and how they are set up is as unique and individual as you are.

Power or Manual?

For some people with high cervical spinal cord injuries, a power wheelchair is an absolute necessity. Even if your injury is lower, a power chair might be better for you if you are at high risk for an upper arm injury. Time in chair, age, weight, prior injury, and environmental factors (such as steep hills or rough terrain) may make you more susceptible to repetitive strain injuries to the hands, fingers, wrists, elbows, and shoulders.

Manual chairs are more versatile. They can go where bigger power chairs cannot. They are more maneuverable and easier to put into a car, and they don't depend on batteries. On the other hand, power chairs are faster and have such features as seat elevators and seat tilt. A power chair can reduce the risk of experiencing or aggravating an arm injury, but proper pushing can help you stay in shape.

For people with good arm strength, the convenience and versatility of a manual chair clearly outweigh the ease of rolling without pushing. For people with weak arms or a painful arm condition, deciding whether to go with a manual or power chair involves many factors. It can be a tough decision.

It is possible to push a manual wheelchair your entire life without pain. In fact, many people use manual chairs for many years before they even think about switching to power. Sometimes pain in the hands, fingers, wrists, elbows, or shoulders forces the switch. Sometimes weight gain or aging makes it harder to keep pushing.

The psychological pros and cons are unique to each individual. For most people, the chair that supports the most independence is the right chair. A small, lightweight chair that you can handle by yourself will provide the most independence—until you reach a point where you can't push it by yourself. You don't want to give up any independence but you don't want to injure your arms either. Changing from a manual to a power wheelchair can be difficult psychologically. It may be helpful to talk to your physician or a psychologist about these feelings.

Manual Wheelchairs

There are heavy chairs, light chairs, and ultralight chairs. The lighter the chair that fits your needs, the better. Lighter chairs are not only easier to push but also easier to lift when you get into a car. Over time, you will push those rims thousands and thousands of times. Multiply those thousands by a few more pounds of chair weight and it adds up to significantly more wear and tear on your hands, fingers, wrists, elbows, and shoulders.

Lightweight aluminum wheelchairs cost more than heavy steel chairs. Ultralight titanium chairs cost more than aluminum chairs. The more you roll, the more important it will be to use the lightest chair you can afford. Over time, lighter chairs will actually cost less because they tend to last longer. They are built of stronger materials and higher quality components. Although the initial cost of an ultralight titanium chair may be higher than an aluminum or steel chair, the expense will likely be made up in durability.

Weight is not the only factor to consider. You need a chair that fits your body. The correct arrangement of the seat, back, and wheels depends on your particular body proportions. Standard chairs do not have enough range of adjustment to get a good personal fit, but wheels of ultralight chairs are attached to the frame with fittings that can be moved to the front and the rear and up and down. These adjustments are essential to minimizing stress on your arms.

Your chair will roll more smoothly and have less resistance if your weight is over the big wheels. Adjust the rear axles as far forward as you can without feeling unsteady; otherwise you might tip over. Anti-tippers will keep you from falling over backward, enabling you to ride farther back over the axles, but they can make it harder to get over a curb, pop a wheelie, or negotiate uneven terrain. If you cannot pop a wheelie and hold it, talk to your therapist to determine if this is something you can safely learn to do. If you can't pop a wheelie, anti-tippers are a good option.

The height of the seat affects the efficiency of pushing the rims. You have to work harder if your wheel axles are too high or too low. A low seat is better than a high one, but if you sit too low, you will have to bend your arms too far back to grasp the rims.

Setting the axle height so your fingertips extend just past the axles when you lean back with your arms relaxed will be about right. From there you can adjust the axle up or down to find the seat height that works best for you.

How you set up your chair depends on your individual needs and style. You may want to go to a specialized seating clinic and work with an experienced wheelchair technician who has the tools and the know-how to adjust your chair to your body. It's a good idea to ask a physical or occupational therapist to watch you push. A physical therapist or an occupational therapist can help you adjust your chair to your unique style and ways of moving. Technicians and therapists can give you advice, but it's up to you to be aware of the feel.

2. Wheelchair Setup: The proper axle height should be so that your fingertips extend just past the axles when you lean back with your arms relaxed.

Remember: Every adjustment you make will affect every other adjustment on your chair. Be sensitive to the overall alignment and feel. You may be surprised at the difference one small change can make. Fine-tune the chair until everything feels "right." If you are unsure how to tune your chair, work with a technician or get a book (see **Resources**). It might take awhile to get everything set up, but it's worth the effort. Your arms will thank you!

Power-Assist Devices

New technologies can add some of the advantages of power to the versatility of a manual chair. Add-on power-assist devices can convert manual chairs to partially or fully powered joystick-controlled chairs. Most power-assisted manual chairs cost less and weigh less than power chairs. But some add-on power devices make chairs rigid, so if you need to fold your chair to put it into your car, these devices might not work for you. In addition, add-on devices that turn your manual wheelchair into a fully powered wheelchair do not perform as well as most power wheelchairs.

Remember: New tools and gadgets are presented in the marketplace every year. If you are making a choice between manual and power, take some time to research the options. Talk to people and explore the topic on the Internet. Make health and independence your main criteria.

Power Wheelchairs

If you and your therapist decide that a power wheelchair is the best option to fit your mobility needs, the next step is to consider the features you will require. However, do not rely on just one health-care provider to select a power wheelchair for you. Instead, discuss your options with a team of health-care providers who have been trained in the use of assistive technology. Such providers would include a physician, occupational therapist, physical therapist, and rehab engineer. If you do not have this type of team available, you should ask at least one other individual who has knowledge and experience with wheel-

chair prescription. Ask your providers if they are certified as an assistive technology provider or supplier. If possible, all members of your team should be certified by the Rehab Engineering and Assistive Technology Society of North America.

Remember: Do not attempt to order a power wheelchair without consulting your health-care provider.

Setting Up a Power Chair

Start with a stable base. Your assistive technology team will begin by making sure that you are sitting on a cushion that not only provides the necessary pressure relief but also stabilizes your pelvis. Next, your therapist will stabilize your legs and, finally, provide you with the necessary support for your trunk and arms. When your body has the proper support, your level of comfort will increase. You will be able to make optimal use of your hands and arms without putting additional stress on your joints.

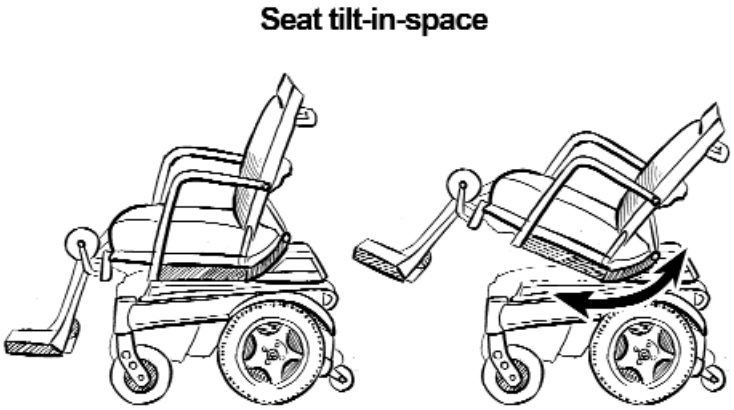
Supporting Your Arms

If you are not able to lift your arms above your head, it is especially important that your arms are supported by some type of armrest, not hanging down by your side. By giving your arms this support, you can prevent shoulder subluxation (a temporary, partial dislocation of the shoulder joint). Shoulder subluxation occurs when the muscles around your shoulder become weak and can no longer support the weight of your arm. If that happens, the weight of your arm must be supported by the shoulder ligaments and by a capsule that encases your shoulder joint. (Picture a balloon around your shoulder joint.) However, the shoulder ligaments and capsule are not strong enough to support the weight of your arm for an extended period of time. You can prevent your shoulder ligaments and capsule from getting stretched out by always providing support for your arms.

Your assistive technology team can suggest options for an armrest. Whenever you sit, make sure your arms feel comfortable and are fully supported.

Relieving Pressure Using a Tilt-In-Space Seat Function

Pressure relief is a key part of skin care, but more than that it is essential to overall health. To perform pressure relief techniques correctly, you must be able to significantly relieve the weight on your buttocks, but be aware that performing this motion puts a lot of stress on your shoulders. For this reason, you should strongly consider getting a power chair that is equipped with a tilt-in-space seating function. This seat function will tilt both the seat and the backrest of your power chair backward, while keeping the angle between the backrest and seat of the chair the same. This change in position will relieve pressure on your buttocks without putting stress on your shoulders.

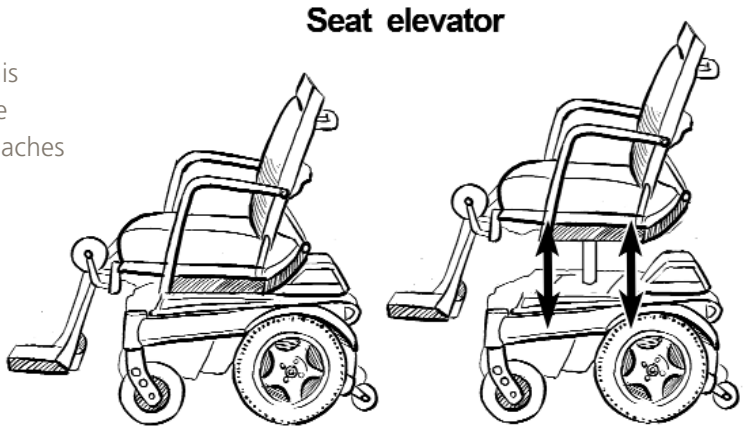


3a. A tilt-in-space seating system: In a tilt-in-space seating system the angle between the seat and backrest remain the same, but the entire seating system tilts backward to relieve pressure.

Elevating Your Seat

Research has shown that reducing overhead activities will significantly reduce shoulder pain. If you perform a lot of activities that require you to reach for items over your head, you and your therapist should discuss the possibility of a seat elevator. Having a seat elevator should lessen the number of overhead reaches you need to perform.

Research has also found that forces on the shoulders are reduced when transfers are level or downhill, rather than uphill. A seat elevator also can reduce the number of uphill transfers you need to perform.



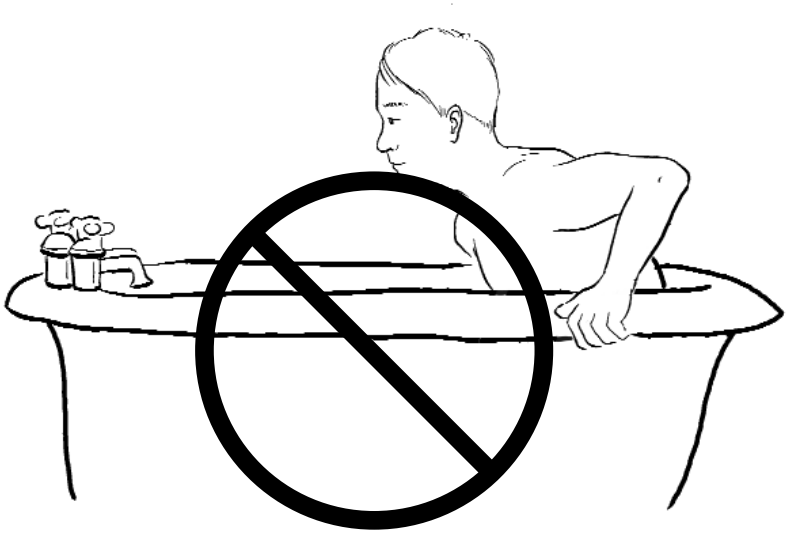
3b. Seat elevator: This device will decrease the number of overhead reaches you need to perform.

Everyday Tools

There are a few handy tools that will help you reduce the stresses that your everyday activities put on your arms.

Transfer boards — If you transfer independently, consider getting a transfer board, especially for the car. A transfer board will get you across the gap between the chair and the car seat with a couple of stepwise short moves instead of a shoulder-wrenching lunge. It will also save your bottom from the drags and snags that cause skin injuries. Transfer boards don't work well for uphill transfers, however, so you should not try to use one to get into a high truck or SUV.

Gloves — Good gloves give a good grip. The texture of the gripping surface reduces the muscle effort it takes to hold and push. Padding in the palm can absorb and distribute the impact when you hit the rims.



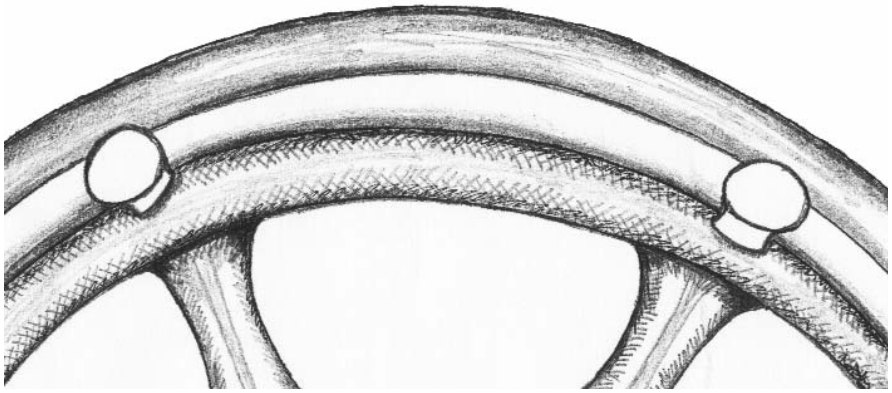
4a. Bathtub: Use a tub chair! Transferring down into a tub can put a lot of stress on your upper extremity. Using a tub chair will significantly help to reduce this stress.

Tub chairs — If you use a tub, use a tub chair. You should always avoid getting into a position that would force you to put your arm behind you to pick yourself up. That position, with the elbow high and out, puts the most stress on your shoulder.

Tire gauge and air compressor — Keep a tire gauge handy so you can check your tire pressures and a small air compressor in case you need to pump up your tires. Tires that are not properly inflated are much harder to push. Don't wear yourself out pushing under-inflated tires. Instead, check your tire pressures often and keep them hard. You'll find the proper inflation pressure printed on the side of the tire.

4b. Flat tires: Don't wear yourself out pushing under-inflated tires! Check your tire pressures often and keep them inflated to the proper level.

Solid tires (tires made out of pure rubber) — This kind of tire is a little heavier than an inflatable tire and may not absorb bumps and vibrations as well. But it is always at full pressure and will never get a flat.



4c. Projection handrims: These "knobs" project outward, perpendicular to the wheel, so you may use the palm of your hand to push them.

Projection Handrims

Projection handrims can be very helpful for individuals with limited handgrip. This type of handrim looks like a ship's wheel with small projections sticking off the standard pushrim. The individual can use their palm to push on these projections and does not have to worry about gripping the standard pushrim.

Power Lifts

Independent transfers are not possible for everyone. Individuals with tetraplegia may not have enough arm strength. A person's weight or too much spasticity may prohibit an independent transfer. Pregnant women and older individuals may find it difficult as well. Power lifts can help people make transfers that they cannot make safely by themselves. If independent transfers become too hard on your arms, don't press on until you hurt yourself. Get a power lift instead.

There are several different kinds of power lifts, and most of them are expensive. If you think you need one, talk to a medical professional who can evaluate your situation and your abilities and give you some advice. Ask if you might be eligible for assistance with the cost.

Good Environments

Imagine an environment where every path is level, every door is wide, every floor is smooth, and every item is in easy reach. Unfortunately, the real world is not built that way, and few people are able to make their homes and workplaces fully accessible. But most everyone can make things a little better.

If you think about it, you can probably find ways to make your places and spaces a little easier on your arms. Look for ways to change the things in your environment that make it slow to roll or hard to transfer. Arrange shelves, counters, and closets so you can reach what you want. Keep things low—not above shoulder height.

Make it a habit

When lifting, don't jerk; use a steady pull. Take the strain gradually; then increase the force.

Here are some more areas of your home and workplace to consider:

Flooring — Soft carpets are a pain in the arms. There won't be hard floors everywhere you want to go, but you should be able to avoid rugs and plush carpets where you live and work (e.g., commercial grade carpet without padding works well for some people).

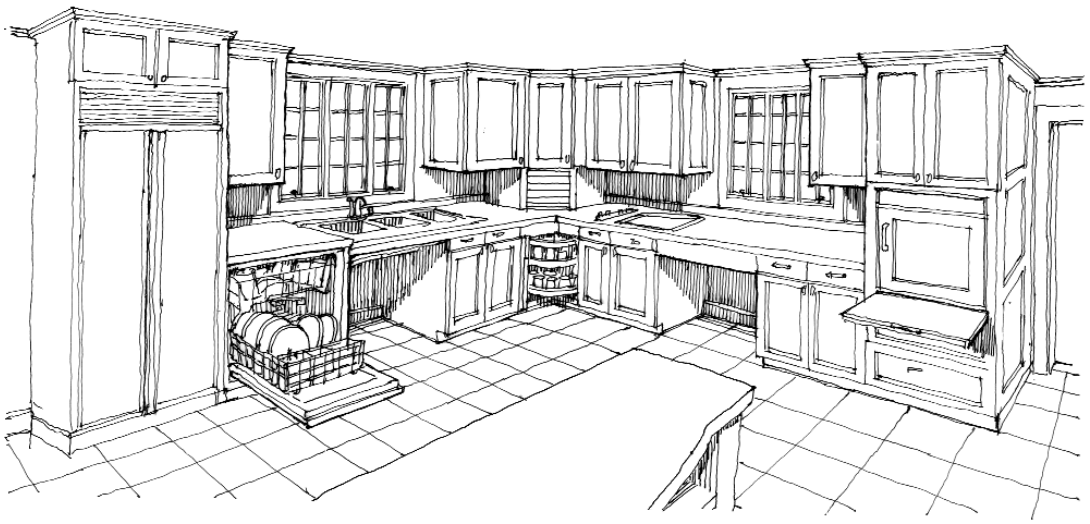
Thresholds — Think about the thresholds in your life. Bumps and jumps add to the daily stress on your arms. Don't put up with little aggravations until they hurt. If you find yourself bumping over something every day, find a way to fix it.

Grab bars — Grab bars are handy and often times essential. Think about the places in your home where a handhold could make it easier to turn a corner or go up a short rise.

Handrails — If you have a ramp, you need a handrail. Handrails should be mounted at the same height as the top of your wheels. If you have to pull on a handrail mounted higher than the top of the wheels on your chair, you have to hold your

elbows high. It's hard to pull at that angle, and it puts additional stress on your shoulders.

Appliances — Arrange your kitchen around your chair. Mount the microwave under the counter or put it on a low table. Use a side-by-side refrigerator so items in the refrigerator and freezer sections are conveniently located for you. Install a low sink that you can roll under. Check out the books on designs for accessible living that are listed in the **Resources** section at the back of this guide. Look at the ways other wheelchair users have made things easier and make your personal space work for you.



5. Modified Kitchen: This is an example of one way an accessible kitchen could be set up. You should work with a professional to design the space to fit your specific needs. Most important, frequently used items should be within easy reach.

Note:

Individual convenience should be the goal when designing accessible rooms. This example may not be the best layout for you.

Fitness

Exercise circulates your blood, tones your muscles, opens your lungs, and clears your mind. The key to a successful exercise program is regularity and routine. If you set aside a time for daily physical exercise and conditioning, your body will adapt. Most of us feel better—physically, mentally, and emotionally—when we exercise regularly.

Before you embark on a fitness program, you need to talk to your physician, an occupational or physical therapist, or an athletic trainer who specializes in training individuals with disabilities. Ask him or her to help you design a program for your specific abilities. If you have a caregiver who helps you exercise, that person needs to be taught proper technique by a qualified professional as well.

Your occupational and physical therapist will teach you which specific muscles need to be stretched and strengthened to protect the structures of your shoulders, provide stability, and improve your transfer and wheelchair propulsion skills. Although beyond the scope of this guide, you may also want to talk to your therapist about the best way to maintain cardiovascular fitness, an important component of a complete exercise program.

Keeping your shoulders strong involves the following muscles:

Infraspinatus: (in-fră-spī-nā´-tŭs)

- This muscle is part of the rotator cuff. Its action is to roll your upper arm outward (external rotation).
- This muscle plays an important role in performance of transfers. It also helps to provide stability to your shoulder.

Subscapularis: (sŭb-skap-yū-lā´ris)

- This muscle is also part of the rotator cuff. Its action is to roll your upper arm inward (internal rotation).
- This muscle also is an important muscle to improve transfer skills and provide stability to the shoulder.

Serratus Anterior: (ser´āt us)

- This muscle is used to move the shoulder blade (scapula) away (abduct) from your spine. In other words, it moves your scapula closer to your arm.

- Strengthening this muscle will help when lifting your buttocks off the surface that you are transferring from.

Latissimus Dorsi: (lah-tis´ĭ-mus dō̆r-sī̆)

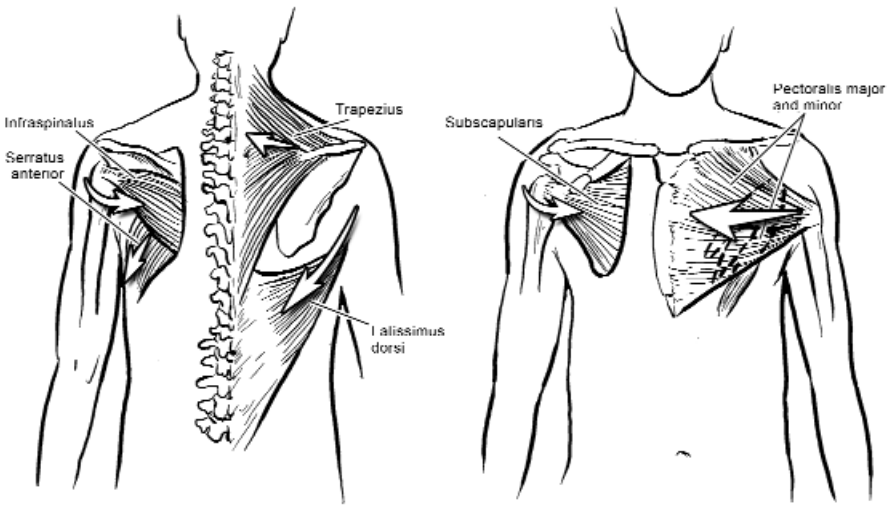
- This muscle helps to extend (pull backward) your shoulder.
- This is one of the primary muscles used when lifting your buttocks off a surface when transferring.
- You can also improve your posture by strengthening this muscle.

Trapezius (tra-pē´zē-ŭs) (Middle and Lower) and Rhomboids: (rom´boyd)

- These muscles are used to retract (pull together) your shoulder blades (scapula).
- These are very important muscles to strengthen to improve posture and protect the structures of your back and shoulder. Often when these muscles are weak, nerve structures are compressed (pinched) in the back, which causes pain in the shoulder and arm.

Pectoralis Major/Minor: (pek´tŏ-răl-is)

- These muscles are used to adduct (pull inward) your upper arm.
- If these muscles get tight, they will cause a slumped posture and can potentially impinge (pinch) important nerves, which can lead to increased pain.



6. Back and Chest Muscles: These are the important muscles in your back and chest that must be stretched and strengthened to maintain the health of your upper extremity.

Stretching and Range of Motion Exercises

For people with SCI, the importance of stretching cannot be overemphasized. Spending a lot of time in a wheelchair tends to make people slump. The chest and stomach muscles get shorter while the back muscles get longer.

Short chest and stomach muscles also restrict your shoulders' range of motion. You end up pushing your chair and performing transfers with your arms too far back or too far out. The result is shoulder and neck pain.

The best way to avoid slumping and all of the bad things that go with it is to stretch your chest muscles every day. In fact, you can do the following exercises several times a day—even when you are resting. Adding these exercises to your daily routine will make you feel better and help you to avoid injury.

Make it a habit

Set an easy pace.

Speed increases impact, and impact increases stress.

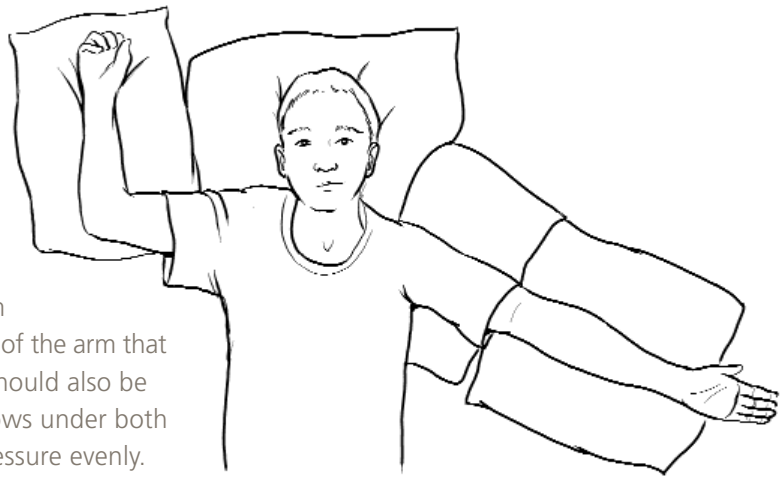
Stretching and Range of Motion Exercises for Posture

Lying on your back — Put your hands behind your head and let your elbows go flat. You will feel the pull across your chest. Hold your hands straight out to the side and move them around in little circles. Don't overdo it. You only want to feel loose—pain is no gain.

Also, while on your back, touch the backs of your hands together over your head. When it feels tight, hold the position and feel the gentle stretch.

Sitting in your chair — The head roll is another exercise that helps improve posture. Very slowly lean your head back as far as you can without discomfort; then slowly roll it around. Roll to the left as if you are going to put your ear on your shoulder. Keep rolling until your chin is on your chest, and then continue all the way around until you are back where you started. Then do the same thing in reverse, but be careful because if you haven't done this in awhile, you will be stiff. Do what you can with no discomfort and do it everyday. In a couple of weeks you will find that it's easy and that you are sitting straighter in your chair.

Remember: When you sit in your chair, think about your posture. Periodically lift your head up a little higher and, if you can, pull your shoulder blades back a little further. Be conscious of what good posture feels like.

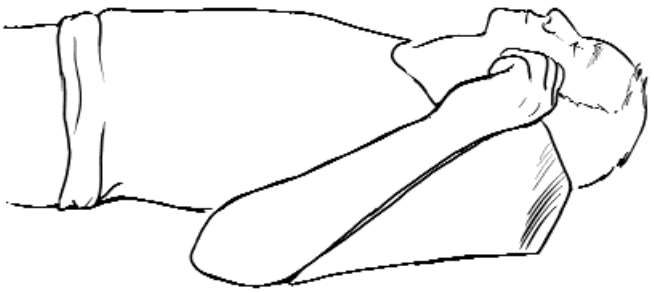


7a. Sleeping on your back: When you are sleeping on your back, bring your arm out to the side (approximately 75 degrees) and the other arm out to 90 degrees. The elbow of the arm that is out to your side 90 degrees should also be bent to 90 degrees. Place pillows under both your arms to distribute the pressure evenly.

Sleeping — When you are asleep, you need to make sure that your shoulder muscles, as well as the supporting tendons and ligaments, do not get tight during the eight hours or so when you are asleep. The positions described below will prevent direct pressure on the shoulders and also provide support to your arms and shoulders at all points.

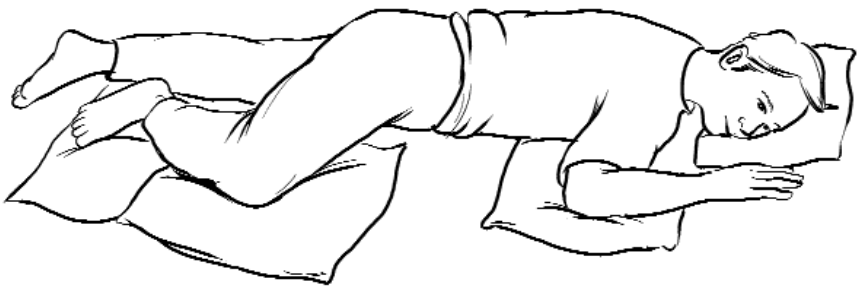
Sleeping with your arms in these positions will help keep the muscles surrounding your shoulders from getting tight. If you sleep in more than one of these positions, you will also be protecting your skin!

Remember: During your nightly sleep it is important to wake up and turn every 2–3 hours, if possible. Once you have trained yourself to do this, it will become natural and you won't have to consciously remember to turn.



7b. Sleeping on your back: When you are sleeping on your back, place a pillow under your forearm that is out to your side at 90 degrees. Elevating your arm 45 degrees will give your arm a nice stretch and make you more comfortable.

Remember: If someone is helping to position you, don't allow that person to pull on your arms.



7c. Sleeping on your stomach: When you are sleeping on your stomach, don't let your arms or legs go unsupported. Place a pillow under your arms, upper legs, and knees. Using pillows can also help to evenly distribute the pressure. Even if you don't feel the joint being stretched, significant damage can be done over time.

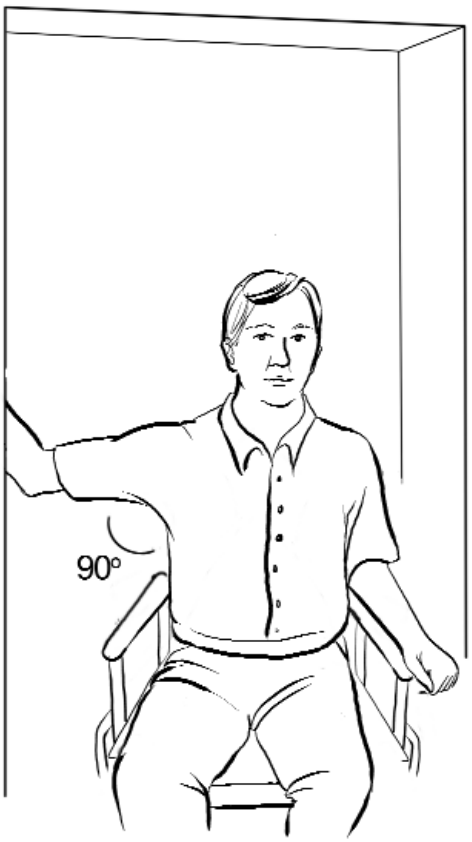
Stretching Exercises for Your Lower Arms and Shoulder Blades

The muscles in your lower arms and around your shoulder blades also need to be stretched. Here are two exercises that target these areas.

Warning: Do these, and any new exercise, with a trained professional before trying them alone.

Shoulder internal rotators:

- Roll your chair into a doorway.
- Raise your shoulder.
- Bend your arm at your elbow to a 90 degree angle.
- Rest your elbow and hand against the doorframe.
- Use your left hand to push your chair slightly forward.
- You should feel a stretch in your chest, near your shoulder.
- If you are unable to move your arm into this position, lie on your back and have your caregiver perform the exercise manually. (Your caregiver will stretch your lower arm out to the side while keeping your upper arm close to your side.)



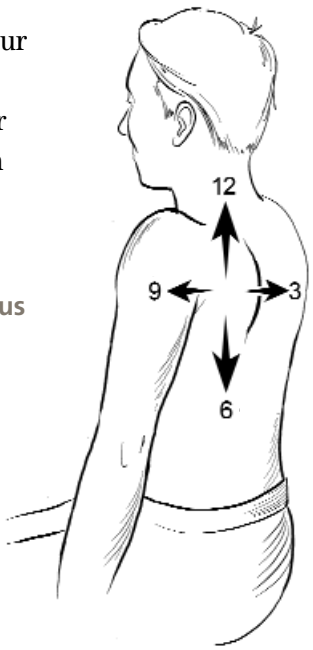
7d. Shoulder internal rotator stretch (sitting in a chair)

- Remember, if you experience pain, stop immediately.

8a. Shoulder internal rotator stretch (lying down)

Rhomboids and Trapezius Muscle:

- Sit in your chair. The goal is to move your scapula in four different directions. If you think of your scapula like a clock, you will be moving your scapula to the 12, 3, 6, and 9 o'clock positions.
- Begin by shrugging your shoulders up and then roll your shoulders forward and push your shoulder blades down. Then squeeze your shoulder blades together. Extend your shoulders back as far as possible.
- If you are unable to move your shoulder blades, lie on your side and have your caregiver move your shoulder blade in these four directions.



8b. Rhomboids and Trapezius sitting stretch

For best results, you need to perform stretching exercises for your lower arms and shoulder blades at least two to three times per week. When you first start, you should stretch each muscle three times and hold the stretch for 15 to 30 seconds each. Increase the amount of time you stretch and the number of reps you perform as you get more comfortable performing the stretches.

Make sure that you are getting a good stretch in *all* of the muscles on the front surface of your neck, upper trunk, shoulders, and arms. If you cannot stretch all of your muscles on your own, find someone who can help you. Both you and your caregiver should be trained by a certified therapist how to perform a proper stretching program. Most likely your therapist will instruct your caregiver to provide a "distraction force" (a gentle pull at the shoulder joint to make stretching more comfortable and effective) on your arm while he/she is stretching you out. Don't be alarmed: This is the proper technique. When stretching, it is OK to have your caregiver provide a *gentle* distraction force. These are just a few of the stretching exercises that you can do. To get a comprehensive exercise program designed just for you, talk to your physician, an occupational or physical therapist, or an athletic trainer who specializes in stretching and strength training for individuals with disabilities.

Strengthening Exercises

To get the most out of your fitness regimen, you need to do strengthening exercises regularly, but, again, talk to your physician, occupational or physical therapist, or athletic trainer before you begin. Strength training is a healthy activity, but you can hurt yourself if you try to do too much too fast. If you have a caregiver involved in your strength-training program, be sure that person is properly trained as well.

You build strength by working against resistance. If you play a sport you may need to work out in a gym or get some professional equipment. Otherwise, a pair of light dumbbells or an elastic band is probably all you need.

Using an elastic band is one of the cheapest and safest ways to add resistance to your exercise program. Elastic bands come in a variety of resistances, to make your exercises harder or easier, as necessary. In most cases, the color of the band tells

you how much resistance the particular band provides. Unfortunately, there are a variety of companies that make these bands, all with different color schemes indicating the amount of resistance each band has. Please talk to your therapist about what band color you should be using to start your exercise program and how you should progress the resistance as you get stronger. You can get an elastic band from a medical supply store or from your occupational or physical therapist.

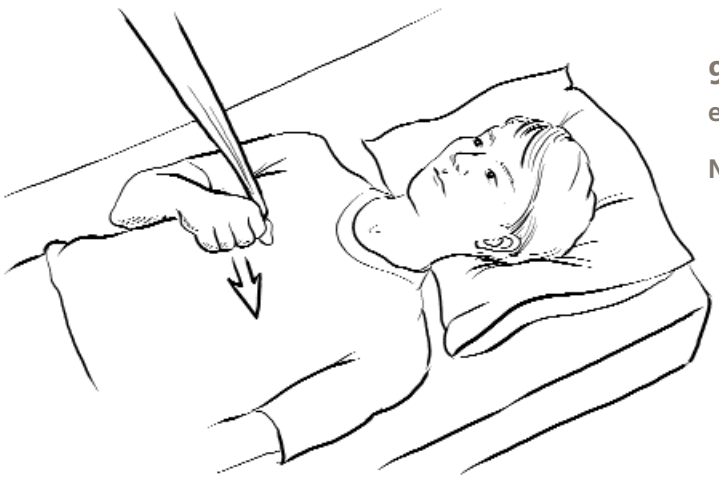
Remember: Strengthening exercises work best if you do them every other day—that is, a day of work followed by a day of rest. Stretch every day; do strength or resistance training every other day.

The following three exercises focus on the most important areas for you to strengthen: your chest, back, and arm muscles.

Shoulder Internal Rotation:

This exercise will strengthen the infraspinatus and subscapularis muscles.

- Lie on your back.
- Put your arm next to your body.
- Bend your elbow to 90 degrees.
- Rotate your lower arm in toward your body to touch your belly and then rotate your lower arm away from your body as much as you comfortably can.



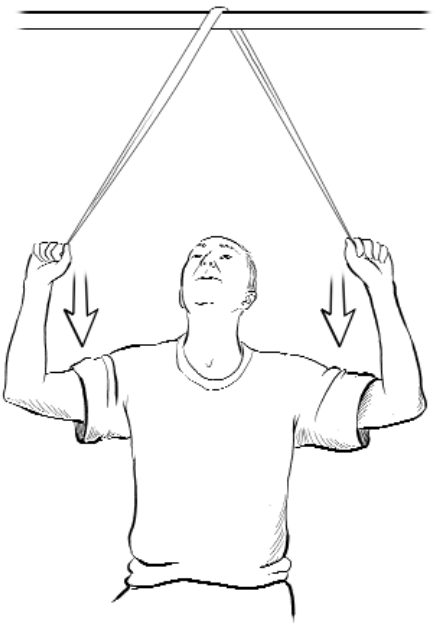
9. Shoulder Internal Rotation exercise

Note: Resistance bands (such as the one pictured) come in different strengths. Check with your health-care provider to determine the strength of the band that is best for you.

"Lat" pulldowns:

This exercise will strengthen your latissimus dorsi and serratus anterior muscle in your back.

- Sit with your arm out to the side with a 90 degree angle between your trunk and your arm.
- Put a piece of elastic band over a securely mounted hook on a wall, or other secure holding device.
- Pull down on the band.

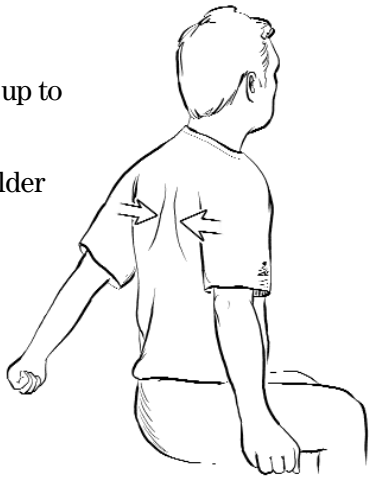


10. "Lat" pulldown exercise
(see picture 6 on page 18 illustrating the "lat" muscles)

Scapular retraction:

This exercise will strengthen your rhomboid and trapezius muscles.

- Sit in your chair.
- If you are able to, lift your arms up to approximately 45 degrees.
- You want to "pinch" your shoulder blades together and hold for approximately five seconds.



11. Scapular retraction exercise

Perform all of these exercises in three sets of 10 repetitions apiece. If this is easy for you, add a hand weight. Start light and gradually move up in weight. You can also use a band that is less elastic and therefore harder to stretch. Use enough weight or resistance to produce fatigue in about ten repetitions, or one set, of each exercise.

Another option is for you to increase the number of repetitions you perform. Start with a few repetitions and work up over the course of a few weeks. As you gain strength, it will take more reps to tire out your muscles. When the number of reps gets too high, add weight, but don't overdo it. Adjust either the weight or the number of repetitions—never both at the same time.

These are only a few of the many strengthening exercises you can do. To get a comprehensive exercise program designed for you, talk to a health-care professional, such as an occupational or physical therapist, or an athletic trainer who specializes in training for individuals with disabilities. A good therapist or trainer will teach you additional exercises specifically for your body and will ensure that you are performing the exercises correctly.

Make it a habit

Do stretching exercises every day and resistance training every other day.

Your exercise program should take into account your age, weight, conditioning, and disability, as well as your daily activities, lifestyle, interest in sports, and personal goals. If you have been neglecting this part of your life, don't delay any longer. Stretching and strengthening exercises are essential to everyone's health.

Remember: Extra body weight means more work, more force, and more stress on your arms. Don't eat more calories than you can burn. The excess will take up permanent residence around your waist.

For even more ideas, check out the **Resources** section in the back of this guide.

Good Habits

Four things you do everyday will eventually hurt you if you don't do them right—pushing your chair, reaching and lifting, transferring, and relieving pressure.

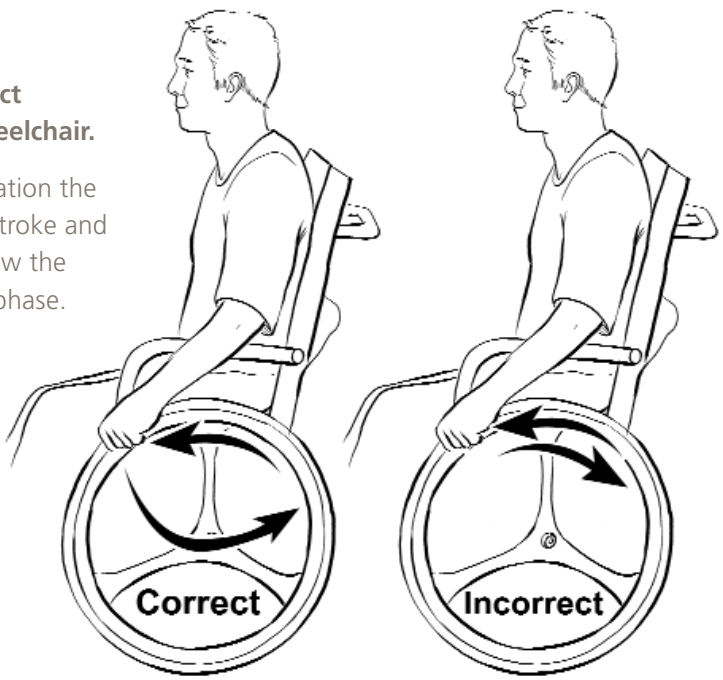
Make it a habit

Push and pull with motions that put the least load on your arms.

Pushing Your Chair

Use long, smooth strokes when you push your wheelchair. Longer strokes mean fewer strokes and therefore less wear on your wrists, elbows, and shoulders. Smooth strokes reduce the impact when your hands hit the rims. A steady follow-through motion keeps the forces on wrists and elbows to a minimum.

The wheelchair propulsion stroke has two parts: the push and the recovery. In the push phase your hands stay on the rim from where you grab to where you release. In the recovery phase the tendency is to bring the hands back along the same path as the push stroke, but that's not the smooth move you want. A push-pull motion gives a short recovery and does not provide a long, low-impact stroke.



12. The correct and incorrect method of propelling a wheelchair.

Note: In the "correct" illustration the individual is using a smooth stroke and dropping his hand down below the pushrim during the recovery phase.

For the smooth, low-impact move you want, the hand motion should be around and around—not back and forth, or push-pull. Drop your hands when you release the rims. Bring them back low, as if you are going to touch the axles. The path of your hands should be a little circle inside the big circle of the rim. Imagine a small gear (your hand) turning a big gear (your wheel). You want to spin it around and around—don't pump it up and down.

Reaching and Lifting

In the kitchen, the laundry, the garage, or at work, high shelves—any shelf above shoulder height—can hurt you. Sure, you can reach them, but just the weight of the flour or sugar in a high kitchen cabinet or the detergent over the washing machine puts a real stress on your shoulder if you have to lift it at arms-length. The higher your arm, the more force you put on your shoulder when you pick up something. Bookshelves, closet rods, filing cabinets at work all hold things you will reach for time and time again. It's worth the effort to rearrange your space so you will be picking things up instead of reaching for things above you.

Make it a habit

Keep your arms close to your body.

Wheelchair users do enough overhead lifting in the grocery store, the library, and all the other public places that are designed for people on their feet. Make the places where you live and work fit you. Keep the things you use low and handy. Save your shoulders for the work you have to do when you adjust your position or transfer.

Be careful not to overreach. When you are going to pick up something, move your chair in close so you keep the weight close to your body. A light load at the end of a long reach puts as much stress on your arms as a heavy load held close.

Make it a habit

Work at a rate that lets you keep your position and motion under control.

Transferring

Your body is the heaviest thing you have to lift. Getting in and out of your wheelchair puts more stress on your arms than anything else you are likely to do. Knowing how to transfer and what to avoid is essential to keeping your arms functioning and pain-free.

Every wheelchair user needs individual transfer training. A physical therapist can evaluate your personal strengths and weaknesses. When working with your PT, talk about the kinds of transfers you make and how often you make them. The therapist will show you "tricks" that will work for you. Over time your transfer techniques may need to change. If your living situation changes or if your transfers become more difficult, go back to your therapist for advice.

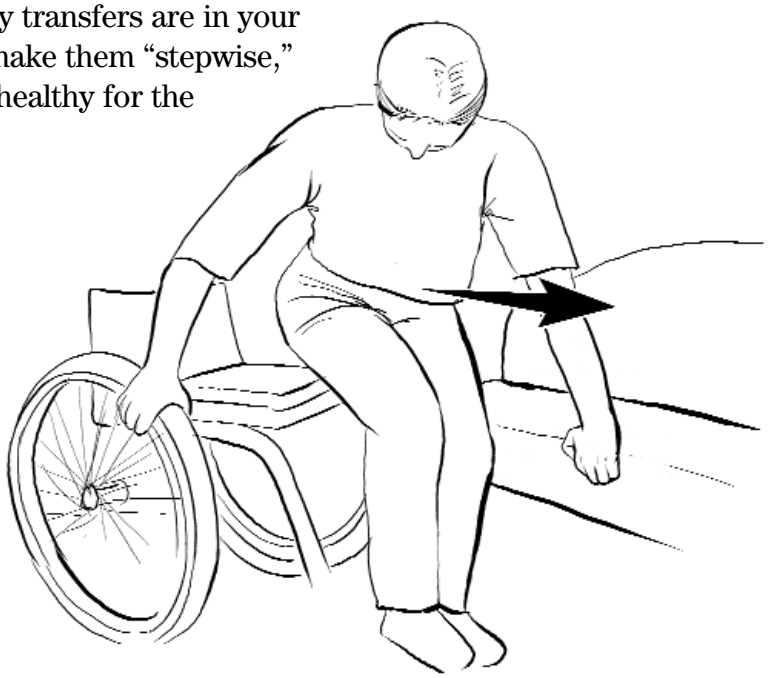
Perhaps the most critical step in the transfer is the setup. The first step is to pull your chair as close as possible to the surface you want to move to. Once your chair is close, position your body. Balance and stability are critical for proper transfers. There are many different ways to transfer; it is most important to work with your health-care providers to determine the transfer method that is best for you. For some people, but not everyone, it is best to put your feet on the floor. This position makes you more stable and can give you a pivot point. Then scoot forward to the edge of the chair. This position gives you a smaller distance to travel and places your body in front of the tire so you won't have to transfer over the tire. If an armrest is in your way, remove it. The less you have to raise and lower your torso, the better.

Remember: Transferring downhill is easier than transferring uphill.

Shoulders — Your shoulders can tolerate a lot more force if you keep your arms close to you (about 30–45 degrees away from your body) during the portion of your transfer when your weight is being supported by them. Lean your trunk forward to make sure you are staying over your hands. This position allows your shoulders to fully extend to their natural position, which leads to reduced wear and tear on your shoulders. Of course, there has to be some reach or you can't move sideways, but the shorter the move, the easier it will be on your shoulders.

One smooth movement leaning over the weight-bearing arm is OK, provided you have plenty of strength to lift your weight. However, if it is a struggle or if you are not strong enough to make this a smooth motion, alternatives, such as transfer boards, should be considered. Transfer boards (see below) allow you to move in short "steps," putting less stress on your shoulders.

Think about how many transfers are in your future. Make them easy, make them "stepwise," and keep your shoulders healthy for the long haul.



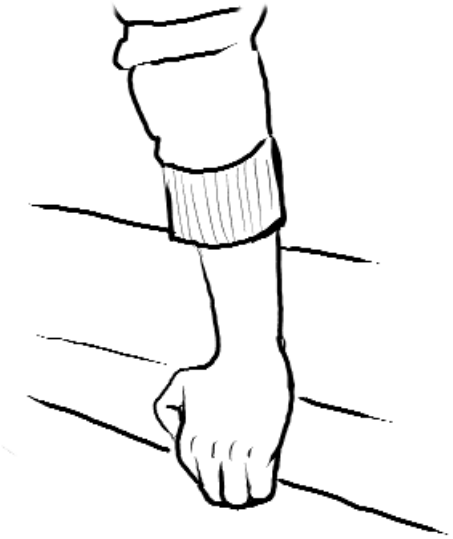
13. Transfer Setup: This is a recommended way to set yourself up for a transfer. It is very important to keep the leading arm about 30–45 degrees away from your body. This will position your shoulder in the best way to handle your body weight while you are transferring.

Note: As stated earlier in this guide, it's important to keep one's arms *as close to the body as possible.*

Wrists — If you transfer with your hands flat and put your weight on your palms, your wrist will be bent all the way back. As you make your move, you are liable to bend the wrist even further. This position puts all the force right where you don't want it—on the nerves in the carpal tunnel. You might not notice any problems for a while, but if you do enough flat-handed transfers, you could end up with carpal tunnel syndrome (CTS). CTS hurts and it can make every transfer painful.

If the surface you are moving onto has an edge, grip it with your fingers. Holding on with your fingers keeps the wrist at a safe angle. If there's a grab bar, use it. If there's an edge, wrap your fingers around it. Gripping something will spread your weight over more of your hand and make you more stable.

However, don't reach too far just to get to an edge or grab bar. It's more important to keep your arms within your base of support.



14. Proper hand position: Whenever possible, try to grip the edge of the surface you are transferring to. However, if the edge or handrail will cause you to lose your balance or move your arm too far away from your body, it is better to put your hand on the flat surface.

If there is a gap between where you are and where you are going, use a transfer board. A transfer board is a smooth piece of wood or other sturdy material that will bridge the gap between two surfaces. You can do many short transfers on the transfer board to get you to where you are going. If you have trouble doing several small transfers, you should *not* try to slide across the board, which can tear your skin and lead to infection. You might prefer a transfer board with a sliding disc. You can sit on the disc and slide across the board without tearing your skin.

Keep in mind that a transfer board can injure your skin. Using a pad or towel is often helpful when transferring; it is generally not a good habit to transfer with skin directly on the board. Different strategies work for different people and in different circumstances. Work with your health-care providers to find the best strategy for you and your transfer needs.

Learn to transfer in both directions. Lead with your left side or lead with your right, but don't lead the same way every time.

Remember: The easiest transfer is no transfer. Don't transfer unnecessarily. Think about your daily routine. For example, you can avoid multiple transfers in the bathroom if you use a shower chair that can also be used for toileting.

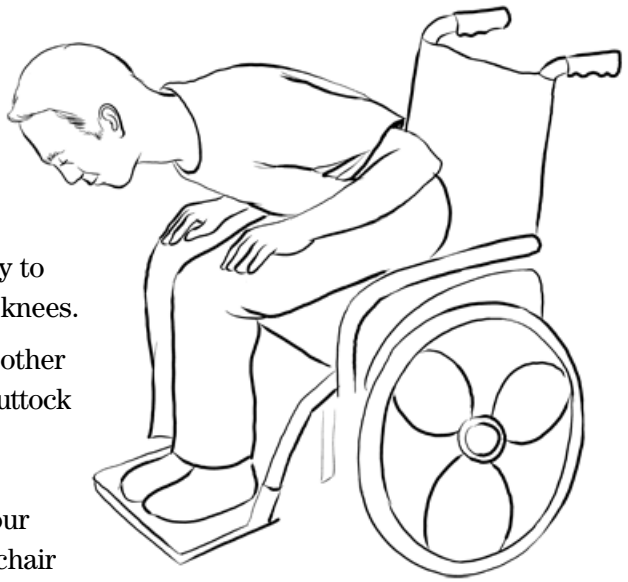
Relieving Pressure in Your Wheelchair

Pressure relief is an essential part of skin care, but it can be hard on the shoulders if it's done the wrong way. Every wheelchair user needs to know how to protect the skin from the damaging effects of pressure without hurting the arms in the process.

Because you may not be able to feel the buildup of pressure and pain in your skin, you need to take special steps to make sure your skin is sufficiently protected. Many people perform a "wheelchair pushup" (that is, they push up on the armrest of the wheelchair and lift the buttocks off of the seat). However, performing a wheelchair pushup puts a significant amount of stress on the shoulders. Plus, recent research has shown that for pressure relief to be effective, the area needs to be "unloaded" for an extended period of time (that is, pressure on a specific area needs to be significantly reduced for a few minutes). Pushing up on the armrests of a wheelchair for the amount of time required to truly reduce pressure is not realistic.

The following methods of pressure relief can both protect your skin for the necessary period of time and decrease the amount of stress on your shoulders.

- Lean forward in your chair. Try to move your chest toward your knees.
- Lean to one side and then the other (that is, lift one side of your buttock up at a time). To increase the amount of pressure relief this method can give you, hook your arm around the back of your chair and pull yourself further over to the side.



15a. Performing a Pressure Relief: Lean forward in your chair to relieve the pressure on your buttocks. Hold this position for about 2 minutes.

15b. Performing a Pressure Relief: Lean to one side then the other in your chair to relieve the pressure on your buttocks. Hold this position for about 2 minutes.

- If you are unable to lean forward or to the side, tilt backward in your chair 65 degrees.
- If you are sitting in a manual wheelchair, enlist the assistance of a caregiver. Ask your caregiver to tilt you backward in your chair for approximately two minutes. To be safe, your caregiver should be seated behind you in a sturdy chair to perform this maneuver.

Remember: Preventing pain and injury is much easier than treating them.

Dealing with Pain

Sometimes bad things happen despite the best efforts. If you develop pain in your wrists, elbows, or shoulders, the smart thing to do is to stop and deal with it. If you treat the cause of the pain as soon as it starts, you will have a better chance of recovery. If you press on and try to work through it, you can cause even more damage, and that will take even longer to heal.

There are two kinds of pain: acute pain and chronic pain.

Acute pain — The treatment for acute pain is to find the cause and fix it. If it's hand, finger, wrist, elbow, or shoulder pain, part of the treatment will be rest. This can be nearly impossible for an active manual wheelchair user, so if you have any arm pain you can't cure with a few of days of relative rest, see a doctor. If it doesn't get better in a short time, it may get worse.

Don't wait; get medical attention. Check with your doctor before you take over-the-counter pain relievers.

Chronic pain — Chronic pain is pain that won't go away. In general, chronic pain refers to pain that has been present for more than six months. The cause is something that will not heal. The treatment for chronic pain is complex. If you have chronic pain, you need at least a doctor and maybe a team of clinicians to work with you. Your clinical team should include a psychologist who can help you deal with the issues that accompany chronic pain.

Most of the arm injuries wheelchair users experience will heal with rest, specialized exercises, and time. More serious injuries may require surgery. If you are considering surgery be sure to get a second opinion. Get input from your entire health-care team as well as at least two surgeons. Questions to ask include: What are the chances of success? How long will recovery take, and what will my restrictions be? What will and won't I be able to do after recovering from the surgery?

Be sure to consider the time recovery may take. It may be a while before you can push a manual chair or make a transfer on your own. After surgery, it may be necessary to switch from a manual wheelchair to a power wheelchair to prevent recurrence. In addition, help may be needed with transfers. All of these factors need to be evaluated before the surgery is done to make sure that after surgery you are prepared with the wheelchair or other assistance you may need.

Important: It is hoped that this consumer guide has provided some helpful suggestions regarding upper limb health. As stated earlier, please keep in mind that all recommendations, exercises, transfer procedures, and other suggestions regarding positioning and wheelchair use should be discussed with your personal doctor and your health-care team **before** trying anything new or different. **Do not try any of the exercises described in this guide without professional assistance.** Please keep your health-care team well informed of anything you read in this document that you would like to try or that you have questions about.

Resources

A. Websites

ANSI/RESNA – Wheelchair Standards: www.wheelchairstandards.pitt.edu

Human Engineering Research Laboratories: www.herlpitt.org

National Center on Physical Activity and Disability: www.ncpad.org

Paralyzed Veterans of America: www.pva.org

B. Books

Information on the following books is available from Paralyzed Veterans of America at www.pva.org.

Accessible Home Design: Architectural Solutions for the Wheelchair User, 2nd edition

A Guide to Wheelchair Selection: How to Use the ANSI/RESNA Wheelchair Standards to Buy a Wheelchair

The Manual Wheelchair Training Guide

The Powered Wheelchair Training Guide

Preservation of Upper Limb Function Following a Spinal Cord Injury: A Clinical Practice Guideline for Health-Care Professionals

Yes, You Can! A Guide to Self-Care for Persons with Spinal Cord Injury

C. Magazines

PN, The magazine for wheelchair users: www.PN-magazine.com

New Mobility: www.newmobility.com

Glossary

Carpal tunnel—A canal located in the wrist surrounded by bone on three sides and a crosswise carpal ligament on the fourth. The median nerve passes through it.

Gloves—Properly padded gloves allow for a good grip thus reducing the muscle effort it takes to hold and push wheel rims.

Grab bars—Grab bars are sturdy bars strategically placed in areas, particularly around the home, to give the wheelchair user more stability when turning a corner or ascending a short rise.

Infraspinatus—This muscle is part of the rotator cuff. Its rolls the upper arm outward (external rotation).This muscle is extremely important when performing transfers. It helps to provide stability to the shoulder.

Latissimus Dorsi—This muscle helps to extend (pull backward) the shoulder. This is one of the primary muscles used when lifting the buttocks off a surface when transferring. Posture can be improved by strengthening this muscle.

Median nerve—The median nerve runs down the arm and forearm. The median nerve is the only nerve that passes through the carpal tunnel, where it may become compressed to cause carpal tunnel syndrome.

Pectoralis Major/Minor—These muscles are used to move the upper arm inward. If these muscles get tight, they will cause a slumped posture and can potentially impinge (pinch) important nerves, which can lead to increased pain.

Power Lifts—Power lifts are mechanical devices that are used to transfer persons with SCI who do not have the upper body strength to perform their transfers without additional help. There are several different kinds of power lifts, and most are expensive.

Projection hand rims—Projection hand rims can be very helpful for individuals with limited handgrip. This type of hand rim looks like a ship's wheel with small projections sticking off the standard push rim. The individual can use their palm to push on these projections and does not have to worry about gripping the standard push rim.

Rotator cuff—The rotator cuff (rotor cuff) is the term given to the group of muscles and tendons that stabilize the shoulder.

Serratus Anterior—This muscle is used to move the shoulder blade (scapula) away from the spine and closer to the arm. Strengthening this muscle will help when lifting the buttocks.

Solid tires (tires made of pure rubber)—This kind of tire is a little heavier than an inflatable tire and may not absorb bumps and vibrations as well. But it is always at full pressure and will never get a flat.

Subscapularis—This muscle is also part of the rotator cuff. Its action is to roll the upper arm inward (internal rotation). It also improves transfer skills and provides stability to the shoulder.

Transfer boards—A sturdy board (sometimes with moving parts built-in) with a very smooth surface used to help persons with SCI to transfer from one location to another. There are many different kinds of transfer boards. Consultation with health-care professionals is advised to determine the best transfer board(s) for specific needs.

Trapezius—These muscles are used to retract (pull together) the shoulder blades (scapula). These are very important muscles to improve posture and protect the structures of the back and shoulders.

Acknowledgments

The Consortium for Spinal Cord Medicine (the Consortium) was founded in 1995 with the goal of improving the quality of life for persons with spinal cord injury by making their care more evidence based and, through concerted outreach efforts, bringing this knowledge to the widest possible audience. The professional health-care, payer, and consumer organizations that comprise the Consortium work in partnership with PVA's research and education team to realize this goal through the publication and dissemination of clinical practice guidelines (CPGs) for health-care providers and companion consumer guides written specifically to provide useful information to consumers of SCI related health care.

Paralyzed Veterans of America (PVA) is proud to fund and administer the Consortium. We are honored to partner with this esteemed group to continue to provide groundbreaking guidelines that consolidate recommendations from the highest level of experts in the field of SCI.

For more information about the Consortium and PVA, please visit www.pva.org.

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