AMERICAN SPINAL INJURY ASSOCIATION

GUIDELINES FOR USE OF

DURABLE MEDICAL EQUIPMENT

FOR PERSONS WITH SPINAL CORD INJURY AND DYSFUNCTION

2022 EDITION

PREMIER SPONSOR

Durable Medical Equipment for Persons with Spinal Cord Injury or Dysfunction:

2022 Manual Update

We thank those who gave time and effort to this project for sharing their expertise willingly to enhance the lives of those with spinal cord injury or dysfunction. We would also like to thank all of the contributors to past versions of this manual.

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EDITORIAL STAFF

Editor in Chief
Allison Kessler, MD, MSc.
Chair, Rehabilitation Standards Committee.

Anne Bryden, PhD, OTR/L.
Chair Emeritus, Rehabilitation Standards Committee

Isa McClure, PT, MAPT.
Chair Emeritus, Rehabilitation Standards Committee

CONTRIBUTING AUTHORS ALPHABETICALLY

Matt Abisamra OTR, CDRS
Benjamin Abramoff MD MS
Nathalie Badro, OT
Maryam Berri, MD
Amy Bohn OTR/L
Anne M. Bryden PhD, OTR/L
Cassandra Buchanan Renfro, DO
Niña Carmela R. Tamayo, DO MS MPH
Christine Cheatham Foley, PT, DPT
Yoni Diamond, MSOP
Michael Flis OTR/L CDRS
Sara Kate Frye MS OTR/L ATP
Allison Kessler, MD, MSc
Michael A. Klonowski PT, DPT, PCS
Jean-Marc Mac-Thiong, MD, PhD
Marissa Malady OTR/L
Amanda Morina, PT, DPT, NCS, ATP
Gregory Nemunaitis, MD
Phyllis D. Palma, PT, DPT, ATP/SMS, CBIS
Danielle Potemri
Andréane Richard-Denis, MD, MSc
Lisa Marie Ruppert, MD
Sally Taylor, PT, DPT, NCS
Heather Theobald, DO MPH
Jeffrey Thompson, MD
Nathaniel V. Zuziak, DO, CHCQM-PHYADV

CONTENT REVIEWERS

Matthias Linke DO, SCIM, FAAPMR
Keara McNair, MS, OTR/L, BCPR, ATP
Abhinav Singh, MD

TABLE OF CONTENTS

INTRODUCTION

Spinal cord injury or dysfunction (SCI/D) can lead to impairments in movement and sensation, which can impair not only the function but also quality of life of an individual. Due to these impairments, Durable Medical Equipment (DME) is an essential component of medical care for persons with SCI/D. Appropriate prescription and training for use of DME can improve independence, autonomy, community engagement, community participation, and ease and spontaneity of functioning. For this reason, the American Spinal Injury Association (ASIA) assembled a committee of expert clinicians working with persons with SCI/D to review the current state of the art for this area, and update the Durable medical Equipment document produced many years ago. This document is a result of extensive literature searches, including peer-reviewed medical, nursing and therapy resources, conducted to determine accepted standards of medical practice with respect to the provision of DME. The result describes the categories of equipment that are essential, or helpful, for the person with SCI/D to function as independently as possible in the home or community environment.

What is durable medical equipment or DME (as it is commonly referred to)? Generally speaking, CMS (Center for Medicare and Medicaid Services) describes DME as any medical equipment used in the home environment to aid in the better quality of life. DME plays a significant role in determining the level of independence for the individual using the equipment. Medical insurances, whether public or private, do cover the cost of some, but not necessarily all, types of DME. All funding resources should be considered including primary and secondary insurance plans, as well as self pay and fundraising options.

For an individual with SCI/D, the amount and specialization of durable medical equipment can vary from very simple and inexpensive to highly complex and very expensive. As SCI usually refers to traumatic spinal cord injury, SCD refers to spinal cord dysfunction, which may present either as a non-traumatic spinal cord injury, multiple sclerosis, or Guillain-Barre Syndrome, etc. The information presented in this document relates to the needs of any of these individuals, with the hope that their function may be augmented by the use of DME.

The purpose of this document is to provide information about DME, as it relates to the general and specialized needs of persons with SCI/D. In doing so, the document describes the available DME that may meet the complex needs of individuals with SCI/D throughout the continuum of life. As an individual with a disability ages, a change in medical and functional status may be accompanied by differing DME needs. Comorbidities (such as amputation, multi-trauma, dual diagnosis traumatic brain injury and lack of safety consciousness, etc) may also alter the prescription or componentry considered appropriate for an individual's use. And not all equipment is necessary for every individual with SCI/D. The information provided and recommendations on types of equipment within this document are not intended to be prescriptive but rather to serve as a guideline. Each individual should be evaluated to determine their individual functional status, prognosis, environmental considerations and caregiver and financial resources when outlining a comprehensive DME recommendation.

Throughout this document, special attention has been given to what is considered medically necessary or medically beneficial. Medically necessary has been defined as "referring to a covered service or treatment that is absolutely necessary to protect and enhance the status of a patient and could adversely affect the patient's condition if omitted, in accordance with accepted standards of medical practice"

The definition of "medically necessary" used in this document is similar to how it is defined by major medical insurance companies. "Medically necessary durable medical equipment" is that equipment which an interdisciplinary healthcare team recommends or provides to an individual for the purpose of evaluating

and treating an injury, disease or symptom, is clinically and medically appropriate for the person's diagnosis, and is in accordance with accepted standards of medical practice. DME is also considered necessary when it has the capacity to prevent present conditions from deteriorating, decrease a person's pain or discomfort, and improve a person's function. The term "medically beneficial" is used in this document for the purpose of describing DME which may not be necessary to sustain life or safety, but may prevent degradation of impairment, augment an individual's efficiency and ease of functional skills even further, decrease caregiver burden of care, and contribute to the health and wellness of those individuals with SCI/D.

Letters of medical necessity (LMN) may be required or helpful for both public and private funding sources to justify certain pieces of DME as both medically necessary and/or medically beneficial to an individual. The sample LMNs that are included at the end of this manual are meant to serve as EXAMPLES ONLY to help justify specific prescriptions of specialized DME. Each LMN should be individualized to the person being served, including information on alternatives tried and why they are not appropriate as well as specific reasons for this piece of equipment and necessary componentry. These should not be used as "template" letters.

The pictures and website links that are utilized in this manual are NOT intended as an endorsement or advertisement for specific models or products, but merely as an illustration of that category or type of equipment. No one brand or type of equipment is appropriate for all persons with SCI/D, and a thorough evaluation should be completed to determine what piece is the "best fit" for that individual.

As the DME market is in a constant state of change, this document will be reviewed and revised on a regular basis. Throughout the continuum of life, the individuals' physical condition, functional status, caregiver availability and environmental factors will also fluctuate and may influence changes to the need for DME. It is hoped that the information presented in this document can be used as a basis for equipment evaluations and prescriptions for persons through their lifetime following SCI/D.

ASSISTIVE TECHNOLOGY

Assistive technology (AT) is "any item, piece of equipment, software, or product system that is used to increase, maintain, or improve the functional capabilities of persons with disabilities" as defined by the Assistive Technology Industry Association (www.ATIA.org). There are three primary goals of the use of assistive technology for persons with SCI:

1. To provide an optimal level of functioning including independence.
2. To increase the individual's autonomy and minimize the need for caregiver assistance.
3. To promote satisfaction with function and a high quality of life, whether it is at home, in the workplace, or in the community.

Assistive technology can refer to any piece of equipment, low tech or high tech, that helps someone to function more independently. For the purposes of this chapter we will focus on technology that helps individuals with SCI/D access and participate meaningfully in their environment. The most functional AT option for a user is not necessarily based on their level of injury. Assistive technology selection must be based on ease and speed of use, user preferences, user stamina or fatigue, and prevention of repetitive strain injuries. Often, a mix of products will be used to create the most effective solution. Working with an interdisciplinary therapy team, an Assistive Technology Practitioner (ATP), researching online, and networking with peers with SCI/D can help identify potential product solutions. You can find a directory of ATP's online at www.resna.org. Assistive technology may not be reimbursable by certain insurers. However state-funded grant programs and low cost loans are available. Furthermore, solutions that are designed for the general population may offer lower cost options than specialized medical/rehabilitation equipment.

In this chapter we will discuss common assistive technology options. Please note that products shown in this chapter do not represent product endorsements, but serve as examples of an array of available technologies. Assistive technology is a rapidly evolving field. While this chapter provides the best summary available at the time of printing, it is wise to search the internet for new, emerging technologies.

ENVIRONMENTAL CONTROL

Historically, the best way for individuals with SCI/D to control objects in their environment was through the use of environmental control units (ECU), also referred to as Electronic Aids to Daily Living (EADL). Traditional environmental control units may still be appropriate for individuals who need switch access, are unable to speak, or require specialized solutions to operate medical devices such as hospital beds.

Today, "smart home" technology designed for home automation is widely available, offering accessible solutions for individuals with SCI/D. Smart home technology can be voice controlled or accessed via an app or remote controller. Smart speakers are commercially available devices equipped with far-field microphones for voice recognition that allow for hand-free operation of environmental control features from medication reminders to wirelessly connected appliances (such as Amazon Echo or Google Home). Switch options are becoming available (such as flic https://flic.io).

Some examples of opportunities for home automation and smart appliances are:

- Door locks
- Automatic door opener
- Lights
- Television
- Computer
- Stereo or Radio
- Intercom
- Thermostat

- Surveillance camera and security system
- Fans
- Coffee maker
- Oven / Crockpot / Microwave
- Dishwasher
- Washer / Dryer

Prior to choosing environmental control technology, the person's functional ability should be assessed to determine the most effective way for the person to interface with the environmental control system. The following sections discuss various access methods for environmental control.

COMPUTER ACCESS

There are many options that will help someone with impaired upper extremity function to access their computer and other personal electronic devices more independently. When considering these options, ease of use, fatigue, and the prevention of repetitive strain injuries should be considered. In most cases, users will find a mix of products to be the best solution to meet their personal, educational, or business needs. Touchscreens are available on some computers, offering additional accessibility. Please note tablets offer their own accessibility features and may combine solutions listed under computer and smartphone access options.

Voice Recognition: Voice recognition allows the user to access the features of the computer using their voice using specific commands. Basic voice recognition features are available on most computer platforms (windows, Mac) and advanced, customizable software is commercially available. The ability to dictate allows users to generate text at a faster speed than other methods. There is a learning curve to use dictation software efficiently to operate all of a computer's functions. In addition, a high quality microphone is imperative for achieving optimal functionality. For individuals with poor breath support due to tetraplegia, voice dictation may be best paired with other methods for maximal function. (Examples of voice recognition software for computers: Dragon Speech Recognition Software: https://www.nuance.com/dragon.html ; Braina Pro: https://www.brainasoft.com/braina/download.html).

Eye Control: Eye gaze technologies allow the user to access their computer by using the movements of their eyes. Eye gaze can be difficult to master initially but allows for total computer control via the mouse and onscreen keyboard with for individuals who have minimal motor movements. (Examples: Tobii Dynavox Eye Tracking System https://www.tobii.com/group/about/this-is-eye-tracking/; Eye Gaze Edge: https://eyegaze.com/products/eyegaze-edge/)

Ergonomic Mouse Options: There are many types of accessible mice on the market. An accessible mouse can be paired with an onscreen keyboard to allow text generation for increased functionality. Commercially available ergonomic mice including variations in the size and shape of the mouse that may meet some users needs.

Trackball or Roller Ball Mouse: The rollerball/trackball allows the user to move the by accessing a roller ball in one space without having a large reach in the arm. This can improve efficiency and reduce fatigue.

Pneumatic or Sip and Puff Mouse: A pneumatic mouse allows someone to access the mouse without the use of their upper extremity using the mouthpiece for sip and puff functions and/or as a joystick. (Example: Quadlife https://quad.life/).

Wheelchair Integration: Power wheelchairs with advanced electronics offer users the ability to access bluetooth mouse functions through their power wheelchair access device (Head array, sip and puff, joystick) and associated switches.

Electronic Pointing Devices allow control of the mouse through a special sensor affixed to the user's head or glasses. (Example: Tracker Pro 2 https://www.ablenetinc.com/technology/computer-tablet-access/trackerpro-2 GlassOuse www.glassouse.com)

On-screen Keyboard displays a visual keyboard with all standard keys on the screen, allowing a user to select keys using a mouse or other pointing device.

Apps are available that allow smart phone control of the computer, using the touch screen as a track-pad mouse.

TELEPHONE ACCESS

There are numerous options to access both landline and cellular telephones. State-based accessible telecommunications programs may offer support to select and procure an accessible telephone.

Landline Telephone Options: There are voice controlled options for landline telephones. Lower cost auto-answer speaker phones allow individuals with SCI/D to receive calls automatically, but still require touch access for dialing. Switch based telephones are also available. Consider the weight of the receiver and size of the buttons when looking at landline access. For individuals who work in office environments, headsets may allow easier access for answering a large volume of calls.

Smartphone Options: Smartphone technology continues to provide more and more voice control and accessibility options. Each operating platform and model has its own accessibility options including a virtual assistant who can help make calls, send text messages, and perform internet searches using voice commands. Assistive touch functions minimize dexterity needed to perform smart phone functions and aftermarket blue tooth switches can provide switch access to smart phones. Consider how the user will activate the phone when it is asleep, make calls, send texts, and access apps and internet functions. Switch options are available for smartphone access such as Tecla-e https://gettecla.com/pages/tecla-e). Touch free options that respond to head movements are also available (such as https://www.sesame-enable.com). Mouse-style control of a smart phone is also possible with an adapted mouse system (such as GlassOuse www.glassouse.com)

Touchscreen Access For those with limited dexterity, devices are available to facilitate touchscreen access. A mouthstick allows someone with SCI to access a stylus through a mouth controlled stick. This can offer improved functionality on tablets for activities such as playing games. **Stylus rings** can be worn on the finger and give easy access to a more isolated pointer. **Typing splints and universal pointers** facilitate typing and pointing for individuals with poor dexterity but good upper body strength. For any of these options that will be used with a touch screen, check to be sure the input from the stylus will be sufficient for the type of touch screen access desired. For devices with capacitive touch, contact with a finger or conductive material is needed and some styluses may be incompatible with certain touch screens.

Mounting Options: When considering accessibility of a smartphone, tablet, or laptop-- consider how it will be mounted to the wheelchair or the bed for access. There are many types of mounts available for individuals with disabilities as well as the general market. Modular hose or flexible mounts allow the user to move the device easily in and out of view while maintaining durability. (Examples: http://modularhose.com/Assistive-Technology/mh-Tablet-and-Device-Solutions)

Charging: Think about how the battery life and how phone will be charged; charge cords can pose difficulty for individuals with limited dexterity and numerous wireless charging options are now available on the market.

ADAPTED GAMING

Video game adaptations provide an accessible leisure opportunity. Products such as the Xbox adapted controller and the quadtick open the door to functional game play (https://www.xbox.com/en-US/accessories/controllers/xbox-adaptive-controller and https://www.quadstick.com/shop/quadstick-fps-game-controller).

SWITCHES

A variety of switches are available that can be used to access power wheelchair functions, environmental controls, or phone options. Depending on the requirements of the system, switches may be wired or wireless. An assistive technology practitioner can assist the client to determine their most reliable and functional switch access methods considering their switch activation abilities and available switch options. There are a variety of switch access methods. Some switches require direct contact (buddy button, microlight, wobble switch), some offer multidirectional control (mini joystick), some may be mouth operations (pneumatic switches), while some are highly sensitive and may be activated from nearby movement (fiber optic or proximity switches).

ACTIVITIES OF DAILY LIVING EQUIPMENT

INTRODUCTION

There is a broad range of adaptive equipment available to assist the performance of activities of daily living (ADL) after SCI. Some equipment is task-specific while other devices may be used for a variety of tasks.

General aids are available to compensate for limited hand function. Examples include universal cuffs and adapted straps, foam tubing (varying diameters), easy hold silicone adaptive aids, splint materials for custom adaptations, and adhesive dycem strips or coban for wrapping around objects. Often, these items are combined with wrist stabilization splints. You can learn more about wrist stabilization splints in the Upper Extremity Chapter of this manual.

FEEDING AND GROOMING

Feeding and grooming activities are typically completed at a tabletop with adaptive equipment compensating for limits in fine motor coordination and upper extremity strength. A bedside table or a lap tray may provide a more accessible surface than a tabletop and a non-slip surface, such as dycem, may be needed to secure items when they are being used.

Some devices are used to stabilize the arm when strength is not sufficient for reaching against gravity. A Mobile Arm Support or overhead sling may be used as a training device or as a long term piece of adaptive equipment. These devices may be secured to a wheelchair or tabletop. You can learn more about these devices in the Upper Extremity Chapter of this manual.

Equipment for Feeding and Grooming

Feeders - These devices sit on the tabletop and use a long arm to transport food from a bowl to an individual's mouth. Mechanical and robotic options are available.

Scoop Dishes/Bowls and Plate Guards - Provide a ring around the surface of the plate/bowl to act as a backstop for scooping.

Adapted Utensils - Utensils are available with various modifications for grip such as built up handles, extended handles, bent handles, and finger loops.

Spillproof Cups - some come with handles to allow for easier drinking, some like the Kennedy cup come with straws.

Long Straw - Long straws allow the user to drink without bringing the cup to the mouth.

Universal Cuffs - Adapted straps that fasten around the palm to secure a utensil such as a fork or a toothbrush for self-care tasks. Universal Cuffs (U-Cuffs) are often combined with a wrist stabilization splint. Wider item-holders, silicone straps, and device-specific straps, such as for a razor, are also available.

Rocker Knives - Facilitate cutting through a rocking motion (versus a sawing motion). Adapted grips including a C grip and a T-bar grip are available.

Automatic Dispensers - Dispensers for soap, lotion, shampoo, toothpaste are activated by motion or button.

Self-leveling Utensils - Maintain a level surface in the presence of unsteady movements or tremors.

Long Handled Brush - extended handle allows hair brushing without raising the arm.

Hair Dryer Stand - stable hair dryer to allow both hands for hair management tasks.

Nail Clipper - One handed clippers allow cutting without bimanual use. A suction plate for a nail clipper stabilizes the clipper for individuals with limited dexterity.

Floss Pick - Holds dental floss so the teeth can be flossed with less dexterity.

Makeup Aids - There are a variety of devices to facilitate independent makeup application, such a safe grip mascara wand holder, ring grip mascara wand holder, and nail polish holder.

DRESSING

Pocket Dresser/Button Hook/Zipper Pull - Used to manage buttons and zippers. Different variations include a pocket knife format, built up grips and U-Cuffs

Zipper Loops - affix to zippers for easier pulling.

Dressing Stick - available in different lengths to extend reach to push and pull clothing.

Reacher - Provides extended grip via a trigger system. Can be used for tasks such as obtaining items from shelves, clothing from closets, and pulling pants over feet. Grip strength, length and type of closure vary. Options with wrist extension activation are available for individuals with limited hand function.

Adapted Laces - Elastic, shoe button, coiler laces, Pull Cord, Lock Laces

Shoe Funnel - Stabilizes the back of the shoe to don.

Shoe Horn - Stabilizes the back of the shoe to don.

Sock Aide - various types are available to pull the socks over the feet.

Adapted Clothing

Rather than use some of the DME listed above, some clothes have or can be adapted to help patients dress themselves from a seated position or allow those with deficits in hand strength or dexterity be able to secure the clothing independently. While once considered a niche market, many mainstream companies including Nike, Tommy Hilfiger, and Target now all sell adaptive clothing lines.

Tommy Hilfiger Adaptive Clothing
https://usa.tommy.com/en/tommy-adaptive?utm_medium=social&utm_source=3491815&utm_campaign=21742417&cid=social:3491815:21742417:230275524:106554094

IZ Adaptive These are more 'non-standard' clothing frames, those who are primarily in a seated position including non-bunching/shorter in back to help avoid pressure sores/discomfort. They are also adjusted for dexterity issues with buttons/snaps/zippers, other. https://izadaptive.com

MagnaReady sells dress clothing using magnets to aid in dressing ease including adapted ties and pants. https://www.magnaready.com

NBZ Clothing "No Buttons or Zippers". This company offers custom alterations as well. https://nbzapparel.com

Nike makes a line of shoes called FlyeEase which come in multiple different styles to allow easier donning and doffing. Some styles include a hands-free option, options with zip off backs to accommodate an AFO, and various types of lace-free designs. https://www.nike.com/flyease

Friendly Shoes also makes fashionable shoes that can be zipped open to allow for easier donning and doffing. https://friendlyshoes.com/

Fashion For All (FFORA) sells fashionable wheelchair accessories including bags, cupholders, purses, etc. https://liveffora.com/

Myself Belts sells one handed closure belts for both kids and adults. https://www.myselfbelts.com/

BATHING AND TOILETING

Having the proper equipment for bathing and toileting is essential for a person with SCI/D to be as independent as possible in their daily life. There are many factors that impact which piece of equipment is best for each individual with SCI/D. One primary factor is the accessibility of the bathroom space. Some equipment can only be used when structural modifications are present. See the structural modifications section of this manual for more information. For all equipment the durability should be considered, including considering the type of materials that will be getting wet during showering and be at risk for mildew, breakdown, and rust.

User factors such as level of upper extremity function, trunk balance, transfer technique, presence of spasms, or difficulty with orthostatic hypotension or autonomic dysreflexia will impact which piece of equipment works best for each individual. Caregivers can also provide valuable input during the DME selection process.

When prescribing bathroom equipment, the health care professional must always consider this population's need for maintenance of skin integrity. Pressure relief must be performed more frequently on bathroom DME to prevent pressure injuries and the method of pressure relief should be practiced when trialing equipment. Padding is always recommended for patients with spinal cord injury with decreased or absent sensation to minimize the risk of sustaining a

FEEDING AND GROOMING

Scoop Dishes/Bowls and Plate Guards

Rocker Knife

Adapted Utensils

Universal Cuffs

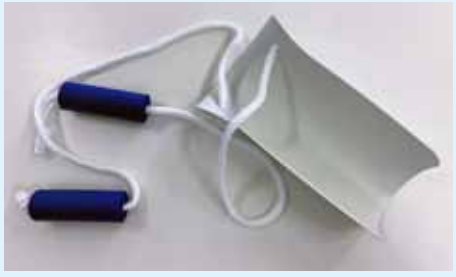
Dressing Stick

Reacher

Shoe Horn

Universal Cuffs

Therafin Electric Razor Cuff
www.therafin.com/catalogsearch/result/?q=electric+razor



Sock Aide

pressure injury. If a shower chair or commode does not provide enough padding to sufficiently protect skin integrity an overlay may be required.

Bariatric Considerations - The weight capacity should always be considered when selecting bathroom equipment. Please note that bariatric options are available for most types of equipment.

Adult DME Options

Rolling Commode Shower Chairs - Rolling commode shower chairs offer the individual the ability to complete bowel training or toileting and showers using one piece of equipment. Rolling shower/ commode chairs decrease the number of transfers necessary to complete bathing and toileting, which decreases strain on the shoulders and minimizes the risk for skin breakdown. A roll-in shower must be present for a rolling shower chair to be used for bathing. Bowel programs can be completed over the toilet or using a collection pan.

Common Features:

- **Tilt-in-space** - Provides pressure relief, postural assistance, and prevention of Orthostatic Hypotension. Tilt-in-space chairs may not fit over commodes for bowel program completion and may not offer self-propelling wheels.
- **Recline** - Opens back angle for trunk balance or to accommodate hip range of motion limitations.
- **Pelvic Belt** - prevents falls and skin shearing.
- **Seat Cutout** - Selection of location direction facilitates patient/caregiver access.
- **Laterals** - Provide trunk support and can correct/ compensate for postural asymmetries.
- **Chest Strap** - Provides trunk support.
- **Headrest** - Supports the head during tilt.
- **Brakes** - The chair must have effective brakes to prevent falls during transfers. Caster brakes are options that may be needed.
- **Arm Troughs** - Provide arm support to prevent shoulder pain and sublux.
- **Wheel Size** - 4 caster wheels allow for tight turns which is important in tight hallways or narrow doorways. Larger back wheels allow self-propulsion for individuals who are able to push the chair.
- **Removable/Swing Away Arms** - Allow lateral transfers.
- **Padding** - Padding is essential to prevent pressure injuries. Waterfall padding extends over the border of the chair frame at the cutouts and offers additional skin protection and is less likely to wear.
- **Collection Pan** - Provides a method to catch waste if the bowel program is not performed over the toilet.
- **Legrests/Footrests with Heel Loops or Calf Straps** - Keep the lower extremities supported during bathing and prevent the legs from sliding off the footplates when spasticity is present.

Commode Chair - Standard bedside commodes often do not meet the needs of people with SCI/D because the inability to move armrests for transfers, the absence of trunk supports, and concerns about pressure injuries.

Commode/Tub/Shower Slider Chair - Slider chairs have a chair on caster wheels that hooks on a sliding frame to allow the chair to slide into a tub or shower. The chair can be used over the toilet to complete a bowel program. Tilt options are available. Caster chairs offer maneuverability in very tight spaces and may prevent the need for structural modifications. Because they use caster wheels they cannot be pushed by the user and require the assistance of a caregiver.

Bath Lift - A Bath Lift is a single-button operation system that allows the users to descend into their bathtub and keep the backrest upright or to recline for more comfort. This is appropriate for users who can transfer but have difficulty lower into and lifting out of the tub's bottom.

Padded Tub Bench - A tub bench is a shower chair that extends over the edge of the tub to provide a more stable base and decrease the lift needed for transfers. Transfer benches include a back and armrest. Additional options include a commode cutout and suction cup legs for extra stability. Non-padded tub transfer benches are available but should be used with caution due to the increased risk of pressure injury.

Shower Boats - shower boats are an option for people who can not safely sit due to wounds, orthostatic hypotension, or skin/wound issues. Shower boats allow people to shower in a laying down position.

BATHING AND TOILETING

Rolling Shower Commode Chair

Bariatric Rolling Shower Commode Chair

Padded Tub Bench with Commode Cutout

Padded Tub Bench

Shower Boat

Shower Boat

They require a very large shower space often not found in the traditional home bathroom environment.

Padded Drop Arm Commode - A padded drop arm commode has arms the drop down to allow transfers and then can be raised for stability. These are typically general use items and not customizable.

Specialty Raised Toilet Seats/Commode Chairs - Many specialty padded seats allow customizable openings for commode cutouts, enhanced padding, and selection of backrest and armrest configuration. Collection pans are often available for these seats.

Overlays - Foam, gel, and air overlays are available to provide pressure distribution on toilet and shower surfaces.

Bidets and Bidet Toilet Seats - Provide hygiene via a water spray to reduce the need for a caregiver's assistance. Full units, toilet seats, and smart options are available.

Pediatric DME Options

Low Back Toilet Chair - a minimal support back used over a standard toilet designed to give support through the use of a positioning belt. It is often used in combination with a padded ring reducer.

Pediatric Commode Chair - a commode with smaller toilet opening and lower floor to seat height which better accommodates pediatric sizes. A chest strap is available as an accessory for those requiring additional trunk support.

Specialty Toileting System - a padded system available in multiple sizes and can be mounted over a standard toilet or used in combination with a mobile base, tilting base or portable base. The toilet opening is smaller for pediatric clients with a myriad of accessory supports, including trunk, pelvic, feet and a tray option.

Other Adaptive Equipment

Catheters - Completing a self-catheterization program independently can greatly impact quality of life for an individual with SCI. Many new catheter options are available that make it easier for people with SCI to catheterize independently. A urologist, a nurse, an occupational therapist, and a physiatrist can help you find the best catheter options that can be used with or without adaptive equipment for independence.

Catheter Inserter - A adapted grip clip used to hold a catheter for insertion.

Catheterization Mirror - Adjustable mirror which has a stable base. Sometimes includes a leg spreader bar. Facilitates vision and position for female catheterization especially during the learning process.

Penis Holder - Holds the penis in position while a catheter is inserted.

Pants Holder - Holds the pants out of the way while seated in a wheelchair for cathing.

Asta-Cath - Provides a guide for female catheter insertion.

Labia Spreader - Spreads the labia for female catheter insertion.

Electronic Leg Bag Emptier - Switch activated control of leg bag emptying mechanism.

Suppository Inserter - Spring loaded with extended handle with U-cuff to aide inserting a suppository.

Digital Stimulator - Used to stimulate the rectum. Also called a dill stick.

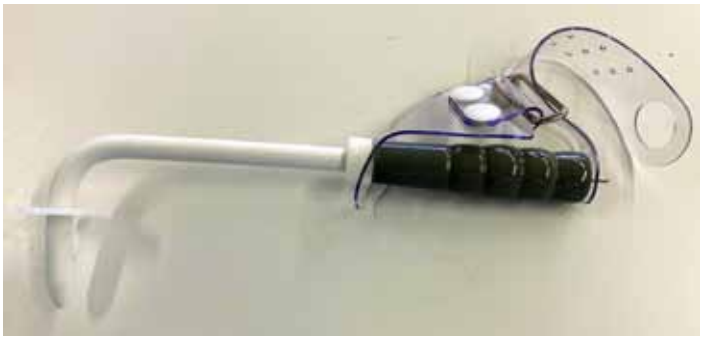
Toilet Aide - Used to extend reach and hold toilet paper for hygiene.

Skin Inspection Mirror - A skin inspection mirror can be used to check the skin for signs of breakdown when bathing. It can also be used to view the perianal area and toilet during bowel care to ensure cleanliness and monitor bowel output.

Wash Mitt - Allows the hand to be inserted into a washcloth mitt for independent bathing.

Soap/Shampoo Dispenser - Pump and automated/motion activated options are available.

Catheterization Mirror



Digital Stimulator

Toilet Aide

Long Handled Sponge - Allows increased reach for bathing. Adapted handles may be needed due to reduced grip strength.

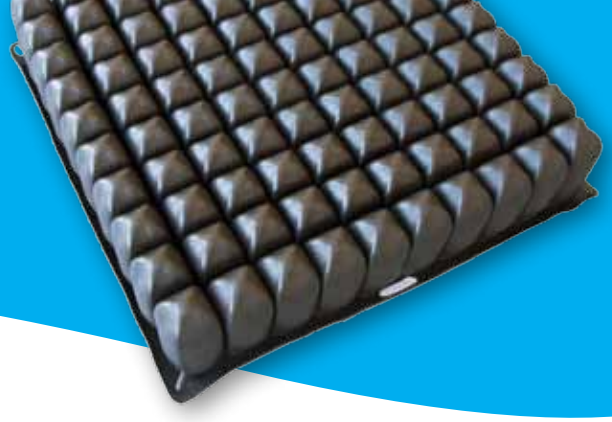
Hand Held Shower - Used to direct water to the desired area during bathing.

3D PRINTING

3D printing offers the opportunity for the development of readily available and potentially customized technology solutions from splints to cupholders. Many patterns are available online and training is available to pattern design and adaptation. Some examples of things that have been printed: pen holders, wheelchair cup holder, enlarged handle with hilt for utensils, mouth stick, pants holder for catheterization, toothpaste tube squeezer, medication bottle holder, zipper helpers, and more.

Some examples of online design repositories and training include:
https://www.thingiverse.com
https://cults3d.com/en
https://www.tinkercad.com

BEDS AND MATTRESSES



INTRODUCTION

Speciality beds, bed frames and mattresses can serve many purposes in the spinal cord disorders (SCI/D) population. They can be used to prevent and treat pressure injuries, enhance mobility and facilitate sphincter management,.[1-3] The addition of power/adjustable components may facilitate positioning for individuals requiring total assistance for mobility, thus enhancing comfort, reducing spasticity and contractures, optimizing respiratory function, and facilitating the management of autonomic dysautonomia (autonomic dysreflexia and orthostatic hypotension).[3] Finally, specialty beds, bed frames and mattresses may help optimize sleep quality, which is a significant health issue in SCI/D individuals dealing with pain, depression and/or poor quality of life.[4] Regardless of the pressure-distribution capabilities of a bed or support surfaces, repositioning is still necessary to manage pressure. [5,6]

In this chapter, specialty beds, bedframes and support surfaces indications for use will be described. Indications for use and specific considerations will also be discussed. Criteria for selection and a summary of current clinical recommendations based on literature will be presented..

BED AND SUPPORT SURFACES: EFFECT ON PRESSURE AND SHEAR STRESSES

The force opposing gravity's pulling force of an individual's body resting on a support surface can be divided into two distinctive components: 1) a perpendicular force resulting in pressure, and 2) a tangential component resulting in shear stresses. [7] Accordingly, soft tissues placed over a bony prominence are being compressed (by pressure) and deformed (by stretching and distorting stresses in the tangential plane) when resting on a support surface (Figure 1). Shear stresses and pressure act in conjunction to produce capillary damage and ischemia of the skin and deeper tissues leading to pressure injury development. Distinction should be made with friction, which refers to the force occurring when two surfaces are rubbed together (for instance, between the skin and support surface). While the latter is not recognized to be a direct cause of pressure injuries, friction is involved in the development of shear stresses in skin and deeper tissue layers.[7]

By offering different pressure distribution properties and position adjustments, bed and mattress devices can influence the impact of pressure and shear forces on the skin and deeper tissues. Support surfaces generally aim to reduce the interface pressure by increasing contact area, thereby decreasing compression and tensile forces. Specific types of support surfaces may also decrease or remove pressure from vulnerable areas (see Section 3.2). Bed frame, providing different adjustments for positioning the individual on the bed, may also influence shearing stresses and friction.

Accordingly, specific positions (such as 90 degrees side-lying or the semi-recumbent position at an angle of 45 degrees from the erect position) should be avoided as they are shown to increase pressure and/or shearing over the trochanteric and sacral bony

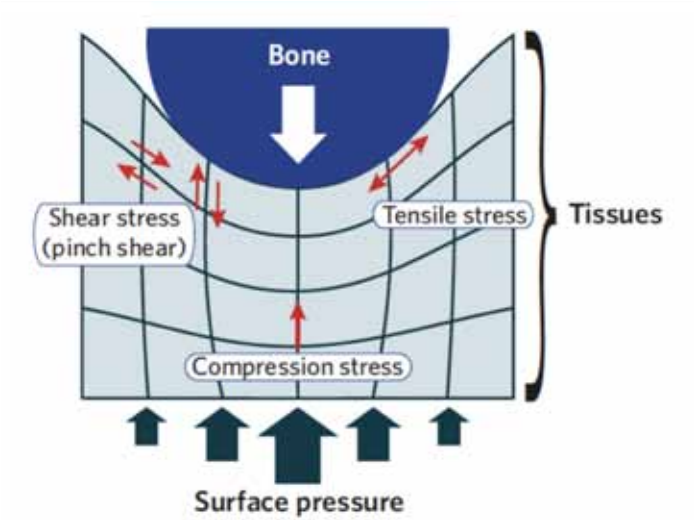


Figure 1: Shear stresses resulting from an even pressure distribution. Retrieved from *Pressure ulcer prevention: pressure, shear, friction and microclimate in control. A consensus document. London: Wounds International, 2010*[7]

prominences respectively. When these positions are required for medical purposes (e.g. dyspnea, prevent aspiration), repositioning should be done more frequently.[6,7]

DESCRIPTION OF BED, BED FRAMES AND SUPPORT SURFACES

The term "bed" refers to the bed frame and operating mechanism, while the term "mattress" refers to the support surface upon which the person lies.

Bed and Bed Frames

Individuals with SCI/D with limited mobility may benefit from specialized beds and bedframes which allow adjustment of height as well as head and foot elevation (Table 1). These adjustments may promote functional independence, enhance sleep quality, and manage different medical conditions following SCI/D.

Mattresses (Support Surfaces)

Support surfaces are specialized devices designed to reduce tissue loads, optimize the microclimate and promote other therapeutic functions, as important strategies for pressure injury prevention and treatmentPressure redistributing support surfaces are available in three main forms[5]:

- **Mattress Overlay:** A support surface device placed over an existing mattress. Mattress overlays elevate the sleeping surface and may put users at risk of falling off the bed if too thick. It is therefore

Table 1: Description of hospital and bed frames

Hospital Bed Frames	**Manual**	**Pros:** Require manual cranking for head and foot adjustments Less expensive than electric beds. Can be dissembled and reassembled for home settings. **Cons:** Cannot be used independently by SCI/D individuals while in bed; adjustments need to be operated by a caregiver. Generally only available in twin or standard sizes.
	Semi-electric	**Pros:** Power may be used for some adjustments of the bed (high-low position or head of the bed). Less expensive than a full electric bed. **Cons:** Some positions can only be adjusted manually.
	Full Electric	**Pros:** All adjustments of the bed are power-generated-enhancing functional independence. Bed adjustments can be made quickly for medical purposes and facilitating transfers. Does not require manual cranking from caregivers. Available in many sizes (twin, double, queen and bariatric). **Cons:** More expensive than manual and semi-electric beds. Can also be noisy and bulky in home settings.
Non-medical Beds	**Adjustable**	**Pros:** Provide head and foot adjustments. Bedroom amenities (such as night light and charging ports) may be available. Controllable through remote control and/or smart phone Aesthetically appealing Available in many sizes (twin, double, queen, king) **Cons:** No medical benefit other than head and foot adjustments. May not allow the use of mobile floor lift. Absence of rails that may support mobility and safety in bed Limited selection of support surfaces that often do not meet the needs for persons with SCI. Generally not FDA-approved medical devices.

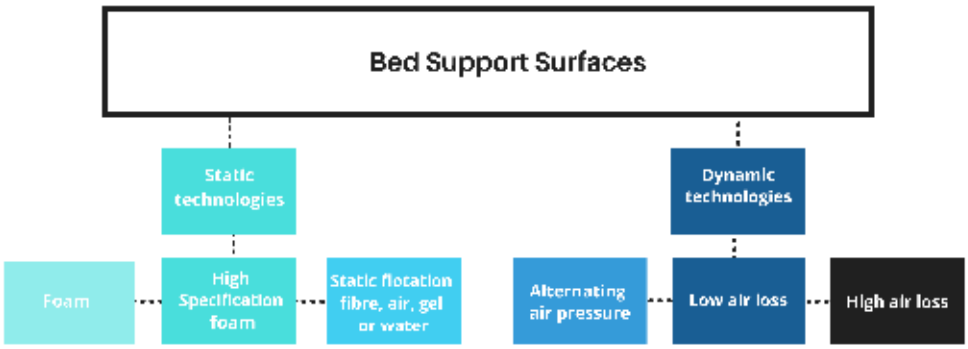


Figure 2: Classification of bed support surfaces based on the Canadian Best Practice Guidelines for the Prevention and Management of Pressure Ulcers in Spinal Cord Injury. A resource handbook for Clinicians (2013)[3]

recommended that bedrails be at least 10cm higher than the surface of the mattress overlay.[6]

- **Pressure Redistributing Mattress:** A device intended to replace standard mattresses while allowing continued use of the existing bed frame.
- **Integrated Bed System:** System combining a bed frame and a support surface (usually an alternating pressure mattress). These are most often used by SCI/D individuals for pressure injury prevention and treatment, or following surgical treatment of pressure injuries.

Gel mattress overlays may be used in the early acute phase following traumatic SCI prior to spinal surgical intervention, as other technologies using air or water may not provide necessary spinal stability. Current recommendations for "pressure-reduction mattresses or overlays" during acute SCI remain unclear.; however,[8] gel/silicone mattress overlays are currently used in specialized SCI trauma centers.[9] Based on this knowledge, it is the author's expert opinion that gel mattresses be used in the early acute phase following traumatic SCI.

Mattresses and support surfaces can be classified based on their capability to change the load distribution. For static technologies, the load distribution will change only when the individual's position changes. For dynamic technologies, periodic changes in load distribution result from the active movement of the mattress and/or support surface.

Static Support Surfaces

Static surfaces are commonly used for prevention and treating pressure injuries. Static technologies can be integrated into mattress replacements or overlays. Static support surfaces involve two modes of pressure redistribution-the envelopment mode and the immersion mode. The "envelopment" mode refers to the ability of the support surface to conform, to fit or mold around irregularities of the individual's body. The "immersion" mode refers to the effect of the body sinking (penetrating) into the support surface. (Figure 3).[6]

Patient needs must be considered when selecting a support surface as immersion and envelopment may impact a person's mobility and independence. For example a softer support surface may limit the individual's postural control, positioning and transferring ability. (Section 4). Moreover, attention should be given to ensure that the support surface's material is not too soft (causing the person to end up sitting on the underlying surface), or that it's cover is not too tight, creating a "hammock effect" (preventing the support surface to properly mould on the body). Both may lead to the development of high pressure over a small area resulting in pressure injury development particularly in the sacral area.[6] The different types of static support surfaces technologies, their specific characteristics and considerations for clinical selection are described in Table 2.

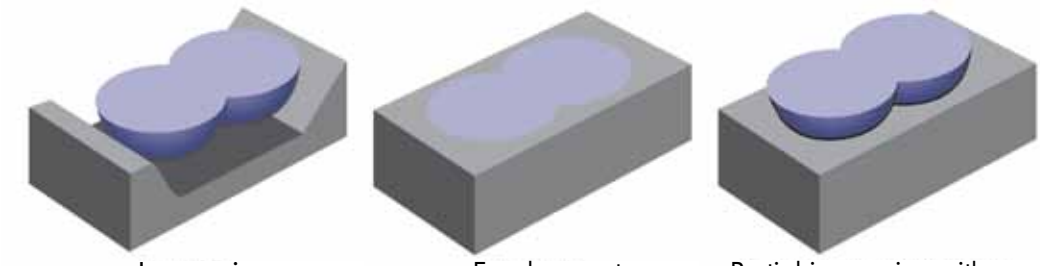


Figure 3: Immersion and envelopment (Retrieved from International review. Pressure ulcer prevention: pressure, shear, friction and microclimate in control. A consensus document. London: Wounds International, 2010)[7]

Table 2: Description of static support surface technologies[3,5]

Type of Redistribution Support Surface	Description and Performance Characteristics	Clinical Considerations PR	SR	MC	T
Monobloc Foam	Single piece of foam covered by a plastic or r nylon cove	+	–	–	–
High-specification Foam	Multiple foam layers of different densities, with specific foam sections that can be removed temporarily to remove pressure on corresponding specific areas. Gel or air-filled cells may be used in addition to foam.	++	–	–	+/–
Static Flotation, Air, Gel or Water	Constant low pressure surface consisting of: • Synthetic fibres coated with silicone arranged in a series of connected cells, • Fluid/water system conforming to body contours, • Air- or gel-filled compartments providing envelopment and immersion depending on the pressure of the air or gel in the compartments.	++	+	–	+

PR, Pressure redistribution; SR, Shear reduction; MC, Microclimate management; T, Impact on self-transferring ability

Static support surfaces do not require power and are considered cost-effective when properly matched to individuals. Despite this, it is important to remember that they can lead to a significant increase in shear loads, heat and moisture.[6]

While monobloc foam mattresses are generally used as standard mattresses for non-SCI patients in hospitals and long-term care facilities, other technologies involving high-specification foam, static flotation, air, gel or water are generally preferred for pressure injury prevention or treatment of uncomplicated pressure injury.[3,7] However, gel and water mattresses can be heavy to move.

Dynamic Support Surfaces

As showed in Figure 2, dynamic support surfaces comprise three different types of technologies and are generally indicated for individuals who are at higher risk of pressure injuries or are being treated for pressure injuries.[3,6,7,10,11] Dynamic support surface technologies are described in Table 3. These systems offer greater pressure reduction than static systems.[3,6]

Low air loss systems are generally used when pressure injuries fail to heal on an alternating air system and when pressure injuries occur on multiple (>1) turning positions of the body.[3,8]

High air loss (air fluidized) surfaces require a completely integrated bed system and may be used for individuals who cannot tolerate other support systems. Several randomized controlled studies have shown the benefit of this system for individuals with stage III and IV pressure injuries in comparison with standard beds, foam and other non-fluidized support surfaces.[7] Air fluidized support surface may also be used for post-operative myocutaneous flaps or skin grafts.[3,12] While this system provides the greatest immersion and envelopment some drawbacks of use have been reported. First, repositioning and transfers may be very difficult to perform independently and thus using this system may result in further functional limitation and may also interfere with patient handling.[3] Also, patients may not tolerate the sensation of floating or the warmth of the surface. Finally, this system may cause dehydration due to increased heat in the room and on the patient. It also requires occlusive dressing on wounds in order to avoid dryness and is very costly.[12]

Additional Features and Emerging Technologies

Fully integrated bed systems may include powered and computerized lateral rotation (tilting) of the support surface for assisting patients requiring total assistance for mobility, in order to allow periodical repositioning

BEDS AND MATTRESSES

Full eElectric

Low Air-loss

Air Cell Filled

High Air-loss or Air-fluidized Therapy

Figure 4
Freedom Bed™ by ProBed Medical: Automated Lateral Rotation Bed available in 3 sizes, Standard, Extended and Bariatric (https://www.pro-bed.com/overview)

Figure 5
Adjustable Rotational Bed (https://theraposture.co.uk/adjustable-beds/rotoflex)

in bed. In addition to potentially promoting functional independence, these systems also facilitate caregiver interventions for turning and transferring the individuals, examining the skin, assisting in bedding equipment changes, and providing physical/respiratory therapies. **Figure 4** below shows a bed which automatically rotates the individual to the right and left sides throughout the night or as programmed. This type of bed can be used in individuals who are unable to reposition themselves while in bed. **Figure 5** below shows an example of a bed which rotates completely to allow the individual to stand up from a seated position though this can only be used for individuals with good trunk control and more minimal mobility deficits. Electronic systems such as these are more expensive than conventional electric bed frames. The efficacy of self-rotating beds versus manual rotation has not been extensively studied in the SCI population.

Table 3: Description of dynamic support surface technologies[3,5]

Type of Redistribution Support Surface	Description and Performance Characteristics	Clinical Considerations			
		PR	SR	MC	T
Alternating Air Pressure	Small or large air-filled cells redistributing pressure through cyclic inflation/deflation	+++	++	–	–
Low Air-loss	Made of air holes in top surface, this technology provides a continual blow out of air causing the patient to float, reducing the skin interface pressure with the mattress surface and reducing moisture.	+++	++	++	++
High Air-loss or Air-fluidized Therapy	Using a continuous circulation of filtered air through silicone or glass-coated beads that have pressurized air forced between them creating a fluid-like medium. This support surface provides the greatest immersion and envelopment of any support surfaces.	++++	++	++	+++

PR, Pressure redistribution; SR, Shear reduction; MC, Microclimate management; T, Impact on self-transferring ability

Features	Reasons
Level of mobility within the bed	Degree of envelopment and immersion may significantly affect transfer and postural control. Patients requiring total assistance for mobility may require electric/ adjustable bedframes to mobilize themselves in bed and help caregivers.
Patient Comfort	Some systems may be uncomfortable for patients.
Need for Microclimate Management	Low and high air loss systems may assist with managing heat and moisture.
Care Setting	Some integrating bed systems may be unavailable or inconvenient for home settings due to weight, noise or power source.
Lifestyle	Total and consecutive number of hours spent on the bed in a day, tasks to be accomplished from the bed surface, and the environmental context (partners who sleep in the same bed and help from caregivers) should be considered
Safety Issues	Beware of entrapment of individuals with reduced mobility between the edge of the mattress and side rails. The height of the bed frame may place the patient at risk of falls during transfers. Falls may also occur when bed rails are not used or are too low compared to the support surface
Financial Resources	Financial capacity and primary payer should also be considered as costs may significantly differs for the different technologies

Bariatric patients require special consideration as they may be too heavy for some active support surfaces, and require extra width or adapted versions of bed and mattresses specifically designed for their weight and size.

KEY SELECTION CRITERIA FOR SUPPORT SURFACE SELECTION

Selection of the bed, mattress, and support surface should not only be based on the risk of pressure injury, but should incorporate a multidisciplinary coordinated approach engaging patients and considering important key features described below.[3,6]

Re-assessment of Bed and Mattresses Devices in SCI Population

Once the bed and mattress are put into place, regular skin assessments should be provided to ensure that the load redistribution strategy is still effective and adapted to the person's condition. Presence of pressure injury, change in the condition of the patient should particularly target systematic re-assessment of the risk levels for pressure injury and of the support surfaces, including bed and mattress devices.[3,5,6]

When a specialized support surface is used, these features should be checked and monitored regularly to ensure that pressure redistribution and other important features are still effective[6]:

- Foam mattress may lose their "spring/memory" effect and thus fail to recover their initial geometry when compression is released
- Air filling devices should be properly inflated and checked for potential air leaks
- Gel should be evenly distributed throughout the surface when a gel mattress is used
- Air alternating systems should inflated and deflated properly
- Power devices should be checked and must be properly plugged into a power supply.

CURRENT EVIDENCE RELATED TO THE USE OF BED PRESSURE-RELIEVING DEVICES IN THE SCI POPULATION

These recommendations are issued from the current Canadian, American and International guidelines for prevention and management of pressure injuries for people with SCI[3,7,8,13]

Prevention and Education

Provide individuals with SCI, their family, significant others, and health-care professionals with specific information on effective strategies for the prevention and treatment of pressure injuries. This should include the following: (Recommendation Level II/III/IV/V)[8]

- Etiology of pressure injury
- Measures for reducing risk of pressure injuries
- Skin cleansing, drying and care techniques
- Management of incontinence
- Frequency and techniques of skin inspection
- Frequency, duration, and techniques of recommended position changes
- Frequency, duration, and techniques of recommended pressure redistribution
- Nutrition as it relates to maintaining skin integrity
- Use and maintenance of support surfaces (mattresses and cushions)
- Skin changes to be reported to the health-care team

Evaluate the individual and his/her environment for optimal maintenance of skin integrity (Recommendation of Level II/III/IV)[8]

- Apply pressure-reducing support surfaces preventively to protect soft tissues from bruise and injury.
- Prevent moisture accumulation and temperature elevation at the support surface-skin interface
- Apply pillows and cushions to bridge contacting tissues and unload bony prominences, do not use donut-type devices
- Establish a mechanism to follow up on equipment performance specific to pressure injury prevention and determine if changes in medical or health status have altered the effectiveness of the support surface

The principles involved in minimising the effect of shear stresses and friction with regards to bed and mattresses, include:[7]

- Decreasing tangential forces by minimising head of bed elevation, and during sitting in bed, avoid sliding downwards and forwards. Accordingly, limit head-of-bed elevation to 30 degrees for an individual on bedrest, unless contraindicated by

medical condition. If sitting in bed is necessary, avoid head of bed elevation or a slouch position that places pressure and shear on the sacrum and coccyx.

- Encourage individuals to sleep in a 30 to 40 degrees side lying position or flat in bed if not contraindicated
- Avoiding actions that induce tissue distortion such as: avoiding sliding or dragging, by ensuring that patients are positioned in a way that does not allow them to slip easily and by ensuring that body tissues are not dragged upon repositioning or left distorted following repositioning, use transfer aids to restrict friction and shear, lift –don't drag- the individuals when repositioning.
- Increasing contact area with support surface: this spreads the perpendicular and tangential loads and friction force over a larger area, reducing the localised pressure and shear stresses.

Selection of Support Surface

Use a support surface with advanced pressure-redistributing properties, compared with a standard hospital foam mattress, to minimize peak pressure areas around bony prominences and protect soft tissue from bruising and injury (Level 4 Recommendation)[3]

Use pressure-redistribution bed support surfaces for individuals who are at risk for or who have pressure injuries (Recommendation Level I,II,IV,V)[8,13]

- Select a static support surface for individuals who are able to reposition themselves enough to avoid weight bearing on all areas at risk for pressure injuries and who have a stable spine.[13]
- Select a dynamic support surface for individuals who are unable to reposition themselves, who cannot be positioned without pressure on a current pressure injury, when a static support surface bottoms out, if there is no evidence of healing or if new injuries develop using this surface[13]
- Select low air-loss or high air-loss (air-fluidized) beds in the treatment of pressure injuries if one or more of the following conditions exist:
    - Presence of pressure injuries on multiple turning surfaces
    - Compromise skin temperature and moisture control in the presence of large stage III or IV pressure injuries
    - For individuals who are status post flap/skin graft within the past 60 days.[8]
- Replace the existing mattress with a support surface that provides better pressure distribution, shear reduction and microclimate control in the following situation (Level 4 Recommendation)[3]
    - Pressure injuries on multiple turning surfaces
    - Compromised control of microclimate in the presence of deep tissue injury
    - Person cannot be positioned off the pressure injury
    - They are a high risk of developing additional pressure injuries
    - Failure to heal or wound deterioration
    - Bottoms out on the existing support surface"
- Select smooth, low-friction, breathable fabrics for bedding and clothing to optimize microclimate control and minimize friction (Level 4 Recommendation)[3]

Positioning

Use bed-positioning devices and techniques that are compatible with the bed type and the individual's health status (Recommendation Level II/V)[8]

- Avoid positioning individuals directly on pressure injuries regardless of the pressure injury anatomical location unless such position is necessary for performance of ADLs, such as eating or hygiene
- Use pillows, cushions, and positioning aids to reduce pressure on existing pressure injuries or vulnerable skin areas by elevating them away from the support surface
- Avoid closed cut-outs or donut-type cushions
- Prevent contact between bony prominences
- Elevate the head of the bed no higher than 30 degrees unless medically necessary

The use of a pressure redistributing support surface does not eliminate the need for repositioning. While a systematic review of pressure injury prevention

strategies found insufficient evidence to support a specific repositioning regimen. However, the traditional 2-hourly repositioning regimen may provide a useful point from which frequency can be adjusted, based on the patient's tissue tolerance, level of mobility, general medical condition and the support surface in use.[7]

Follow-up and Re-assessment

Regular observation is essential in evaluating the efficacy of pressure redistribution strategies: any sign of pressure damage should prompt re-evaluation of the strategies in place.[7]

Re-evaluate the suitability of the support surface for pressure injury prevention and treatment at least every 4 years, and sooner if the person's medical condition changes (Level 4 Recommendation)[3]

CONCLUSION

Individuals with SCI are highly vulnerable to pressure injuries throughout the continuum of care. Selection of bed and mattress and recommendations when using bed devices should be individualized based on many factors, such as the level of mobility, medical status and previous or current pressure injuries. A multidisciplinary evaluation by a team who has expertise in SCI care is thus recommended using a holistic approach.

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PERSONAL TRANSPORTATION AND DRIVING OPTIONS

INTRODUCTION

It is imperative that an individual with SCI/D receive at minimum a comprehensive evaluation when exploring personal transportation options. These options are ever-changing and through assessment by a qualified professional, an individual with SCI/D can be assured of receiving current information on trends in the industry. This Chapter refers to driving possibilities only and does not cover other alternative transportation, such as trains, planes and bus transportation.

A Certified Driver Rehabilitation Specialist (CDRS) is an individual certified to provide services in the field of driver rehabilitation through the Association for Driver Rehabilitation Specialists (ADED). CDRS are found in both rehabilitation hospitals as well as the private sector and are governed by a best practices guideline as provided through ADED. Occupational Therapists who have been certified through the AOTA (American Occupational Therapy Association) as "Driving Generalist" or "Driving Specialist," are also qualified to provide these services. It is vital that whoever is providing these services stay abreast of both transport and independent driving venues and must provide accurate direction in all program and vehicle options.

DRIVER REHABILITATION PROGRAM

Evaluation, Training, Vehicle Modification and Follow-up Services

The following details a list of the services that may be appropriate for individuals with SCI/D. Since SCI/D can affect each individual with varying neuromuscular deficits and clinical symptoms, this overview is only a guide and reinforces the necessity of assessment by qualified professionals.

Vehicle Assessment for Passenger Transportation Only

- Clients who opt not to or are unable to drive independently
- Funding source needs to be taken into consideration
- Sedan, SUV, Truck or Van based options
- Vehicle selection is often determined by:
  - type of mobility device utilized, for example the use of power versus manual wheelchair
  - tolerances such as wheelchair seating height, width and length (final wheelchair measurements must be utilized), folding or rigid wheelchair frame
  - wheelchair base for respective tie-down system, if applicable
  - special considerations such as ventilator dependency
  - available caretaker and their capacity to assist
  - usable space inside of vehicle
  - transfer ability/upper extremity health
  - skin integrity
  - client age

Vehicle Assessment for Passenger Only with Future Driving Considerations

- Level of injury indicates the potential to drive in the future (in many instances C5 and lower).
- Vehicle initially modified to only aid in the transport of client
- Choice of vehicle is determined while considering the possibility of the client as a future driver/operator as well as aforementioned considerations in section A (eye level, future transfer ability, future wheelchairs, etc).
- Funding source considerations for passenger tie down, and for future driving modifications
- Modifications, structural and otherwise, prescribed with the intent to enable this person to drive

independently if possible with future addition of driving controls (such as lowering entire floor area of minivan or (sometimes) full size van, instead of mid-section only, power operated wheelchair ramp instead of manual ramp and power operated entry door instead of manual door).

Van Assessment for Those Receiving Full Driving Consideration

- Comprehensive evaluation provided by an occupational therapist or a CDRS (Certified Driver Rehabilitation Specialist).
- The ideal model has all evaluations completed in house by a CDRS with either a traffic safety or allied health professional background.
- If an outside source is being utilized, strong consideration should be given to a CDRS.
- Clinical Assessment
  - Interview and compiling a record of the medical and driving history and developing a rapport with the client, licensing and funding source considerations
  - Vision screen; acuity, fields, depth, color and other oculomotor skills
  - Physical/Functional status; available extremities, strength, range of motion, trunk balance (static), spasticity, transfer skills
  - Cognitive/perceptual testing
  - Assessment of mobility assistive device, appropriateness and compatibility with overall requirements of the potential driving scenario
  - Discussion of potential vehicle options and the modifications/adaptations that may be required for independent community access for the individual.
- Static Behind the Wheel Evaluation
  - Evaluation vehicle made available for assessment
  - Independent function is primary in observation
  - Entry and egress options trialed
  - Independent access to the driver station whether driving from the wheelchair or a transfer seat
  - Capacity to achieve a viable and safe operator position
  - Ability to secure and release mobility device
  - Assess transfer to an adapted transfer device such as a six way transfer seat base
  - Ability to operate seat belt and torso strap
  - Access and interface with primary control functions
  - Access and interface with secondary control functions
  - Preparations to advance to the dynamic phase of assessment
- Dynamic Behind the Wheel Evaluation
  - Start in low impact setting and may advance to on road. A low impact setting is a driving environment that is not complex, such as a driving range, parking lot or side street.
  - Motion will often produce the need for ongoing or frequent adjustments, for example, sometimes with impaired balance the wheel can be more difficult to turn
  - Assess into the vehicle (wheelchair) and the operator's interaction (trunk stability)
  - Assess active range of motion and endurance in motion. Determine capacity to move into driver training phase
  - Develop a preliminary vehicle choice, adaptation and modification recommendation

Sedan Assessment for Those Receiving Full Driving Consideration

- Greatly determined by an individual's capacity to manage the transport of any assistive mobility device, whether it be power, power assist or manual, with the use of the sedan vehicle
  - wheelchairs
  - scooters
  - walkers, crutches, canes, braces, prostheses and splints
  - assistive technology is available on a limited basis for mobility device management in a sedan setting
- Capacity to ambulate short distances may be required in some instances
  - must be timely in completion of requirement
  - must not jeopardize safety in the complete circuit

- Quality of movement and endurance must be scrutinized. Capacity to transfer into and out of vehicle and manage any devices must be completed in a timely manner and not jeopardize safety issues.
  - Lifestyle and vocational goals are strongly considered
  - Assistive technology is available on a limited basis for assisting in the ingress and egress process in a sedan setting.
  - Consider weather/climate
- Evaluation process very similar to the aforementioned in the van section
  - Clinical
  - Static
  - Dynamic

Recommendations/Summary/Program Direction

- Upon completion of the dynamic assessment a comprehensive report is generated and recommendations made. The summary of all results is shared with the individual, and in the final process, a report is generated to be distributed to the client, referring source and any third-party payer.
- Determination of whether driving is an appropriate activity for this individual is formulated by the assessment team.
- If driving is inappropriate, a discussion may include appropriate goals that may improve potential for future success;
  - Seating assessment to improve interface with vehicle or to improve clients interface with wheelchair
  - Therapeutic intervention to improve physical status, wheelchair management skills, transfer training, trunk stability
  - Medications
  - Surgeries such as Baclofen pumps/tendon transfers etc.
  - Vocational counseling or other alternatives to determine the availability of funding sources
  - Alternative transportation options available for community access if driving is not an option today and in the future (i.e. public transit options, transport services, rentals, etc.)
- Driver Training
  - Training is necessary in most instances where adaptation/modification is made.
  - Training is tailored to suit individual needs and previous experiences.
  - Most states have medical review and licensing requirements that must be addressed.
  - Comprehensive training should include multiple traffic scenarios and roadway conditions.
  - Speeds to meet local requirements through freeway operations. Can the client achieve, adjust to, and handle the speeds required in multiple traffic scenarios and densities from local roadways in addition to freeway driving?
  - An ongoing assessment of needs is based on the driver's independence.
  - Upon completion of the training program and licensure with any appropriate equipment restrictions, a final prescription/document for adaptation/modification of the appropriate vehicle of choice is developed.
- Discussion of Mobility Equipment Vendors and their role
  - Best options include those vendors that are members of National Mobility Equipment Dealers Association (NMEDA).
  - NMEDA vendors are held to standards of practice and many are certified in various levels of adaptation/modification processes based on complexity.
  - Vendors will provide vehicle options, adaptations and modifications based upon the evaluator's recommendations or final prescription.
  - Vendor, client, funding source and evaluator(s) will collaborate to ensure the project is completed with integrity.
- Upon procurement of vehicle for driving/ transportation:
  - Many funding sources will require an inspection of all adaptations and modifications by a qualified outside source.
  - In all instances the evaluator should provide a vehicle inspection to ensure the prescription has been adhered to throughout the process.

- In all instances the evaluator should provide a functional assessment of the driver's independence and capacity to operate the vehicle on the road.
- Completion of any follow-up training as indicated by the functional assessment should be completed as soon as possible, by a qualified trainer.
- Evaluator may have a temporary brake installed or use a brake stick.

DRIVER REHABILITATION PROGRAM

Description of Injury Levels and Potential Assistive Driving Technology

C1-4 Motor Complete Injury

- Not a driving candidate in majority of instances, unless injury has significant motor function in the C5 and C6 Myotomes
- Transport Van Consultation
  - Minivan or Full-size van, SUV Pickup Truck options for wheelchair accessibility
  - Home site considerations for parking
  - Caregiver assistance available
  - Type of wheelchair and special considerations
  - Entry/egress clearances of the vehicle
  - Location of the individual in vehicle
  - Wheelchair securement and occupant restraint system options

C5 Motor Complete Injury

- Driving Considerations to include:
  - Driving a van, SUV or Pickup Truck modified for wheelchair accessibility
  - Driving vehicle from a power wheelchair (vehicle within the vehicle), with power securement (tie down) system
  - Supplemental support for trunk stability and extremity support (laterals, chest straps, backrest, arm rests, shoulder block, etc)
  - Ingress/egress clearances
  - Independent to and from safe operator's position
- Primary Driving Controls
  - Hi-Tech or power assisted controls for acceleration, braking and steering functions with orthotic interfaces. Examples include: a joystick to operate any combination of gas/ brake and steering, a small satellite steering wheel, an electronic gas/brake lever, etc.
  - Modification to vehicle system resistances. Examples include low/reduced effort braking, moderate/maximum reduced effort steering.
  - Location of controls critical in maximizing clients available range of motion, strength and endurance
- Secondary Driving Controls
  - Remote operation of ignition, gear selector, horn, wiper/washer, headlamps, turn signals; Remote location of consoles, pads, buttons to allow for activation within a client's AROM, or voice commands, (some of which must be capable of activation while driving or while the vehicle is in motion).

C6 Motor Complete Injury

- Driving Considerations
  - Driving a van modified for wheelchair accessibility
  - Driving from a power wheelchair and in some instances a manual chair
  - Driving from a manual w/c dependent upon seating system arrangement. Does the seating system provide adequate support for the demands of driving and/or a secure position for vehicle operation?
  - Is the wheelchair compatible with a wheelchair tie down system for a driver?
  - On rare occasions may be capable of appropriate transfer to a transfer seat base in the van

Supplemental Support for Trunk Stability

- Primary Driving Controls
  - Some hi-tech driving considerations in most instances (see C5 section for examples).
  - Can include a reduction in required effort through modification of an existing system in the vehicle such as steering or brakes.
  - Low tech is a mechanical adaptation added to an existing control without a reduction in effort. Examples for gas/ brake are mechanical hand controls that can be mounted on the right or left side of the steering wheel or the right (and

occasionally the left) side floor in the driver's area. Gas/brake controls (hand controls) can be grouped by their movement, such as: push/rock, push/pull, push/twist, push/right angle, etc. There are many different types of handles/orthotics for the hand controls themselves and for the steering wheel. Common examples of steering wheel orthotics (or steering devices) include: spinner knobs, bi-pins, tri-pins, palm cuffs, V grips, etc.

- Potential for operation of low-tech or mechanical controls with or without modification to vehicle system resistances

- Location/positioning is critical and orthotic interfaces may be needed.
- Secondary Driving Controls
  - Refers to anything aside from acceleration, braking and steering such as gear selector, lights, horn, directional signals, parking brakes, windows, radio, climate control etc.
  - Remote secondary controls required in some instances but may be limited. Examples are buttons mounted near the elbow, hand, head that allow the client to operate turn signals, high beams, wipers, horn etc while still driving the vehicle. Voice command controls are also examples of secondary controls that may be indicated for this population.
  - Fitting in the vehicle to determine capacities and needs, which includes the need to position the client in the driver's station or position and through demonstration determine what they can or cannot activate or operate independently without adaptation or modification to a control.
  - Mechanical adaptations may preclude the need for power assist in some instances. Examples can be longer lever arms on hand controls to make the motion have less resistance (but this will require greater range of motion). Another example can be steering wheel extensions, to get the steering wheel closer to the client for positioning needs (sometimes necessary for a client with shorter arms and a protruding stomach).
  - In some instances, an adaptation to a control can be completed without having to utilize an electronic device to achieve independent operation of that control such as extensions on the original equipment in the vehicle. Examples are extended handles for gear selectors/turn signals/keys, pegs/small sticks for window operation or climate control operation.

C7 Motor Complete Injury

- Driving Considerations
  - Many in accessible vans but potential for sedan driving
  - More manual or power assist wheelchairs used here
  - Seating issues may prevent driving from the manual wheelchair; Inappropriate support for the demands of driving, patient safety and wheelchair securement compatibility (not enough torso support sometimes requires added equipment.
  - Some drive from transfer seats drivers in a van or truck
  - Wheelchair management skills and transfer capacities are indicators for use of sedan
  - Power assistive devices available for some to assist in wheelchair management in sedan scenario, such as car top wheelchair carriers.
  - Supplemental trunk support still likely to be needed to provide the necessary support allowing for a consistent and safe interface with the adaptations to the vehicle's primary controls which are acceleration/braking and steering.
  - Wheelchair lifts for non- modified pickup trucks/vans. These can put the wheelchair into a side door or the bed of a pickup truck.
- Primary Control Considerations
  - Hi-tech less prevalent if not eliminated
  - Mechanical controls and intact factory resistances (see examples listed under C6).
  - Potential need for orthotic interface with controls (see examples listed under C6)
- Secondary Control Considerations
  - Potential for adaptations to actuators per vehicle and clients' needs, such as climate controls, wipers/washers and headlamps
  - Some custom assistive devices are found in these instances without power requirements.

- These are control adaptations that are customized on a specific client- needs basis by a qualified fabricator who works for a mobility equipment dealer.

C8 and Below Motor Complete Injury

- Driving Considerations
  - Access to sedan or non-structurally modified vehicle driving in many instances
  - Wheelchair management still a major issue with power assistive devices still available
  - Trunk stability still requires supplemental support in many instances
  - Primary and Secondary control of vehicle with mechanical interface at the original equipment manufacturers settings

When an individual presents with a SCI/D defined as incomplete, personal transportation requirements can vary greatly from the information that has been provided in this guideline. It is imperative that a comprehensive evaluation be provided to determine each individual's capacities from a motor activity return perspective, regardless of diagnosis, to ensure that appropriate recommendations are developed and safety is addressed. This assessment is a necessity for consideration of personal transportation and driving.

Figures

Below you will find picture examples of some of the adaptive devices available to allow persons with limited mobility to drive independently. These pictures are meant to be representative of some of the different types of devices available and are not an endorsement of any one product.

Figure 1: This is a side entry lowered floor minivan with a foldout wheelchair ramp. These are typically equipped with power sliding doors, power ramps and kneeling rear suspension, which are all required to enable a wheelchair user to drive independently. There are lower cost conversions for wheelchair users who do not drive, with manual sliding doors, manual wheelchair ramps but these cannot be used for independent drivers. Rear entry versions are also available to transport wheelchair users who do not drive though side entry models are more popular.

Figure 2: Figure 2 shows a full size van with lowered floor, raised top, power door openers and platform style wheelchair lift. Generally, raised tops are installed to increase headroom and entry height for persons in wheelchairs to be transported in their wheelchairs or for persons who can transfer to a six way power transfer seat. Lowered floors are installed for persons who will drive from their wheelchairs. Lowered floors also provide increased headroom and entry height but also compensate for people in tall power wheelchairs to bring their eye level to an appropriate height to see out of the windshield while driving from their wheelchair. Lowered floor minivans provide the same result.

Figure 3: Figure 3 shows a six way power transfer seat in the driver's location of a lowered floor, wheelchair accessible minivan. This seat moves up and down, forward and back and swivels toward the center of the vehicle (transfer site) enabling the wheelchair user to transfer between a wheelchair and the transfer seat by being able to move from the driving position to a position next to the wheelchair at the same height for a safe transfer. The OEM seat is installed onto the transfer base and retains all OEM adjustments and functions. It is operated via 3 toggle switches which are visible in the photo. Optional pendant cord equipped with the same 3 functions is also available. They are typically installed in the driver's location but can also be installed in the front passenger location.

Figure 4: Figure 4 shows a side entry truck conversion. This allows for driver's side entry with a wheelchair lift system for the person to stay in their wheelchair without transferring to drive.

Figure 5: Figure 5 shows a quick release, removable mechanical left foot accelerator pedal with built in guard covering the OEM accelerator pedal to avoid accidental acceleration. This enables a driver with impaired right lower extremity function to use the left foot to accelerate. A more permanently mounted electronic version is also available, which is activated via a switch on the instrument panel each time the vehicle is started.

Figure 6: Figure 6 shows the electronic servo assist accelerator and brake hand control with tri-pin handle for drivers with impaired hand function. It can be installed for left or right hand operation. This device is useful for drivers who do not have sufficient upper extremity function to operate a mechanical hand control. The electronic servo multiplies force for acceleration and braking, requiring only a few inches of travel on the handle. The tri-pin is equipped with a switch that, when rocked to the left, activates a menu

PERSONAL TRANSPORTATION AND DRIVING OPTIONS


Figure 1


Figure 2


Figure 3


Figure 4


Figure 5


Figure 6


Figure 7


Figure 8


Figure 9


Figure 10


Figure 11


Figure 12

of secondary controls including turn signals, horn, headlight dimmer, windshield wipers and washers, cruise control. Generally it is installed in vans for persons who drive from their wheelchairs.

Figure 7: Figure 7 demonstrates a push/rock style accelerator and brake hand control installed for left hand operation with a steering spin knob and a quick release removable pedal guard which prevents the driver with impaired lower extremity function from inadvertently placing their feet onto or under the OEM accelerator and brake pedals. In this photo, they are installed in a sedan, for persons who are able to transfer independently between a wheelchair and a sedan or ambulate to the sedan.

Figugre 8: Figure 8 shows a set of push/turn style accelerator and brake hand controls which are installed for right hand operation. These are equipped with a brake hold button for use during gear selection and can be equipped with an electronic secondary control pad to operate turn signals, wiper/ washer, etc

Figure 13

Figure 14

Figures 9 - 11: These three photos show a set of push/ rock accelerator and brake hand controls installed for left hand operation with a steering spin knob mounted on the steering wheel (figure 9), a tri-pin steering spinner mounted on the steering wheel (figure 10) and a palm grip spinner device (figure 11).

Figure 12: Figure 12 shows a steering spin knob equipped with electronic button switches to operate secondary controls such as turn signals, wiper/washer, horn and headlight dimmer.

Figure 13: Figure 13 shows push rock mechanical hand controls

Figure 14: Figure 14 shows Viegel Classic Push twist mechanical hand controls. With this style of hand control pushing in brakes and turnig the handle accelerates. The hand controls are slim in profile allowing seat adjustment close to the hand controls.

Figure 15: Figure 15 shows another style of steering spinner device equipped with switches to operate secondary controls including turn signals, wiper/ washer, horn, headlight dimmer.

Figure 16: Figure 16 shows a remote electronic gear selector for people with impaired hand function who cannot operate the OEM gear selector. It can be mounted to the left or right of the driver.

CONCLUSION

The preliminary, individualized evaluation of an individual with SCI is imperative when investigating transportation and driving options. For many individuals with SCI, community re-integration is not achievable without either the ability to drive or to access appropriate transportation. Thorough patient assessment and evaluation of driving and transportation options make it possible for those persons to get back on the road again!

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LOWER EXTREMITY ORTHOSES

INTRODUCTION

This chapter provides guidelines for equipment and orthoses used to augment or replace lower extremity (LE) function affected by spinal cord injury or dysfunction. It addresses both external devices such as standers which patients can be placed into, as well as orthoses which are worn to improve positioning and upright mobility. Orthoses can be used to help with ambulation at the therapeutic, household, and/or community level. Patients may require assistive devices such as crutches or a walker, even with the use of lower extremity orthoses.

Functions of Orthosis

1 Reduce energy cost of ambulation
2. Pain reduction and provide comfort
3. Deformity correction and prevention (Solid AFO prevents equinus deformity of foot, KAFO for preventing Genu Recurvatum)
4. Support/stability of joints (Eg. KAFO provides mediolateral stability)
5. Assist action of weak muscles (assist motion)
6. Spasticity control (tone reducing orthosis)
7. Restriction of range of motion of hyperflexible joints
8. Pressure redistribution (helps in prevention of joint deformity and pressure sores)

GENERAL CONSIDERATIONS

A multidisciplinary approach incorporating the patient, caregivers, physician, physiatrist, physical and occupational therapists and certified prosthetist-orthotist is essential for orthotic decision making. Orthotic options are determined by the strength of both key and non-key muscles of the lower extremity assessed using the International Standards for Neurological Classification of Spinal Cord Injury (ISNCSCI). Non-key muscles include hip extensors, knee flexors, and gastrocnemius assessed in traditional manual muscle testing positions. In addition, sensation, skin integrity, range of motion, blood pressure and fluid status should be assessed. The patient should be evaluated for cognitive ability to understand the wear/care of orthotic use. The patient should be deemed a candidate based on expected compliance and/or a support network.[1]

Further evaluation for orthotic use should include upper extremity strength as an assistive device, such as crutches or a walker, may be required for mobility even with the application of lower extremity orthoses. In addition, a thorough orthopedic evaluation for scoliosis, kyphosis, pelvic obliquity, hip subluxation/dislocation, lower extremity fractures or amputation, and evaluation of biomechanics, kinematics of gait, proprioception, and spasticity should be completed to determine indications and contraindications of orthotic care.

Orthoses must fit and function well and re-assessment is necessary to ensure continued fit and appropriateness. A client who receives an orthosis must receive education regarding its use and maintenance in order to prevent changes in skin integrity as well as maintain optimal effectiveness of the orthosis.

Table 1. Considerations for Orthotic Use

Strength of lower and upper extremity musculature
Orthopedic impairments (scoliosis, pelvic obliquity, hip subluxation/dislocation, lower extremity fracture, amputation)
Spasticity
Joint contractures
Proprioception
Biomechanics in upright positioning and kinematics of gait
Orthostatic hypotension
Endurance/energy expenditure requirements

LOWER EXTREMITY ORTHOSES

Three primary goals for the use of orthotics for persons with spinal cord injury (SCI) are:

1. protect and/or maintain bone and joint integrity
2. assist with function/ mobility while substituting for muscle strength, and
3. to encourage normal orthopedic development in children[1].

Lower extremity orthoses range from off-the-shelf products, which do not require modification, to custom-fit off-the-shelf products and custom-made orthoses. They can be worn unilaterally, bilaterally, and in some cases are connected and encompass both limbs within one orthosis. In general, a custom-made orthosis is indicated for anatomical abnormalities, heavy-duty/obese patients, patients presenting with weakness throughout the limb, and/or long-term repeated use.

Table 2. Common materials/components used in Lower Extremity[4] Orthotics

Carbon Fiber	Lightweight, durable, and has energy storing/returning properties Consider for heavy duty users, obese patients Possibly indicated for edematous patients as total contact can be reduced
Metal	Traditional style often indicated for legacy patients with similar exisiting braces Possibly indicated for edematous patients as total contact is reduced Increased durability but also increased weight and bulk Steel, aluminum and titanium configurations possible
Plastic	Custom orthoses can be configured for more or less contact and more or less stiffness
Padding	Can be added to most custom braces Indicated for edematous, insensate, and sensitive patients Various durometers/types of padding possible
Joint Options	Various hip, knee and ankle joints exist to help restore function and/or prevent deformities Activity level, ROM, desired outcome, patient strength and weight should all be considered

Orthoses can be made from various materials such as metal, plastic, and/or carbon fiber. Orthoses may contain mechanical joints which help assist or prevent certain motions at the level of the hip, knee, and ankle or contrarily may be unjointed if no motion is desired. One may want to consider padding if a patient presents with poor sensations and/or volume fluctuations to prevent skin breakdown. Please see flowchart below to determine which materials may be indicated depending on your patient's condition.

The following are descriptions of lower extremity orthoses typically used with persons with SCI:

Stander: commercially available and usually includes a seat that the user transfers into or a pelvic strap which allows the patient to stand directly from the wheelchair. A manual, hydraulic or electric lift is used to bring the individual to standing. Lower extremity, trunk, chest, and upper extremity supports are available as needed.

A stander is beneficial for multiple body systems affected by spinal cord injury including cardiometabolic, bowel/bladder function, as well as the prevention of skin, bone, and joint complications. Standers also encourage increased participation level in activities in an upright position (i.e. school, social activities.[14]

Ankle Foot Orthosis (AFO): When used for upright mobility, this type of lower extremity orthosis provides ankle and foot support for the user as well as influence for hip and knee mechanics. An AFO can allow improved foot clearance during swing phase of ambulation and/or provide stability of the ankle/knee in stance phase of gait. They can improve safety during transfers by preventing unwanted motion, as well as standing and mobility by providing ankle and foot support.

AFOs may be off-the-shelf or custom-made depending on the patient's indication. There are both articulating and non-articulating versions available depending on the patient's presentation. See Table 2 for design considerations.

For AFOs the general options are as follows:

- Solid AFOs which control motion at ankle in sagittal, coronal and transverse planes. Generally indicated for someone with profound weakness throughout foot and ankle. This design can be used both as a positional AFO for standing/ transfers, as well as for ambulation.
- Semi-solid AFOS which are trimmed to the midline of the malleoli to allow for more motion at the ankle than a solid AFO. Indicated for someone primarily with sagittal plane foot drop and fair strength in coronal/transverse plane at the foot and ankle.
- Posterior Leaf Spring AFOs are trimmed posterior to the malleoli and allow for more sagittal motion at the ankle. Indicated for someone primarily with sagittal plane foot drop and good strength in coronal/transverse plane at the foot and ankle.
- Ground/Floor reaction AFOS(GRAFOS or FRAFOS) have an anterior component of the AFO which extends below the knee. GRAFOs are generally indicated for people who need knee extension assistance and/or have plantar flexion weakness. It promotes knee extension through mid-late stance and assists with plantar flexion in late-stance.
- Articulating AFOS are jointed at the ankle level which can be used to limit, allow, and/or assist with certain motions. For example, a joint can block plantar flexion but assist with dorsiflexion. There are several joint types and configurations which can be used based on the patient's presentation so be sure to consult with your local specialist.
- Stretching AFOS are used to increase/ maintain ROM at the ankle and foot. There are OTS options which can be purchased to control purely sagittal motion but if a patient has severe contractures and/or contractures in more than one plane(ex: equinovarus) a custom-made orthosis is likely indicated. It is even possible to use dynamic stretching orthoses which can increase ROM in 2 or more planes(ultraflexsplint images)

Knee Ankle Foot Orthosis (KAFO): KAFOs cross the knee, ankle and foot, are generally custom-made, and provide knee, ankle, and foot stability. There are various mechanical joints which can be used to increase stability including locking joints and posterior offset joints. It is important consider patient compliance with KAFOs due to their bulk and relative difficulty to be donned/doffed. See Table 2 for design considerations.

Hip Knee Ankle Foot Orthosis (HKAFO): This type of lower extremity orthosis stabilizes the hip, knee, and ankle. When used bilaterally, this orthosis consists of a pair of KAFOs attached to one another by a pelvic band, or trunk orthosis. With the hip component locked a swing to/through gait pattern is used. With the hip component unlocked, the user may be able to ambulate with a reciprocal gait pattern. It is important consider patient compliance with HKAFOs due to their bulk and relative difficulty to be donned/doffed. See Table 2 for design considerations.

Reciprocating Gait Orthosis (RGO): Consists of a pair of HKAFOs that are connected to one another by a pelvic band and cable system, allowing the user to ambulate with a dynamic reciprocal gait. RGOs allow the user to ambulate with a dynamic reciprocal gait pattern by using body weight shifts. The patient must have sufficient hip extension and lordosis to benefit from an RGO. It is important consider patient compliance with RGOs due to their bulk and relative difficulty to be donned/doffed.

FES Surface Stimulation Systems: These systems provide stimulation of specific nerve/muscle groups, generally via electrodes worn on the skin. Commonly, such devices can be used to target ankle dorsiflexors to improve foot clearance. Benefits of such devices are that they don't limit ROM, there is reduced bulk, and they promote muscle hypertrophy. They require a specialist to program the device and are indicated for patients with good cognition and/or a good support system. Examples of these devices are the Walkaide and Bioness. They can be worn in conjunction with other orthoses such as a foot orthotic inside of the patient's shoe to control ankle instability.

Hybrid Systems: These systems combine traditional orthoses with functional electrical stimulation (FES) components. The FES components may provide stimulation via implanted, percutaneous or surface systems. These systems can be used for brief functional activities such as standing to cook or retrieve items or short distance walking. Of note, the use of these systems require much more training than orthoses alone.

LOWER EXTREMITY ORTHOSES


Stander with built in air cell filled cushions (https://easystand.com)


Solid AFO


Carbon Fiber AFO

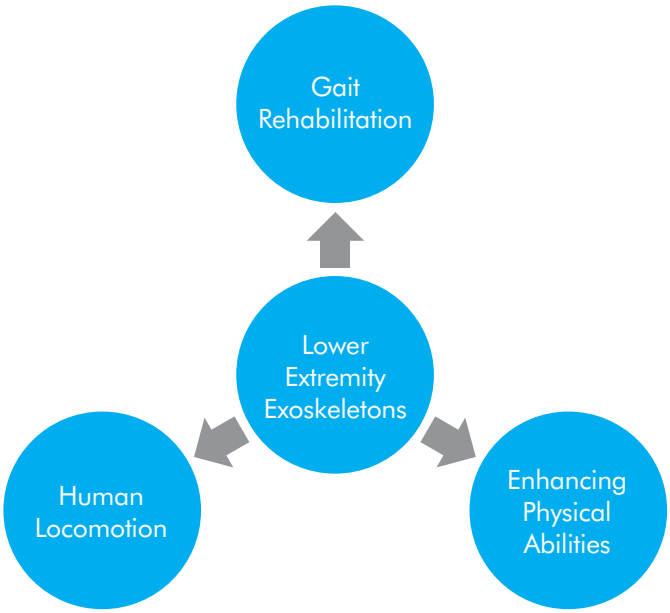

Articulated AFO


Drop Lock KAFO


Bale Lock KAFO

Stance Control KAFO

Robotics: The use of robotics in spinal cord rehabilitation has increased due to growing research interest and the advancement of robotic exoskeleton systems. Exoskeletons are wearable devices that augment, reinforce, or restore human performance. Some exoskeletons are fixed (see Lokomat below), while some are mobile devices in which clients can utilize for therapeutic and functional ambulation (see ReWalk below).[18] These devices may also be termed as motorized orthoses. Per Chen et al, exoskeletons can be classified into 3 categories:



Adapted from Bing Chen, Hao Ma, Lai-Yin Qin, Fei Gao, Kai-Ming Chan, Sheung-Wai Law, Ling Qin, Wei-Hsin. Recent developments and challenges of lower extremity exoskeletons. Journal of Orthopaedic Translation (2016)

Gait rehabilitation exoskeleton devices are utilized as training tools to improve an individual's ability to walk and improve gait mechanics while human locomotion devices provide an opportunity for clients to ambulate when they lack the strength to do so without robotic assistance. Many devices on the market can be utilized for either gait training or human locomotion, but availability, pricing, funding, and approval for home use of these devices vary across the nation/ country. There are some robotic devices that are approved for research, some that are approved by regulatory agencies for use with a skilled professional, and others that are approved for use in the home and community. Other considerations with robotic orthoses is the increased training needs for the devices. Robotics that enhance physical abilities are often utilized in military or industrial settings to increase repetition or efficiency for a particular task, and are not utilized in spinal cord injury rehabilitation. While the term exoskeleton is implied due to the application to bilateral lower extremities and the trunk, there are robotic devices being developed for a unilateral lower extremity issue or for an individual joint. Benefits of lower extremity robotic systems include: increased repetition of task-specific training, uniformity and precision of lower extremity movements, and the opportunity to ambulate for those whose impairments prohibit otherwise. Some features that are continuing to be addressed are: availability, cost, weight of the device, access to the device, and increased time for set up/ fitting. It is important to note that while there have been studies that demonstrate benefits of robotics, they have not shown them to be superior to other gait training devices.[17] Several studies have been completed to determine the safety and effectiveness of robotic devices and these studies show few adverse effects and improvement of walking patterns in clients with incomplete injuries, however, further research is warranted, especially as technology advances.[15]

Orthotic Considerations Based on Neurological Level of Injury

C1 to C6 Levels with Complete (AIS A) SCI:
Medically Beneficial Use of LE Orthotics

- Standing: Tilt table or Hydraulic standing frame[2]
- Functional Ambulation: not indicated

C7 to C8 Levels with Complete (AIS A) SCI:
Medically Beneficial for Use of LE Orthotics

- Standing: Hydraulic or standard standing frame[2]
- Functional Ambulation: not indicated[2]

SCI at the T1 to T9 levels with Complete (AIS A) SCI:
Medically Beneficial for use of LE Orthotics

- Standing: standing frame[2]
- Functional Ambulation:
  - typically not functional mobility
  - typically therapeutic/exercise ambulation[1-2],
  - significantly increased physiological demand[6-8]

SCI at the T10 to L1 Levels with Complete (AIS A) SCI:
Medically Beneficial for Use of LE Orthotics

- Standing[2]

Reciprocating Gait Orthosis (RGO)

https://www.bostonoandp.com/products/lower-limb-orthotics/reciprocating-gait-orthosis-rgo

Bioness FES Surface Stimulation Systems

https://bionessrehab.com

Fixed Exoskeleton
www.hacoma.com

Mobile Exoskeleton
www.ReWalk.com

- Functional Ambulation:
  - typically therapeutic/exercise or household ambulation, with practice and assist for independence with the use of assistive device and lower extremity orthosis[2]
  - the orthosis may also be medically necessary if it is required to substitute for lost/absent muscle function.

SCI at the L2 to S5 levels with Complete (AIS A) SCI Medically Beneficial for use of LE Orthotics:

- Standing: with orthosis[2]
- Functional Ambulation:
  - typically household to community ambulation, with practice and assist for independence with the use of assistive device and lower extremity orthosis

Possible options of LE Orthoses by SCI Motor Level:

Level of SCI	Standing	Prevent/Correct Deformity	Functional Ambulation
C1-C6	Stander	Stretching AFOS, Positional Solid AFOs, ROM Knee Orthoses	N/A
C7-C8	Stander	Stretching AFOS, Positional Solid AFOs, ROM Knee Orthoses	N/A
T1-T9	Stander	Stretching AFOS, Positional Solid AFOs, ROM Knee Orthoses	N/A
T10-L1	HKAFO/ KAFO	Stretching AFOS, Positional Solid AFOs, ROM Knee Orthoses	RGO, HKAFO, KAFO
L2-S5	HKAFO/ KAFO/ Solid AFO	Stretching AFOS, Positional Solid AFOs, ROM Knee Orthoses	KAFO, AFO

Complete SCI

*This table is assuming there is a complete SCI. A thorough evaluation of each patient must be done to determine ROM, strength and functional abilities. This table is only to be used as a rough guideline and, in addition, the specific functions of the orthoses should be determined with a trained professional such as determine solid versus semi-sold AFO or locking KAFO versus free-moving KAFO, etc.

- the orthosis may also be medically necessary if it is required to substitute for lost/absent muscle function.

Incomplete Spinal Cord Injuries (AIS C and D): When considering the use of LE orthoses for mobility and ambulation, for individuals with incomplete SCI, it is necessary to look at the strength and function of individual LE muscle groups as opposed to using the individual's Neurological Level to make recommendations.

LE Orthotic Considerations with Special Populations:

Pediatric:

- In children with SCI, orthoses are frequently used to promote normal bone alignment during growth at the hips and the spine.
- 80% to 98% of children who sustain SCI prior to skeletal maturity develop a scoliosis[9-10].
- Early bracing of the spine, using an orthosis such as a thoracic lumbar sacral orthosis (TLSO), may delay the age that surgical intervention is required, and in curves less than 20 degrees, an orthosis may reduce the possibility of a surgical fusion[11].
- Hip dislocation and subluxation is also a concern in the pediatric SCI population, as one study[12] found that 93% of patients injured prior to 11 years and 9% of children older than 11 years had at least one hip subluxed or dislocated.
- To facilitate proper femoral head and acetabular positioning while in supine an abduction pillow can be used to maintain hip abduction[13].

Bariatric:

- Weight capacity considerations

CONCLUSIONS

A thorough clinical evaluation and discussion of functional goals is essential prior to initiating orthotic use. A multidisciplinary approach incorporating the patient, caregivers, physician, physical and occupational therapists and certified prosthetist orthotist is essential for orthotic decision making.

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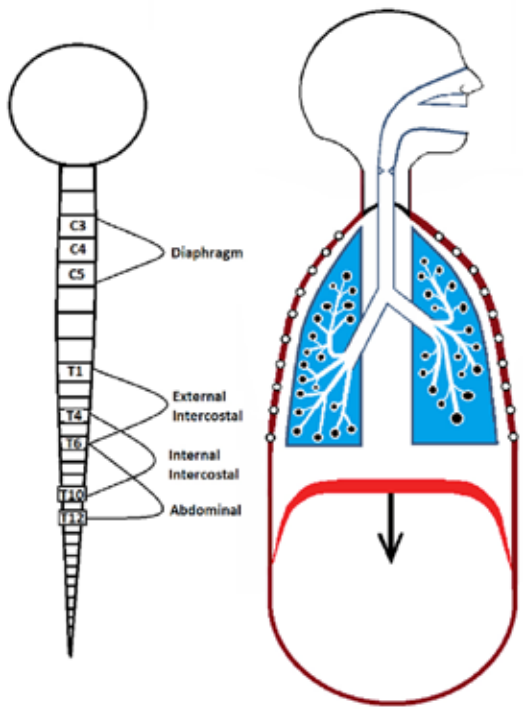
RESPIRATORY DYSFUNCTION AND MANAGEMENT

INTRODUCTION

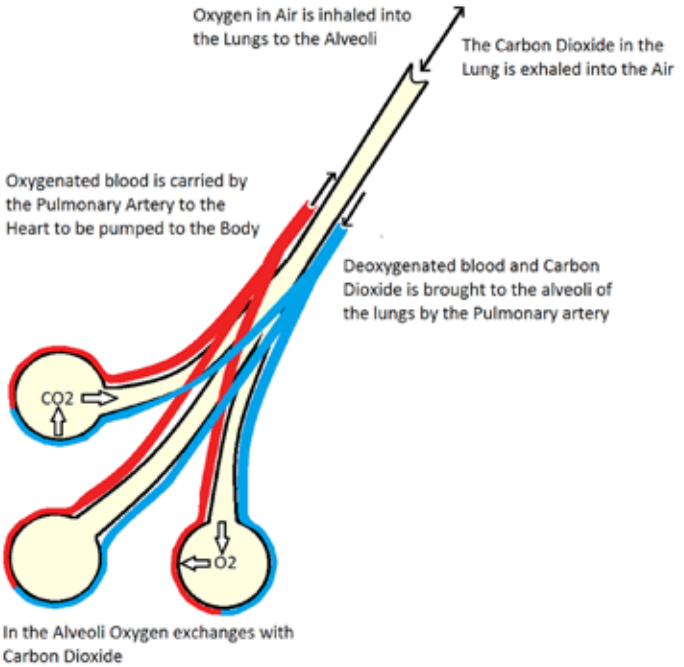
Diseases of the respiratory system have been the leading cause of death in persons with spinal cord injury (SCI) from 1973 to 2019 (National SCI Statistical Center, 2019 Annual Report). Breathing is both the physical and chemical exchange that moves air in and out of the lungs. In the process, several key functions are affected:

1. Breathing enhances oxygen and carbon dioxide exchange to maintain life
2. Cough is enabled to propel air and secretions out of the lungs
3. Vocalization occurs as air passes over the vocal cords
4. Smell and taste is enhanced as air passes over the nasal epithelium
5. Acid-Base balance is controlled with the elimination of carbon dioxide



The neurological level and completeness of SCI will help determine whether there is impaired or absent innervation of the breathing muscles, which can affect inspiration and expiration. In addition, breathing can be passive or active. Passive involuntary breathing is the process in which air is drawn into the lungs by the negative pressure generated by diaphragm muscle contraction and pushed out of the lungs by positive pressure created during elastic recoil of the chest wall. Active breathing can be produced by voluntary diaphragm, intercostal and abdominal muscle contraction.

The brain controls the rate and depth of breathing. Signals from the brain travel down the right and left phrenic nerves that innervate the diaphragm muscle (C3-C5). Signals from the brain also innervate the external intercostal muscles (T1-T6) that are important for active inspiration and the internal intercostal muscles (T4-T10) that are important for active expiration. And finally, the contraction of abdominal musculature (T6-12) produces forceful expiration and therefore cough.



The diaphragm is the major muscle for quiet restful breathing. When the diaphragm contracts, it moves downward, and spreads out. This movement increases intra-abdominal pressure and decreases intrathoracic pressure. The decreased intrathoracic pressure around the lungs, causes the alveolar pressure to drop and air flows into the lungs. In addition, decreased intrathoracic pressure also enhances venous blood flow to the heart that will enhance delivery of carbon dioxide to the alveoli. The air flowing into the lungs is rich in oxygen and blood flowing to the alveoli is rich in carbon dioxide. Arteriole blood vessels absorb the oxygen and the venous blood vessels expel carbon dioxide into the alveoli. When the diaphragm relaxes, intrathoracic pressure increases, alveoli collapse and carbon dioxide is forced out of the lungs.

Continued management of ventilator needs for those discharged to home and for those that require full-time or part-time mechanical ventilation is coordinated by a multidisciplinary team of in-patient and outpatient providers to ensure all needs are met. Caregivers are provided detailed education and training on the equipment and techniques necessary to maintain a safe home environment. This section provides an overview on some of the equipment and techniques available for respiratory management when discharged from an acute care or rehabilitation facility. This is not an endorsement of products pictured in this chapter.

Equipment That is Medically Necessary for Those That Require Breathing Assistance and/or Assistance with Secretion Clearance

Breathing Assistance

- Mechanical ventilator (recommended one for bedside and one for wheelchair)
- Wheelchairs can be fit with a ventilator trays or racks for easier maneuverability
- Gel-Cell batteries (recommended one for bedside and one for wheelchair)
- Battery charger
- Vent circuits with necessary adapters
- Manual ventilation bag with mask

Humidification

- Heated humidifier with water chamber
- Sterile water for humidification
- Heat-Moisture Exchanger (used to provide humidification when not using heated humidification)

Optional Equipment for Breathing Assistance

- Non-invasive ventilation with mask interface
- Diaphragm Pacing

  Surgically implanted device for patients that have intact phrenic nerves

  Provides natural, physiologic breathing

Secretion Clearance

- Suction machines (Electric and battery powered)
- Suction catheters appropriate for size of tracheostomy tube
- Saline for suctioning

Airway Management

- Tracheostomy tubes

  If cuffed tube is used, syringe for cuff inflation/deflation
- Tracheostomy tube holders
- Tracheostomy cleaning kits
- Lubricant
- Dressing supplies
- Travel/Emergency bag

  Current size tracheostomy tube

  One size smaller tracheostomy tube

  Syringe for cuff inflation/deflation

  Tracheostomy tube holders

  Lubricant

  Manual ventilation bag with mask

  Ventilator circuit with HME

  Suction catheters

  Saline for suctioning

  Emergency contact information

Comfort and Mobility

- Adjustable hospital bed
- Wheelchair with tray for battery

RESPIRATORY DYSFUNCTION EQUIPMENT

Breathing Assistance / Ventilator

Wheelchairs Ventilator Trays or Racks
https://quantumrehab.eu/accessories-eu/trilogy-vent-tray

Non-invasive Ventilation with Mask Interface

Suction Machines
www.drivemedical.com/us/en/Products/Respiratory/Suction-Therapy-Accessories/c/SuctionTherapyAndAccessories

Diaphragm Pacing

Mechanical Cough Assist Device with Appropriate Interface

Equipment/Techniques That May be Medically Necessary

- Oxygen, if indicated
- Finger pulse oximeter device to monitor vitals and oxygen saturation
- Incentive spirometer
- Pneumobelt for assistance in exhalation
- Speaking valve with necessary adapters to facilitate speech
- Air compressor for aerosolizing medication with necessary adapters
- Mechanical cough assist device with appropriate interface
- High frequency chest wall oscillation (HFCWO)
- Intrapulmonary percussive ventilation (IPV)
- Chest physiotherapy (CPT)
- Manually assisted cough techniques
- Combination Device (Metaneb System - Lung expansion, secretion clearance, aerosol delivery)

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WEBSITES

Breathing Assistance
www.usa.philips.com
www.vyaire.com

Wheelchairs Ventilator Trays or Racks
https://quantumrehab.eu/product/trilogy-vent-tray

Non-invasive Ventilation with Mask Interface
www.usa.philips.com
www.resmed.com

Suction Machines
www.drivemedical.com
www.devilbisshealthcare.com

Mechanical Cough Assist Device with Appropriate Interface
www.usa.philips.com
www.respironics.com

Diaphragm Pacing
www.synapsebiomedical.com

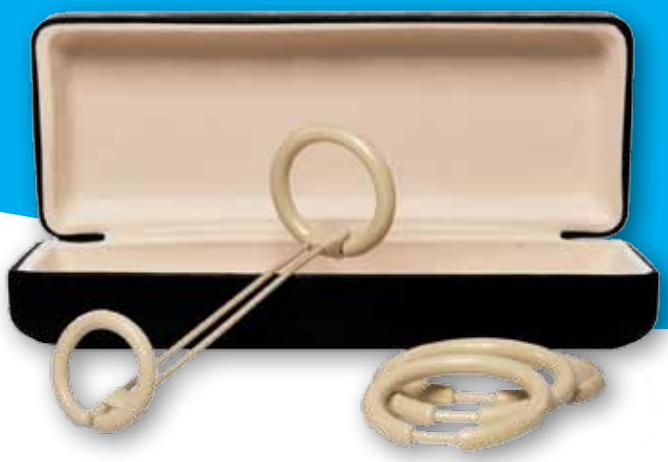
High Frequency Chest Wall Oscillation
www.hillrom.com
www.afflovest.com

Combination Device
www.respiratorycare.hill-rom.com

AffloVest by International Biophysics Corporation

Combination Device

SEXUAL FUNCTION AND FERTILITY



INTRODUCTION

Sexual and reproductive functions are important parts of life for most individuals. There are many forms of sexual function and ways that people interact intimately with themselves and with others. The needs and concerns of an individual should be addressed as part of the comprehensive care plan provided to a person with SCI/D during the rehabilitation process as well as throughout the duration of their life to allow them to engage in both sexual and reproductive function as desired. For women with SCI/D, while fertility remains unchanged[1,2,3], SCI/D can impair genital and erogenous zone sensation as well as vaginal lubrication. For men with SCI/D, in addition to sensory impairments of the genitals and/or erogenous zones, many will experience erectile dysfunction, ejaculation dysfunction, and abnormal semen quality which leads to a decrease in fertility. [4,5] Orgasm is variable for both men and women with SCI/D.[6,7] In addition to the above, the strength and flexibility of an individual will play a part in positioning during sexual activity as well as the ability to engage in stimulating activity for a partner or oneself. Education on sexual and reproductive function is an essential part of a comprehensive rehabilitation care plan. This chapter will focus on types of adaptive equipment that can be used to help augment both sexual function and fertility management after SCI/D.

Appropriate selection of equipment to improve sexual function and satisfaction should be tailored to the desires and needs of the individual. A full physical exam as well as a sexual history can aid in the decision for proper equipment or interventions. It is also important to counsel individuals who have had a history of Autonomic Dysreflexia (AD) or have injury levels above T6 that the use of any stimulating or penetrating device can precipitate an episode of AD. In addition, equipment used for sexual function and fertility will need to be cleaned regularly and after every use to prevent infections. Finally, it is also worth noting that while third party payors may cover part or all of the cost of medical grade equipment, oftentimes similar products can be found online or in stores at a reduced cost and without the need for a prescription. This chapter includes examples of both medical and non-medical grade devices currently available. Pharmacologic and surgical interventions to augment sexual function are beyond the scope of this manual and should be discussed directly with the medical team.

ERECTILE DYSFUNCTION:

This section contains descriptions of some of the devices to help achieve, maintain, or strengthen an erection in men with SCI/D. These devices can be used in conjunction with prescription medications.

Constriction Ring

Constriction rings are placed at the base of the penis and can be used to help maintain an erection by slowing the flow of blood out of the penis. Constriction rings can be combined with oral or injectable medications or with a vacuum device which can help achieve the erection followed by use of the ring to maintain the erection.

- Pro: Inexpensive, reusable, easily obtained without a prescription.
- Con: Requires hand dexterity to apply and remove. Should not be used in conjunction with anticoagulants.
- Risks/Complications: Pain or skin breakdown with prolonged use. Avoid metal rings which can get stuck or cause more damage. Rings should not be used more than 30 minutes at a time and a careful skin exam should be performed after every use.

Penile Sleeve

Penile sleeves come in various different types. They can be a full sheath covering the entire penis, a partial sheath which leaves the glans uncovered for stimulation, or have a harness which allows the penis

to be inside of the sleeve which is then strapped on to the individual. In addition to the different shapes, penis sleeves can also come with textures or vibratory features for additional stimulation.

- Pro: Easy to use. Some made with a realistic look and feel. Does not require a prescription.
- Con: May not look or feel natural. May require assistance from a partner for placement. More expensive than other prostheses.
- Risks/Complications: May cause pain or skin breakdown.

Example: https://www.rxsleeve.com/product-category/shop-all

Penile Support Devices

Penile support devices consist of two rings, one that is placed at the base of the penis, one at the glans of the penis with a rigid rod in between.

- Pro: Easy to use. Does not require a prescription. Lower profile than penis sleeves.
- Con: May cause pain for the partner. May require assistance from a partner for placement.
- Risks/Complications: May cause pain or skin breakdown.

Example: https://www.theelator.com

External Penile Prosthesis

External penile prosthesis are also called belted prosthetic phalluses or in the common vernacular "strap-on". These devices consist of an artificial phallus which is then strapped on to an individual to allow for penetration. Different products can attach to different parts of the body including the genital region or thigh.

- Pro: Easy to use. Does not require a prescription.
- Con: May not look or feel natural. May require assistance from a partner for placement.

Examples: https://www.lovehoney.com/sex-toys/strap-ons

Penile Prosthesis

In addition to the strap-on versions above, some penile prosthesis are used without being strapped onto the genital region. Instead these devices can be used for self penetration or penetration of a partner using a hand, universal cuff, strap or velcro.

- Pro: Easy to use and inexpensive. Widely available. Does not require a prescription.
- Con: May not look or feel natural.

Vacuum Tumescence Device

Vacuum tumescence devices are used to achieve an erection by pulling blood into the penis. They can be used in conjunction with penis rings shown above to maintain an erection. Lubrication should always be used to prevent skin damage during use.

- Pro: FDA-tested brands have safety mechanism to limit vacuum to avoid bleeding risks. Medical grade pump (shown below) may be covered by insurance. Also available in non-medical grade without a prescription.
- Con: Requires good hand dexterity or a partner for use. Cannot be used with anticoagulants or history of Peyronie's disease.
- Risks/Complications: Pain and bruising. Requires time to use to stimulate an erection.

Semi-rigid Penile Implant

Semi-rigid penile implants consist of two semiflexible rods which are placed surgically into the penis. The rods do not change length or stiffness but can be placed in an up or down position in order to allow for concealment under clothing or for penetration.

- Pro: Rigid enough for penetration but flexible enough for concealed position when not in use. Various lengths and widths available.
- Con: Requires surgical implantation.
- Risks/Complications: Because these are surgically implanted, there is a risk of infection as well as erosion of the prosthesis through the skin. Individuals with SCI/D are at higher risk of these complications than the general population therefore implantation should involve discussion with a surgeon on the potential complications.

Inflatable Penile Implant

Inflatable penile implants consist of three pieces – a fluid-filled reservoir which is implanted under the abdominal wall, a pump and release valve which is placed inside the scrotum, and two inflatable cylinders placed inside the penis. When not in use the penis is flaccid. Manual pumping of the pump releases the valve and causes fluid to fill the cylinders inside of the penis for an erection.

- Pro: Allows penis to be flaccid when the implant is not in use. Various lengths and widths available. Lower risk of tissue perforation than semi-rigid implant.

ERECTILE DYSFUNCTION SILICONE CONSTRICTION RINGS

Constriction Ring

Elator Sleeve
www.theelator.com

RX Sleeve
www.rxsleeve.com

Harness attachment for External Penile Prosthesis

Vacuum Tumescence Device

External Penile Prosthesis

Inflatable Penile Implant

- Con: Requires surgical implantation. Device wears out and requires surgical replacement overtime.
- Risks/Complications: Because these are surgically implanted, there is a risk of infection as well as erosion of the prosthesis through the skin. Individuals with SCI/D are at higher risk of these complications than the general population therefore implantation should involve discussion with a surgeon on the potential complications. There is slightly less risk of erosion with the inflatable penile implant compared to the semi-rigid implant.

ANEJACULATION

Studies estimate that only 16% of all men with SCI and 11.8% in men with complete SCI are able to ejaculate during sexual activity.[8] Penile vibratory stimulation (PVS) and electroejaculation (EEJ) are two non-surgical options which require DME in order to help achieve ejaculation for semen collection. PVS is considered the first line therapy due to the safety profile, reliability, cost-effectiveness, and ability to perform it at home.[8,9] PVS is performed by applying a vibrating device to the dorsum or frenulum of the glans penis. Although any vibrating device can be trialed at home, medical grade devices such as the Ferticare Personal device shown below are able to deliver vibratory amplitudes of 2.5mm and 100Hz which has been shown to have the highest ejaculatory success rates in men with SCI T10 and above.[10] If PVS is unsuccessful EEJ can be attempted. EEJ is performed in the office setting by inserting the probe or electroejaculator into the rectum and stimulating against the prostate. Although ejaculation with the use of PVS and EEJ is generally successful except in the cases of complete sacral root injuries[11], it is important to remember that sperm quality is also impaired after SCI and therefore semen collection may need to be used in conjunction with a comprehensive reproductive plan of care.

Vibratory Stimulation Device (Non-Medical Grade)

- Pro: Inexpensive. Does not require a prescription. Can be used at home.
- Con: Not as reliable as medical grade devices for semen retrieval.
- Risks/Complications: Autonomic dysreflexia (AD), bruising, bleeding, and skin ulceration.

Vibratory Stimulation Device (medical grade)

Examples: https://medicalvibrator.com

- Pro: Higher rate of success than non-medical grade vibrators. May be utilized in the medical setting or at home. Some home devices have a sensor light that indicates when too much pressure is being applied. May be covered by some third party payors.
- Con: Requires a prescription. Expensive.
- Risks/Complications: Autonomic dysreflexia (AD), bruising, bleeding, and skin ulceration.

Electroejaculation Devices

- Pro: Higher rate of success for semen collection than vibratory stimulation.
- Con: Must be used in the medical setting by trained individuals. Most expensive.
- Risks/Complications: AD, rectal injury, and retrograde ejaculation.
- Additional: Due to the potential for life threatening AD, EEJ is always performed in an office with trained medical personnel. Medications may need to be used to help control AD during use.

DECREASED GENITAL SENSATION

Below are examples of different vibrating pieces of equipment which can be used alone or with a partner to enhance sensation, genital or erogenous zone stimulation. These products come in many forms including internal, external or a combination of stimulation points. More expensive versions also come with phone applications or remote controls that can be used by someone who has limited upper extremity strength or dexterity to provide stimulation to themselves or to a partner.

Examples: https://www.lovehoney.com/sex-toys/vibrators

External Penile Sleeve Vibrator

- Pro: Inexpensive. Does not require a prescription.
- Con: Requires good hand dexterity to apply, operate, remove, and clean.
- Risks/Complications: AD and skin damage with prolonged use.

Anal / Prostate Vibrator

- Pro: Inexpensive. Does not require a prescription.
- Con: Requires good hand dexterity to apply, operate, remove, and clean.
- Risks/Complications: AD, hemorrhoids, rectal bleeding.

ANEJACULATION

Vibratory Stimulation Device (Non-Medical Grade)

Vibratory Stimulation Device (Medical Grade)

Electroejaculation Devices

DECREASED GENITAL SENSATION

Anal/Prostate Vibrator

External (Clitoral) Stimulator

Combination Internal and External Vibrator

Internal ("G Spot") Vibrator

Combination Internal and External Vibrator

External (Clitoral) Stimulator

Different stimulators are handheld, are attached to a finger or tongue in cases of limited dexterity.

- Pro: Easily available. Does not require a prescription.
- Con: May require a partner for placement or to turn the device on and off.
- Risks/Complications: AD and skin damage with prolonged use.

Examples: https://www.lovehoney.com/sex-toys/vibrators/clitoral-vibrators

Internal ("G Spot") Vibrator

- Pro: Higher rate of orgasm even with complete SCI. May be used alone with limited hand function or with a partner. Inexpensive and easily available.
- Risks/Complications: AD.

Examples: https://www.lovehoney.com/sex-toys/vibrators/g-spot-vibrators

Combination Internal and External Vibrator

- Pro: Higher rate of orgasm even with complete SCI. May be used alone with limited hand function or with a partner. Inexpensive and easily available.
- Con: May need more hand function or partner to operate.
- Risks/Complications: AD, skin breakdown with prolonged external use.

POSITIONING DEVICES

Pelvic Supports / Pillows / Wedges

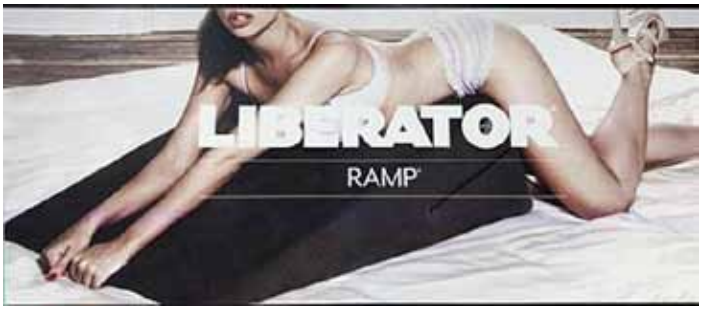
Pelvic support devices, pillows and wedges can all be used to aid in pelvic positioning during sexual activity. Some wedges can be used for positioning for other activities of daily living such as helping to position individuals for lower body dressing.

- Pro: Inexpensive. Does not require a prescription. Can be used for ADLs or sleep positioning.
- Con: Depending on the material may be hard to clean.

Examples: https://www.intimaterider.com
https://www.liberator.com/wedge.html

Examples: https://www.intimaterider.com/ridermate/deluxe-7160

https://www.liberator.com/sex-furniture.html



Chairs

- Pro: Allows for seated sexual activity. Aids in positioning. Some chairs allow for easier movement.
- Con: Requires good truncal balance and skin integrity.
- Risks/Complications: Potential for falls given movement of the chair and need for good truncal balance. May also cause pressure injuries.

Slings / Harness

There are various slings and harnesses on the market that can be used in a hanging position to provide movement with minimal effort or in a laying position to help hold legs or thighs in an open position to allow for easier access. Most products include adjustable and padded straps for versatility.

- Pro: Easy to obtain, relatively inexpensive, easy to use.
- Cons: Requires a partner for placement of the devices.
- Risks/Complications: Can cause injuries if the straps are not positioned properly or are too tight.

Examples: https://www.amazon.com/Access-Portable-Restraint-Fetish-Bondage/dp/B00AT4GRSQ

https://www.LoveHoney.com/Bondage/Sex-Swings-Machines

VAGINAL LUBRICATION

Women with SCI/D may have impairment of vaginal lubrication which can decrease sexual function or pleasure. Lubricants are available without prescription

and are inexpensive. Lubricants are mentioned in this chapter as certain lubricants such as silicone based lubricants should not be used with silicone based devices or condoms as they can stick to or erode the devices. In addition, oil based home lubricants such as baby oil should not be used vaginally as they can cause infections or cause latex condoms to fail.

Water Based Lubricants

- Pro: No prescription necessary, inexpensive. Can be used in conjunction with devices, condoms, or while attempting to become pregnant.
- Cons: May wear off more quickly or be stickier than silicone-based lubricants.
- Additional: Comes in many varieties including thin, thick, warming, cooling, and hypoallergenic.

Silicone Based Lubricants

- Pro: Smoother, less sticky, more 'natural' feeling, longer lasting than water-based or hybrid lubricants. No prescription necessary, inexpensive.
- Cons: Should not be used with silicone toys or condoms. May cause an allergic reaction.

Patient Resources:

Many patient facing resources including personal stories, videos, articles, research, and manuals are available for further education on sexual function and fertility including DME available as well as guides on how to use and maintain the equipment. Some resources are included here though many others also exist:

https://www.sexualitysci.org/

https://scisexualhealth.ca/sexuality-201-sci/

https://facingdisability.com/resource/sexuality-resources-from-stanley-ducharme-ph-d

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STRUCTURAL MODIFICATIONS

STRUCTURAL MODIFICATIONS AND DME FOR HOME ACCESSIBILITY

Environment structural modification ideas and suggestions vary with each individual and their environment(s). Modifications are based on the individual's functional strength, skills, mobility, age, home or work structure support system, lifestyle and funding resources. A home evaluation is recommended to provide the most appropriate information for the individual and their family to ensure safety and functional wheelchair accessibility. If an on-site structural evaluation is not possible by rehabilitation professionals, alternative means of assessing the structural environment include real-time video conferencing consultations, review of floor plans with dimensions, and video or pictures of specific structural considerations. These can include, but are not limited to doorways, entrances and exits, hallways, bathroom, bedroom and work spaces.

There is no legislation stating home modifications are medically needed or necessary. Thus, the financial burden typically falls to the individual and their family. Local foundations and organizations or fundraisers may add support for modifications needed. Federal, state and local governments may offer programs and grants to assist the private home owner and those living in a multi-dwelling building with the financial burden. Workers' Compensation insurance, Veterans Administration, Medicaid Waivers, victim's compensation funds, catastrophic accident insurance or a medical trust fund may pay for some or all home modifications. The State Division of Vocational Rehabilitation may fund a portion of needed home modification for the client with SCI who will be returning to work or school.

When considering home modifications, a rehabilitation therapist and/or assistive technology professional will generally recommend one of four design principles: Transgeneration, accessibility, adaptability or universal. The Americans with Disability Act (ADA) includes guidelines that state the with minimal specifications for wheelchair access in and around public and commercial buildings. These specifications identify specific measurements that are meant to be widely applicable for any disabled individual and therefore are not customized to the individual. For the individual with an SCI, a broader understanding of their specific physical mobility, adaptive equipment, medical and functional status needs to be considered when structural modifications are made. Below you will see recommendations which include ideal measurements for all wheelchair users, however it is important to remember the specific clients' needs and an individual with a small or narrow wheelchair may not need the same measurements for clearance or turning as an individual who uses a bariatric power wheelchair.

Considerations for individual environmental assessments:

- A temporary set up can be recommended to provide a safe and functional space, while the loner term renovation plans are developed. This provides time to make a final decision about structural changes or change in residence.
- The functional mobility status of the person with the SCI will determine their ability to access their home environment, whether through power mobility, manual wheelchair or as an ambulator.
- A back-up generator should be provided for the person who is dependent on mechanical ventilation in addition to ensuring power to other necessary durable medical equipment.
- Is the individual dependent on caregivers to complete basic self-care skills?
- What space is needed for durable medical equipment storage, wheelchair accessibility and able body person movement while assisting?
- Will the individual return to work or school?

Finally, while this chapter addresses modifications for a primary residence, the concept of visitability may be useful for family and friends of people with disabilities. Visitability refers to making core spaces accessible to all individuals, but not necessarily having all of the modifications required by a person with a disability (AARP doc). For example, a visitable home's basic requirements include:

- A zero-step entrance
- Wide interior doors
- An accessible half bathroom on the main floor

These modifications enhance access for people with disabilities for social purposes, but do not include some of the more expensive modifications such as a roll in shower and certain kitchen modifications.

PHYSICAL ACCESS

The slope of the property, driveway and other natural or man made barriers need to be considered for possible modification to provide the person with safe and functional access to the home. For the person using a wheelchair for mobility the following are considerations to provide full access:

Appropriate parking space to accommodate the vehicle and their wheelchair for transfers, or a modified van with lift; this includes additional side space compared to standard parking space, usually marked with an accessibility sign.

Exterior doorways should be devoid of screen and storm doors. A 5'X5' clear level platform on a porch or entryway with a minimum 18" space on the latch side of the door is recommended.

Where there are steps to enter a home, the addition of a ramp or exterior lift allows for independent access. Two forms of entry / egress are suggested for safety reasons in cases such as fire, so in addition to modifying the primary entry, a secondary exit, such as a ramped deck off of a back bedroom or family room should be considered.

Ramps should meet the following ADA specifications if possible:

- For every inch of rise, a foot of ramping is required resulting in a 30' max run
- Width 36" to 48" with a non-skid surface so not slippery when wet.
- Bilateral guardrails for safety measuring 30" to 32" high with a railing grip of 1.5" wide and spaced 4" apart should be provided. A curb border measuring 4" high along the edge of the ramp and platform to prevent a wheelchair from falling off the sides is necessary.
- If the ramp changes direction, reaches 30 feet, and/or rises higher than 3 feet off the property, an interim flat landing is recommended to provide a resting spot and allow for turns.
- To provide for wheelchair maneuverability and space for the caregiver, the platform should measure 5'X5' for manual and power wheelchairs and 6'X6' for tilt-in-space and wheelchairs with ventilators.
- Overhead coverings are suggested, if possible, to protect against environmental factors. Walkway should be level, non-slip and minimum of 48" wide.

Suitcase ramps are portable to be used on multiple homes or for travel and are not permanent: and typically no more than 16 feet in length at maximum.

Portable and modular ramps should meet the same specifications and ADA guidelines.

Threshold ramps are appropriate for navigating high entryway thresholds where there may only be one small step or a high threshold to navigate.

RAMP ALTERNATIVES

Ramps require adequate space to allow for a gentle enough rise for use. Vertical platform lifts are an alternative to ramps when there is not enough space for a ramp with a safe slope, or if the slope would be excessively long and thus burdensome to individuals who use manual wheelchairs or ambulatory devices.

The following are recommendations when considering a vertical platform lift:

- Consult with a qualified lift vendor to evaluate the building structure and appropriateness of lift use.
- Standard safety and emergency features, accessible switches, fold down ramp and lift's weight capacity should be evaluated for appropriateness to the individual who will use the lift (i.e. hand function, size of wheelchair, weight of person plus wheelchairs, etc.).

PHYSICAL ACCESS AND RAMP ALTERNATIVES

Covered Access for Loading and Unloading a Car

Custom Built Ramp to Existing Home

Threshold Ramp
https://expressramps.com/ez-access

Modular Ramps (Permanent or Temporary)
PATHWAY® 3G Modular Access System
www.discountramps.com/ez-access-modular-pathway-wheelchair-ramps/p/PATHWAY

Portable ramp / Suitcase Ramp

- An exterior mechanical lift may be needed due to limited space or terrain of property, limiting the ramping possibilities.
- An interior vertical lift may be considered for an individual who needs floor to floor access.

INTERNAL STAIR NEGOTIATION

While single level or ranch style homes may afford the most accessibility, multi-story homes can also be made fully accessible.

Stair Lifts

An incline platform lift that accommodates the wheelchair is a modification option for stairs. It requires expert assessment due to structural requirements.

www.accessiblemed.com/wp-content/uploads/2020/03/inclined-wheelchair-platform-lift-b.jpg

Stair Glides

A stair glide (seat that someone transfers onto and off of at the other end and moves up/down stairs on a rail) would be recommended only for those with strong upper body strength, trunk stability and independence with transfers. Multiple wheelchairs are needed for use at the top and bottom of the stair glide.

ELEVATORS

Elevators can also be installed in homes and are an alternative to a stair lift to move between floors though are usually a more costly option and require adequate space.

Elevators vary in cost depending on the cab size (number of people or size of the wheelchair needed to be transported), type (hydraulic, pneumatic, traction, chain-driven, cable-driven, electric rails), and number of floors needed to access. The more floors that need to be accessed generally the more expensive the elevator. More expensive elevators are also needed in order to lift the weight of a power wheelchair.

Elevators can be categorized by how they move the cab (chain, cable, hydraulic, pneumatic, traction) or by whether or not they require a shaft. Traditional elevators require built in shafts and mostly utilize a chain and drum or cable with a counter-weight system to lift the elevator. Some cable driven elevators require additional space for a mechanical room in addition to the elevator shaft and some require a pit below the elevator shaft. Due to the construction requirements, traditional shaft elevators with or without a mechanical room may be more costly to install and especially more difficult to retrofit in an existing home. Traditional elevators have the advantages of being able to lift heavier loads, access homes more than 3 stories high, and be installed in out of the way areas of the home or put into the initial design of the home.

Some smaller home elevators utilize traditional lifting systems but have eliminated the need for construction of a shaft, pit or mechanical room which allows for space saving, easier installation into an existing home, as well as faster installation.

Examples of shaftless elevators can be seen here:

https://www.easyclimber.com/home-elevator

https://www.stiltzlifts.com

Pneumatic elevators use a vacuum air technology to lift the cab. Pneumatic elevators do not require a pre-constructed shaft, pit, or machine room therefore are generally easier to fit into an existing home and require less space. They are limited in the number of floors they can access and with a lower weight capacity.

https://www.vacuumelevators.com/pve52-home-elevator

AUTOMATIC DOOR OPENERS AND ACCESS

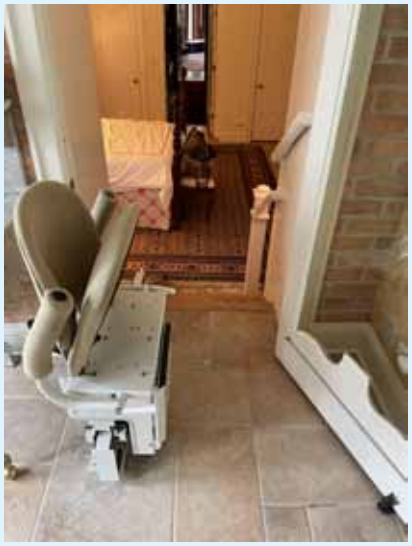
Automatic door openers can enable complete independence when entering and exiting a residence. These systems can be operated by remote control, which can be mounted on the wheelchair. Some systems allow connections into existing specialty switches or wheelchair control units. Finally, some newer universal models can be connected to phone apps. Customization is possible through a wide range of activation devices including:

Proximity Sensors - allow access without requiring hand use by activating the door when a smart tag is within a specified area of detection.

Wireless Keypad - mounted outside of the door eliminates dependence on keys by allowing entry with a code.

Electromechanical systems allow access similar to getting "buzzed in" to an apartment building.

INTERNAL STAIR NEGOTIATION



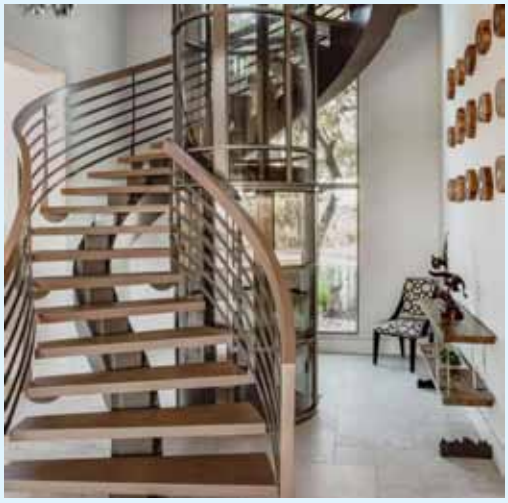
Stair Glide

AUTOMATIC DOOR OPENERS AND ACCESS

Open Sesame Door Systems

ELEVATORS

Traditional Built-in Shaft Elevator in a Home.



Pneumatic Elevators

https://www.vacuumelevators.com/pve52-home-elevator

Biometric Fingerprint/Smart Lock Systems
For a review please see: https://www.pocket-lint.com/smart-home/buyers-guides/154026-best-biometric-locks

Touchless systems are also becoming available.

Video Doorbell Systems

Many of these features enhance security and facilitate entry by visiting family members or care providers.

www.opensesamedoor.com/automatic-door-opener-for-home

https://lockly.com/collections/door-lock?gclid=CjwKCAiAg8OBBhA8EiwAlKw3ksH6uJyLjvJrV5JKHySguVrQXQkUOsluk5jo_8n13G9cUdiCWgsn7RoCwgEQAvD_BwE

INTERIOR DOORWAYS AND HALLWAYS

The following is recommended for maximal accessibility in doorways and hallways:

- Doorways leading off of a 36" wide hallway should also be 36" wide to allow for wheelchair turning radius through the door.
- Hallways may need to be up to 5' wide for a manual wheelchair or 6' wide for a power wheelchair to accommodate a 360 degree turn within the hallways
- Doorways need to be wide enough and clear of obstacles to allow the individual access and maneuverability, including a width that allows for manual propulsion of wheel rims, or power box use as passing through the doorway.
- Doorways should measure a minimum of 32" to 36" wide with the door swinging in for manual and power wheelchair users. Typically a straight entry into the doorway should measure 32" wide and if you are turning into the doorway it should measure 36" wide.
- Doors should open to at least a 90 degree angle leaving the doorway opening measuring approximately 1.5" to 2" wider than the wheelchair.
- Door thresholds should be beveled and measure ½" interior and ¾" exterior in height.
- Kick plates are recommended to prevent damage from the wheelchair and on the door.
- Lever handles are easier to manage then knobs both to open, and swing the door out of the way.

Simple modifications for doorways and hallways can maximize space and provide full accessibility, the following are some possible modifications:

- Pocket doors
- Barn Style Door
- French style doors to replace sliding glass doors
- Remove door, jam and molding, and replace with a curtain


Barn Style Door


Pocket Doors

- Offset hinges to replace standard door hinges which opens the door out of doorway, adding 1-2 inches to doorway width

https://www.mobility-aids.com/assets/images/adm6402-offset-door-hinge-brass-door-w.jpg

https://secure.img1-fg.wfcdn.com/im/99290129/resize-h800%5Ecompr-r85/3498/34985098/3.5%2522+H+x+4.5%2522+W+Offset+Pair+Door+Hinges.jpg

- As with exterior doorways (see above), automatic door openers can be considered for interior doors to maximize independence.
- 36" to 44" from the floor increases independence for individuals with fair upper body strength and weak grip. Lever door handles can also be modified for loops or straps to increase ease of use.

BEDROOMS

A minimum room size of 10' X14' will accommodate a bed, bureau, desk and adequate room for maneuverability of all equipment and wheelchair

Some Considerations:

- Access along both sides and end of the bed are needed in order to change linens along with enough space for appropriate and safe transfer (4 feet).
- Adequate storage space for medical and urological supplies.
- Closet access with pocket or sliding doors and rungs set approximately 3' 6" to 4' from floor.
- Lower closet bars that can be accessed from wheelchair height.
- Work or desk space provided; measurements depending on how high the individual sits in their wheelchair; Average measurements are approximately 2'6" to 2'10" high and 2'deep and 3' wide.
- A clear area within the room to turn around measuring 5' X 5'.
- Mirrors should be low enough to be useful from wheelchair level.
- Lower bed level height - some beds such as platform beds can be used without a box spring to lower the height. If the individual can not transfer to a standard bed hospital beds can provide an adjustable height.
- Provide access on both sides of the bed. One side should allow 5' X 5' feet of maneuverability for the wheelchair and possible use of a lift. The other side of the bed should, at minimum, allow for an individual to be able to stand alongside of the bed to assist with self-care and position changes in bed as needed.
- Provide adequate storage space for medical and urological supplies, etc.

Considerations for People with Tetraplegia or Ventilator Dependency:

- Ample power source and outlets for durable medical equipment (DME), electronic aids for daily living (EADL), ventilator and any other electronic devices.
- Back-up generator for emergency use.

Complementary information can be found in separate chapters, Beds and Mattresses, and Transfer Devices and Lifts.

BATHROOMS

Bathroom modifications will vary by level of injury, durable medical equipment needed, available space, and funding. For individuals with good upper body strength and trunk stability a standard bathroom may be able to be modified with minimal changes such as adequate doorways to enter. For individuals with tetraplegia, more substantial modifications may need to be made in order to allow for roll-in shower and assistant access.

Important Considerations for Bathroom Accessibility Include:

- Open floor area 5' X 5' for wheelchair or shower commode chair maneuverability.
- Minimum 4 feet floor clearance in front of fixtures.
- Mirrors, cabinets and shelving mounted no greater than 40" (bottom edge) from floor.
- Appropriate grab bars mounted around toilet and shower area, depending upon hand grip available, and accessibility if stationary (swing-away bars are also available).
- Close proximity to the bedroom.

FOR SPECIFIC BATHROOM FIXTURES

Sink

For the Person with Paraplegia:

- Although people with paraplegia may be able to maneuver a wheelchair sideways to access a standard sink with no opening underneath, roll-under sinks provide improved access and maneuverability.
- A wall mounted sink or sink set into a vanity cabinet with open area underneath, and insulated exposed pipes to prevent burns; Shallow sink bowl approximately 5" deep.
- Clearance under the sink varies with the seated height of the individual's legs. An average minimum is 27" to 32" high with the sink set at 34" from the floor.
- Width of the opening under the sink should be approximately 27" to 32" wide and a minimum of 25" deep.
- Counter and cabinet space should be available adjacent to the sink for supplies.
- The faucet should be placed within reach.

For the Person with Tetraplegia:

- Clearance measurements may vary depending on seated height in wheelchair or shower commode chair.
- Lever handles or an automatic faucet should be set within reach and at a maximum distance of 1'9" form the edge of the vanity to allow for oral and facial grooming.

Toilet

- The ideal height should be based on the commode chair to be used and the individual's transfer status. A standard style and height (14-15 inches from floor to seat) toilet is recommended for use with a standard height roll-in-shower/ commode chair or a drop arm commode. High Boy, comfort height, ADA height, chair height, or long toilets or those with flared shapes are not recommended for people using commode chairs because they may not fit over.
- If the patient has adequate strength, mobility and balance to transfer to a standard toilet without the use of an over-toilet commode then an ADA height toilet (17-19 inches from floor to seat) may be preferred.
- If transfers do not occur independently, or over-toilet modifications are needed then space on both sides of the toilet should be considered. Adequate space would be 18" from the center of the toilet bowl (or can measure 10" from the side of the toilet) to the nearest wall or cabinet. This allows clear access to complete personal care and for a commode chair to slide back over the toilet.

Showers

Showers can be modified to be roll-in, stall type, or leave existing tubs. Products including pre-fabricated collapsible silicone water dam thresholds can be installed to prevent water leakage but allow for wheelchair access. Shower stalls should be graded to allow for appropriate water drainage towards the shower drain.

Modifications should be based on the individual's balance, strength, and safe transfer status. Accommodations can be made for different showers or tubs using different showing DME that is available.

Complementary information on showering DME such as shower chairs, tub transfer benches, and shower boats can be found in the chapter on Activities of Daily Living (ADL).

In regards to creating accessible spaces for DME use the following should be considered:

- For use of a standard wheeled shower-commode chair, a space of 5' x 5' is needed for a 2 or 3-sided roll-in-shower unit.
- To accommodate a tilt-in-space rehab shower commode chair and the caregiver the area will need to be a minimum of 6' X6' space for the constructed 2 or 3-sided roll-in-shower unit with no curb.
- The floor should be tiled or have non-slip material with a slope down toward the center drain for adequate drainage and without a curb in the entryway.
- A hand held-shower allows for personal use and should include adjustable height. Models with height adjustment or multiple shower heads provide flexibility if multiple people will be using the bathroom. Adapted grip options are available.

SPECIFIC BATHROOM FIXTURES

A pre-fabricated standard sink which is wide enough and high enough to allow for manual wheelchair roll-under access.

Hand-held shower with adaptation for limited hand function

ADA height toilet turned to allow full side access for transfers including a grab bar for additional transfer assistance. This would be for an individual who is independent with transfers and does not need an over-toilet modification.

Handheld shower with adjustable height, grab bars, single button push to turn on, and set temperature control.

An open floor plan roll in shower which will accommodate a rolling shower commode chair, til-in-space shower commode chair, and shower attendant.

- A ceiling hung track shower curtain is helpful.
- Temperature controls should be used to prevent burns from insensate skin and can include anti-scald mechanisms on individual faucets, temperature controlled/locked controls, and pre-set on-demand shower controls.

Prefabricated shower stalls and kits are available to fit into smaller spaces or for existing tub footprints. Depending on the size and individual need they can come with built in seats and grab bars.

https://www.freedomshowers.com/Handicapped-Accessible-Showers/APF4836BF4P

https://www.barrierfree.com/product/barrier-free-shower-five-piece-54x36-diamond-tile-look-2/

https://www.homedepot.com/p/Ella-Plus-24-38-in-x-38-in-x-79-in-4-piece-Shower-Kit-in-White-with-Center-Drain-3838-BF-4P-5-C-W-SP24/205481352

Prefabricated shower pans are also available to provide appropriate water drainage towards the drain while allowing for barrier free access.

https://www.tileredi.com/shower-pans-and-bases/redi-free-barrier-free-brands

For the person with strong upper body strength, balance and trunk stability the choice to use a standard tub is an option. Guidelines state that a floor clearance of no less than 4 feet will provide wheelchair maneuverability and a safe transfer onto a padded tub bench set into the tub. The tub should not have shower doors.

Complementary information can be found in the chapter on Activities of Daily Living (ADL).

KITCHEN

Even if the individual is not the primary homemaker, they should be able to access the kitchen for meals and partake in family gatherings. For the individual with good stability and upper body strength rearranging stored items and minimal modifications may be the only set up needed.

Kitchen Considerations May Include:

- The table should have an open leg space, with a height to accommodate knee clearance when sitting in their wheelchair.
- The kitchen may need to be rearranged to move freely by providing a 5′ X 5′ turning radius, and incorporating 4 feet maneuverability along appliances/furniture. Provide one work area with width of about 36″ and height between 30″ to 34″ for knee clearance and 2′ depth and accessible reach of 1′9″.
- Clear access under the sink by removing cabinets and insulating exposed pipes. Use of a shallow sink with lever style faucet.
- Use of cabinet shelves with pull out drawers, rotating shelves and/or a lower counter with a pull-out board; safety considerations.
- In order to see the stove, install a tilt mirror over the stove for visibility into pots and front dials on the stove to avoid reaching over burners.
- Consider installing a lower section of counter for meal prep accessibility. A stovetop can be installed on a lower counter for improved accessibility.
- Microwaves can be installed in lower cabinets for wheelchair access.
- A kitchen cart should be used for item transport to prevent burns and spills.
- For people who are able to stand, a perching stool can provide a mobile workspace and conserve energy while cooking.
- Some modern faucets allow for touch control which can be more easily used with limited upper extremity mobility to turn on and off a faucet.

Other Structural Considerations:

- Temperature regulation is important. Be sure walls are insulated, and heat and air conditioning are adequate for the individual's needs.
- Install and maintain smoke and carbon dioxide detectors throughout the house. In addition, the individual should inform the fire department and police station someone with a disability is living in the home, and the location of their room, so they can assist them first in an emergency.
- If possible, it is recommended to have two exit emergency routes.

KITCHEN

Roll Under Sinks

Roll Under Stovetop

Lowered Height French Door Oven

Touchless automatic trash cans

Roll Under Counter with Mixer Attached.
The mixer is stored in the cabinet and more easily lifted into the use position with the adjusted rack.

- Hardwood, tile or linoleum floors are easier for wheelchair propulsion and easier to clean in multi-purpose areas (such as bed-bathing). Smooth flooring is also convenient when a hoyer lift is needed. If carpet is present, low pile carpet is preferred and a plastic mat, such as an office mat, can make a lift or wheelchair easier to maneuver.
- Rearranging furniture may enhance wheelchair maneuverability.
- For the individual on a ventilator and other medically necessary equipment should have a back-up generator in case of power outage.
- For the bariatric individual, the structure of the home must be able to hold the patient's weight coupled with the necessary durable medical equipment's weight.
- Wheelchair wheels can track dirt or moisture from the outside into the home. Having a textured mat inside the entrance can reduce tracking outside dirt inside the home.

An alternative consideration could be to create a fully accessible living space consisting of a bedroom, modified bathroom, and work station area through new construction or by an addition to an existing home. This type of project should not be a quick decision, and requires extensive planning and funding resources.

MODULAR, PREFABRICATED, AND "TINY" HOMES

Modifying an existing home can be costly and time consuming especially if large or multiple structural modifications need to be made or if modifications are needed quickly. Depending on the existing home, accessible modular homes, prefabricated homes, or tiny homes including "PAD"s (Personal Accessible Dwellings) are available that are wheelchair accessible and specifically designed for people with mobility impairments. Unlike structural modifications to an existing home, some prefabricated homes can be available on-site within a matter of weeks. In addition, some of the tiny homes or PADs are available to rent while home construction or other accommodations are undertaken to allow people to reside in the community.

Some examples:

https://www.wheelpad.com

https://littlehouseonthetrailer.com

https://impresamodular.com/accessible-modular-homes

https://modularhomesmi.com/handicap-accessible-floor-plans

QUICK FIXES

These easy accessibility options are great for those who need temporary or low cost options.

1. Provide privacy with a room divider privacy screen. Tri-fold display boards can provide privacy.
2. If a doorway is too narrow with the door in-place, removing the door and replacing it with a curtain hung from a tension rod can be an alternate option.
3. If the wheelchair is unable to make tight turns in hallways or fit through bathroom doors, a transport chair has a smaller turning radius and narrower profile and can be pushed by a caregiver into some otherwise inaccessible areas.
4. Suitcase ramps can provide access over low curbs and thresholds and can even be stored in the trunk of a car.

CONCLUSION

This basic guideline can be used when addressing structural modifications for access for persons with mobility impairments. It is recommended that prior to any modification/construction a professional consultation should be pursued with qualified professional and licensed contractors and accessibility design specialists who understand functional accessibility, not just dimensional guidelines. The individual modifications should be tailored to the needs and functional mobility of the individual.

A Note About Funding and Resources for Home Modifications

Some insurance companies may cover modifications considered medically necessary, and these would need to be outlined in a letter of justification by an occupational therapist (OT). Funds for modification are also available through civic and government

organizations. Many of these organizations advertise services for older adults, but they may also assist younger adults with disabilities. Local fire departments' Benevolent Associations are often willing to assist with minor remodeling projects for access. Stores such as Lowes and Home Depot may be willing to donate supplies and materials.

Use your best judgment when hiring contractors. Get references, and check the company with the Master Builders Association and the Better Business Bureau (contact information below).

Note: The following list is not meant to be inclusive or an endorsement by ASIA

References and Resources

AARP HomeFit Guide
www.aarp.org/HomeFit

Adaptive Access
http://www.adaptiveaccess.com

Americans with Disabilities Act
https://www.ada.gov

Better Business Bureau
https://www.bbb.org

The Center for Universal Design – North Carolina State University
https://projects.ncsu.edu/ncsu/design/cud/index.htm

Christopher and Dana Reeve Foundation
https://www.christopherreeve.org/living-with-paralysis/home-travel/home-modification

Directory of Centers for Independent Living
http://www.virtualcil.net/cils

Easterseals
https://www.easterseals.com/explore-resources/making-life-accessible

Master Builders Association
https://www.mbaks.com

Muscular Dystrophy Association
https://www.mda.org/quest/article/right-ramp-can-make-your-life-easier

Open Sesame Door Systems
https://www.opensesamedoor.com

Paralyzed Veterans of America
https://pva.org

Rehabilitation Engineering and Assistive Technology Society of North America (RESNA)

National Assistive Technology Technical Assistance Partnership (NATTAP)
http://www.resnaprojects.org/nattap/goals/community/HMRG.html#laws

Sisto, Sue Ann, Erica Druin, and Martha Macht Sliwinski. 2009. Spinal Cord Injuries: Management and Rehabilitation. St. Louis, Mo.; London: Mosby.

United Auto Workers National Community Outreach Program
https://www.uawford.org/nationalcommunityoutreachprogram

United Spinal Association – Spinal Cord Resource Center
https://askus-resource-center.unitedspinal.org/?pg=kb.printer.friendly&id=3

United States Access Board
https://www.access-board.gov

United States Department of Housing and Urban Development
https://www.hud.gov/program_offices/fair_housing_equal_opp/physical_accessibility

Universal Design Living Laboratory
https://www.udll.com

University of Southern California Leonard Davis School of Gerontology Fall Prevention Center of Excellence
https://homemods.org

TRANSFER DEVICES

INTRODUCTION

For individuals with spinal cord injuries, a primary goal of rehabilitation is learning the ability to successfully transfer between different surfaces or pieces of equipment. Transfers can include, but are not limited to, moving from the bed to the wheelchair, from the wheelchair to the commode, and from the commode to bathing equipment.

Some individuals will be able to perform transfers without any medical devices, but many will require the use of an assistive device, with or without a caregiver assisting. In addition, the difficulty of the transfer (such as the distance between two surfaces) may change the level of assistance or the assistive device an individual may require in that instance.

Table 1 illustrates expected transfer equipment by level of injury for individuals with motor complete spinal cord injuries.

Motor Level	Expected Transfer Equipment
C1-C4	Power or mechanical lift with sling.
C5	Maximum assistance with transfer board or with power/mechanical lift
C6	Possibly independently with or without transfer board, may require some assistance, especially for varying surface heights.
C7-T1	Likely independent with transfer board over uneven surfaces, potentially able to transfer without equipment.
T2-T12	Likely independent with transfers with or without transfer board.
L1-S5	Likely independent with transfers without transfer board.

Table 1: Expected Transfer Equipment by Level for Individuals with Motor Complete Spinal Cord Injuries

This chapter will give a comprehensive overview of potential transfer equipment that may prove useful for individuals with spinal cord injuries. One important caveat when evaluating the different equipment in this chapter is that availability and reimbursement by insurers is variable and often depends on strict criteria. If possible, it is important to trial equipment before purchase because obtaining incorrect transfer equipment could limit the independence of an individual and insurance may deny coverage for a second device.

AMBULATORY ASSISTIVE DEVICES

Although most commonly thought of to help with mobility, these devices are critical for many individuals to successfully transfer.

Typical Users: These devices are most commonly used by individuals with incomplete spinal cord injuries or lower level spinal cord injuries, often in conjunction with bracing.

Gait Belt

Lifting Belt

Transfer Sling

Contraindications and Cautions: Using ambulatory assistive devices, particularly without caregivers present, often requires significant upper extremity strength to help lift the body. This can lead to degenerative changes of the shoulders and upper extremities. Individuals are also at risk of falls when using these devices.

Caregiver Manual Gait Assistive Devices: Although relatively simple in design, a gait belt can effectively be used to prevent falls in appropriate individuals. The person who is assisting with the transfer should stand with hands spread and securely holding the gait belt. They should have a wide base of support and while assisting the individual should bend at the knees and not at the back.

Gait Belt/Lifting Belt/Transfer Slings: These devices are generally a few inches thick and come in many materials such as canvas, nylon or leather. They can be secured with a buckle or a loop with teeth. There are variations of the gait belt that also include leg loops, handles or a full chest harness. Others types do not fully lock around the waist and just provide support with standing.

FLOOR STAND-TRANSFER SYSTEMS

Infrequently used in those with spinal cord injury, the goal of these devices is to help individuals with adequate strength to stand but difficulty with transferring. The person assisting with the transfer can place their foot on the device to add stability.

Turntable: Made of two discs that rotate over one another, these devices should be used with caution in those with spinal cord injury as they can lead to falls if the individual is not closely monitored.

Pivot Transfer Mat: Non-stick mats, these provide a stable surface for individuals to stand on while performing a transfer.


Turntable


Pivot Transfer Mat

WALKERS

Walkers are devices of variable designs that provide a wide and stable base of support for individuals to lean/push against in order to stand, transfer and walk. Essentially, the user is transferring weight from their legs to their arms. They can be used with both sit to stand transfers and stand pivot transfers. When standing with a relaxed arm, the handgrips of the walkers should be at the crease of the user's wrist. Walkers can generally be adjusted to the user but may require a junior, tall or bariatric walker in select cases.

Standard/Basic Walkers: These walkers have no wheels. Users need to lift the walker in order to advance forward. Standard walkers tend to be the most stable but can be difficult to advance.

Two-Wheeled Rolling Walkers: These walkers have two casters on the front legs of the walker. They provide for an easier and more natural gait pattern than a standard walker but are less stable.

Three-Wheeled Rolling Walkers: These walkers have one swiveling wheel in front and two fixed wheels in the back. These are more maneuverable, lighter and easier to transport compared to a four wheeled walker.

Four-Wheeled Rolling Walkers: Often known as a rollatortm, these walkers are also maneuverable. They often have a seat as well.

Platform Walker/Attachment: These walkers have a platform (or attachments) that allows individuals to use a walker without having to use their hands or forearms, which may be options for those with weight bearing restrictions.

CANES

Canes can be used to help with transfers for those with good lower extremity function but difficulty with balance or standing from sitting. They effectively assist with balance by increasing the user's base of support. It should be used in the hand opposite the weaker side as it allows the user's' weight to shift off the more involved leg. Canes can also be used bilaterally to provide even greater support. When standing with a relaxed arm, the cane handle should be at the

WALKERS


Standard/Basic Walkers


Two Wheeled Rolling Walkers


Four Wheeled Rolling Walkers


Platform Walker


Platform Walker Single Arm Attachment

CANES


Single Point Cane


Tripod/ Quad Canes


Hurry Cane™

height of the crease of the user's wrist. There are a variety of shapes, materials, and modifications to the handgrip of the cane for comfort or to accommodate grip preferences.

Single-Point Cane: These canes come to a single tip (or point of contact with the ground).

Hurry Cane™: Similar to single point canes, but they have a 360 degree pivoting head with 3-point rubber tip, which is non-skid and all-terrain.

Tripod/Quad Canes: These canes come to three or four tips and have greater contact with the ground which provides greater stability.

CRUTCHES

Crutches are similar to canes and walkers, and can be used to help those with lower body weakness transfer. They also take weight off the legs by providing weight bearing through the arms. They generally require greater coordination and balance thean a walker.

Axillary Crutches: Traditionally used to offload a limb, axillary crutches can also be used for lower extremity support and balance. These axillary pad (top part of the crutch) should rest 1-2 inches below the armpit and pressed against the ribcage to stabilize the crutch. Weight is placed through the handgrips.

Axillary Crutches

Forearm/Lofstrand Crutches

The height of the handgrips should be adjusted to the user's hip, leaving a slight bend in the elbow. Axillary are often used for more short term use compared to Forearm/loftstrand crutches (see below).

Forearm/Lofstrand Crutches: Forearm crutches have a cuff that fits around the user's forearm and a handgrip. They are more portable than axillary crutches but require the most coordination and balance. Compared to axillary crutches, they are often for longer-term use and allow for a more reciprocal gait pattern.

Hands Free Crutches: These crutches are designed to provide maximum comfort and mobility support. Unlike axillary/forearm crutches, they eliminate the pressure placed on the armpits, hands, and wrists. Instead, pressure is distributed through the elbows and forearms.

TRANSFER BOARDS

One of the most commonly used transfer devices for individuals with spinal cord injuries, a transfer board aids individuals in completing lateral transfers from one surface to another. They work to bridge the gap between the two surfaces. Individuals should anteriorly weight shift to avoid sheering across the board. It can be helpful to go down a slope, if possible, to allow the assistance of gravity. Slip-resistant pads, or friction tape, can be adhered to the bottom, to increase stability during transfers

Typical Users: Individuals with low tetraplegia (C7-T1) or paraplegia. They are used when individuals do not have sufficient upper body strength to fully clear their buttocks between the two surfaces, as it allows them to break the transfer down into multiple small movements. They also may be helpful to those experiencing fatigue, chronic pain, or joint deterioration due to previous transfer methods.

Contraindications and Cautions: Individuals are at risk of sheer injuries if they slide their buttocks across the transfer board. Boards should be inspected to ensure they are smooth, undamaged and splinter free. Shear-free boards also have the risk of skin getting pinched and torn.

Transfer Board: Transfer boards come in many shapes, sizes and materials (such as wood or plastic) to accommodate varying transfer conditions and individual sizes.

TRANSFER BOARDS

Contoured Transfer Boards

Beasy Transfer Board™

Standard Transfer Board

Scooter Transfer Board

Notched Transfer Board

Standard Transfer Board: Average 8-12" wide x 24-25" long. Shorter boards are easier to get under buttocks and reach to the secondary surface. Longer boards are for wider gap transfers, such as wheelchair to car. These can come with or without slots, which allow individuals with poor hand strength/dexterity to hold them. Weight capacities listed for commercially available standard board models range from 300-400 lbs. If the individual weighs more than 400lbs, they will require a bariatric model. The bariatric models are thicker to accommodate the increased load.

Notched Transfer Boards: Notches to help stabilize on transfer surfaces (for example, the wheelchair).

Contoured Transfer Boards: Contoured to fit around a commode seat, they allow placement and use while on the commode/toilet.

Shear-Free Boards: Designed for those that are unable to adequately lift during transfers, shear-free (or anti-shear) boards consist of a movable surface that does not require the individual to lift during transfers.

- **Beasy Transfer Board™:** The most common type of shear-free board is the Beasy Transfer Board™. It is constructed with a sliding round disc in the middle of a curved board that moves from one end of the board to the other while the person sits on it. An individual will require enough trunk control to maintain upright posture throughout the transfer or it can lead to increased risk for falls.
- **Scooter Transfer Board:** These boards are made of a series of wheels that allow the user to slide on the board. These boards are generally contraindicated in spinal cord injury given the risk of pinching skin leading to the development of wounds.

LIFTS AND LIFT SLINGS

Another commonly used transfer modality are individual lifts. Individual lifts physically go underneath the individual and lifts them from one surface to another. They come in a variety of types based on individual needs and their environment. Another consideration is the need for an appropriate lift sling.

Typical User: Typically used in people with C1-C6 tetraplegia who do not have the strength to independently transfer, bariatric individuals, individuals with weak upper extremities, and for individuals whose caregivers cannot provide the amount of assistance required for a safe manually assisted transfer. Furthermore, lifts can help protect caregivers as frequently lifting the individual they are caring for can put them at risk of injury. They are also helpful in those who have a history of, or currently have, skin breakdown on their buttock.

Contraindications/Cautions: The biggest risk of using a lift is that the individual falls out of the lift during a transfer which can lead to a serious injury. Caregivers are also at risk of repetitive stress injuries by using a manual lift.

Floor Lifts: These lifts are placed on the ground. They come in a variety of styles and sizes based on the needs of the user. Manual lifts are usually covered by insurance if necessary for daily transfers within the home while other lift types are generally not covered.

- **Manual Hydraulic Mechanical Lifts:** These lifts are composed of a floor base, hand pump mechanism, push handles to steer the lift, and overhead cradle for attaching the sling. The base legs have locks and are able to open laterally and close inward to allow access under various surfaces, such as a bed, wheelchair, toilet/commode, or standard chair. The bases take up floor space and are unable to be moved under surfaces with less than 4" of clearance from the floor. The overhead cradle may have two or four hooks for sling attachment, which varies depending on brand/model. To raise the individual into the air, the caregiver must crank a lever.

  Specialty models are available that take up less space/fold, are portable or accommodate lower arm systems, allowing difficult transfers in tight spaces, such as in and out of a car. Standard floor models have weight capacities ranging from 400-500 lbs. Bariatric models have capacities between 600-1000 lbs.

- **Electronic Mechanical Lifts:** These are composed of the same parts as a manual lift, but are operated using a hand push button control. These lifts are battery powered and recharged using a standard AC outlets or a battery charger. All devices should have an emergency stop and a manual emergency release lowering capability in case of loss of battery power. These also come in standard or bariatric models. They also can have various features (such as folding). These are often not covered by insurance, but are available to be purchased by the individual/caregiver for ease of use in the home.

Overhead Lift Systems: These systems are similar to floor lifts although they are mounted from a fixed point overhead. These systems are generally expensive and often limited to institutional settings. They also generally do not allow the freedom of transfer locations, unlike floor lifts, although custom units can be made to encompass an entire room or even multiple rooms.

Ceiling Lift: These systems may be mounted directly to a reinforced ceiling or joists, or through posts placed strategically in corners of the room (or sometimes mounted to the walls). Ceiling lifts are power operated. Weight capacities range from standard models 300-500 lbs. and bariatric models up to 1000 lbs. These systems are advantageous as they leave open floor space without a floor base unit to maneuver and can be used with beds/chairs that manual lift frames would not fit around. A structural engineer and permits are generally needed for home installation to ensure safety.

Slings: All lift systems require a sling to harness the transferring individual. There are a variety of slings that can be used for multiple different purposes. Slings are available in both solid and polyester mesh (usually used for bathing). Slings come in different sizes. There are also padded varieties of the below slings.

Split Leg or "U" Slings: These are suitable for a wide variety of users and lifting operations including from a seated or lying position. Split leg splints support the entire body. Some models offer additional head support. The sling is ideal for lifting, moving and positioning users who have reduced control of their upper and lower body. These may be contraindicated in the setting of thigh and sacral wounds.

LIFTS AND LIFT SLINGS


Ceiling Lift


Split Leg or "U" Slings


Full Body (Hammock) Slings


Standing Slings


Manual Hydraulic Mechanical Lifts


Electronic Mechanical Lifts


Electronic Stand-Assist Lift

Full Body (Hammock) Slings: These slings are designed for lifting and moving people with diminished motor function as they support the entire body and provide extra support around the hips and thighs. Unlike the split leg slings, this sling allows the hips to remain in a neutral position. Hammock slings can be solid (above) or can have a hole at the buttocks area to allow for use on the commode/toilet.

Standing Slings: These slings attach to an overhead lift system and are designed for individuals with sufficient leg strength to stand upright, but who have difficulty balancing. These slings reduce the chance of falls during early mobilization for transfers and walking.

Trapeze: These are generally a triangular shaped metal bar that can be used to facilitate bed positioning or transfers in and out of the bed to either a wheelchair or shower/commode chair. These can be stabilized to a metal overhead bed frame, to a ceiling/wall, or to a portable frame base. If attached to the bed or wall/ceiling, they are more secure, but can only be used in that location. Despite being less secure, the portable frame base can be used in multiple locations. There are also concerns about the biomechanics of overhead lifting when using a trapeze, related to repetitive stress shoulder injuries in people with spinal cord injuries.

Stand-Assist Lifts are designed to assist an individual to a semi-standing position for transfer. These devices include handles for the individual to hold, at the same time their trunk and hips are secured. These devices can be:

Manual: The individual uses the leverage of the device to help stand and then the caregiver uses the wheeled frame to help with the pivot portion of the transfer. An individual must have enough leg strength to come to and maintain at least a partial stand to use these devices. Common name brands of these devices include: Molift Raiser™ and Sara Stedy™.

Electric: A sling is positioned under the arms and around the individual's thoracic region to provide support. The sling system and hydraulic lift helps raise the individual to a semi-standing position with feet secured on a footboard. An individual must be able to tolerate weight through their legs and exhibit some trunk control to be used safety. It is not recommended for those post thoracic or lumbar spinal surgery due to the distraction it provides to the spine.

UPPER EXTREMITY SPLINTS AND ORTHOSES

INTRODUCTION

Since the 1940s, knowledge of upper extremity (UE) management after tetraplegia has grown significantly, particularly in respect to optimizing functional outcomes across the continuum of care.[3] The main goals of UE management are to restore as much function as possible while maintaining normal appearance, preserving joint integrity, preventing edema, preventing pain and controlling spasticity.[17] A key component of UE management is focused on use of splints or orthotic devices to promote function and preserve normal appearance of hand by maintaining joint mobility, preventing contractures/deformities, and preventing skin breakdown. It is important to keep in mind that the splints/orthoses may change during the continuum of care in response to individuals' change in tone, spasticity, or neurological recovery.[3,20]

GENERAL CONSIDERATIONS

The Consortium for Spinal Cord Medicine has published clinical practice guidelines for upper limb function and preservation following SCI[9] and on Outcomes following traumatic SCI,[8] both of which provide important UE treatment guidelines for tetraplegic rehabilitation. Clinicians working with persons with SCI should know and understand these practice guidelines and integrate them into existing clinical pathways in their clinical setting.

An understanding of SCI classification systems is important in making decisions about UE splinting and equipment needs. The International Standards for Neurological Classification in Spinal Cord Injury (ISNCSCI) remains the most widely used assessment of motor and sensory impairment after SCI.[1] The International Classification of the Hand in Tetraplegia (ICSHT) is a more specific assessment of muscles in the upper limb below the shoulder, and is used for decision-making about surgical procedures to enhance function for people with cervical SCI.[16] The ICSHT augments the motor and sensory information gained from the ISNCSCI. In addition to the motor and sensory systems, joint range of motion and pliability of the hand are essential to evaluate, as limitations in these areas will greatly impede use of devices and application of orthoses.

In select SCI centers world-wide, surgical reconstruction of the UE has restored elbow extension, wrist extension, forearm rotation, and hand grasp and release. While a discussion on surgical restoration of UE function is beyond the scope of this chapter, readers are referred elsewhere.[5,7,11,14,20,21]

EQUIPMENT RECOMMENDATIONS

This chapter provides guidelines for splints/orthotics and other equipment to augment or replace UE function lost to paralysis from spinal cord injury or dysfunction. Orthotic management in SCI involves static protective splinting, static functional orthoses, and dynamic functional orthoses. The selection of orthotic intervention is dependent upon neurological level, time post injury, and goals of the user. Comprehensive management usually involves a combination of different types of splints and orthoses. This chapter addresses equipment that can be placed on the upper limb (for example a functional orthosis) and equipment that the upper limb can be placed in (for example, a balanced forearm orthosis). Although serial casting is not considered durable medical equipment, the chapter briefly addresses serial casting.

Since upper extremity splints/orthotics are intimately related to adaptive devices, upper extremity equipment recommendations, and assistive technology, references will be made in this section, however discussed in detail in their respective chapters. Finally, therapeutic and functional UE devices such as robotics, or prosthetics that employ electrical stimulation are outside of the scope of this chapter.

With this in mind, this chapter will examine the use of splints/orthotics by purpose at each joint, concluding with a brief summary of devices by level of injury and function.

When recommending upper extremity splints, care must be taken to provide proper training to the client and their caregivers. People with spinal cord injury are at risk for skin breakdown from UE devices and wearing schedules should begin with short trials. If skin inspection reveals no issues, wearing time can be increased. Training should also include how to don and doff the device and proper use and care. Some devices have specific instructions for cleaning that must be followed to optimize the lifespan of the device.

Client acceptance of upper extremity devices includes many factors such as their understanding of the benefits, their perceived comfort, and the cosmetic appearance of the device (Kuipers et al, 2009).[12] Engaging the client in decision making will promote carryover of selected devices.

Finally, it is important to note that while some types of orthoses or splints are available off the shelf, custom orthoses or splints should be evaluated and then fabricated by trained occupational therapists or certified hand therapists to ensure proper fit.

SHOULDER

Proper positioning of the shoulder is essential to prevent: shoulder pain, prevent shortening of upper chest muscles resulting in rib tightness that can impede respiration, and enhance proximal stability necessary for distal function.[3] Proximal instability is often caused by weakness in muscles that stabilize the glenohumeral and scapulothoracic joints, resulting in instability, poor positioning, and poor biomechanics.[3] Proper positioning of the shoulder at all levels of injury during both static and dynamic activities should be carefully considered to prevent secondary conditions such as impingement syndrome, recurrent dislocations, rotator cuff injuries, bicipital tendinitis, capsulitis, osteoarthritis, and myofascial pain syndrome involving the cervical and thoracic paraspinals.[9] Achieving proximal stability through taping or an orthotic device should be considered to counteract protracted resting shoulder position.

Sidelying Shoulder Pillows

Some pillows can be used to help promote good shoulder positioning while in side laying position however they should be used with caution in persons with SCI/D as they should not be used with someone who is too weak to reposition off of the shoulder.

Daytime Static Shoulder Positioning

For individuals with high cervical injury and significant paralysis in the shoulder, proper positioning of wheelchair armrests is paramount to provide optimal shoulder support and prevent subluxation. Examples can be found in the Wheelchairs and Seating chapter.

Shoulder Supportive Slings

These have been developed to prevent or correct shoulder subluxations in order to reduce pain.[10] There are many styles of slings that help with this. Below are a few examples.

Giv Mohr Sling

Giv Mohr Sling used to provide upper extremity support during standing and ambulation.

Shoulder brace with compression sleeve support strap

Figure 8 Brace

A scapular retraction, or figure 8, brace provides a postural cue to facilitate shoulder retraction.

https://www.doctordorsey.com/wp-content/uploads/2015/01/Olive-Posturific-Brace-Posture-Brace.jpg

Giv Mohr Sling

Shoulder Brace with Compression Sleeve

Figure 8 Brace
Posture Corrector Brace
https://posturificbrace.com

Suspension Arm Devices

These devices were found as early as the 1940s in occupational therapy clinics. They are low cost, easy to manage and have the ability to support proximal weakness of the upper arm. They are made up of overhead suspension rods and can be attached to the wheelchair, a child's body jacket, highchair, or overhead track system for ambulatory patients.[19] See page 76 for a few examples of commercially available suspension arm devices.

Mobile Arm Supports

Mobile arm supports are devices that allow individuals with significant weakness in the shoulder to perform activities of daily living.[2,15] May provide individuals with proximal arm weakness due to tetraplegia improved independence. Conventional mobile arms supports use elastic bands connected to a forearm trough to reduce gravity and elevate the arm. Power-assisted mobile arm supports (also called powered exoskeletons) have been offered in more recent years. Often, a mobile arm support is combined with other devices, such as a wrist splint and universal cuff for tabletop activities such as feeding or tablet use.

ELBOW

For people with tetraplegia, maintaining a good arc of motion is essential to promote an expanded workspace and weight-bearing function in mobility activities.[3] People with C5 and C6 motor function are at risk of developing elbow flexion tightness or contracture from the unopposed activity of the elbow flexors.[3] Elbow flexion contractures have been associated with lower motor neuron damage of the triceps in addition to upper motor neuron paralysis.[4] Though uncommon, elbow extension tightness or contracture may develop from absence of elbow flexors resulting in unopposed elbow extension from spasms or spasticity in people with C4 or higher level injury. Regardless of the type of contracture, the following static and dynamic splints and orthotics should be considered.

Pillow Splints

Pillow splints are a good option to promote static elbow extension, and are a preferred method for nighttime use due to comfort.

Static Elbow Extension Splints

Static elbow splints can be made from low or high temperature thermoplastics. These splints may be a better option for nighttime use to oppose moderate to high elbow flexion forces.

Dynamic Elbow Extension Splints

This splint is often used when a low load constant stretch theory is needed. The dynasplint is available for both elbow flexion and extension contractures.

Hinged Elbow Braces

Hinged braces are useful for blocking active or passive movement in one direction while allowing movement in the other. This brace is often used after a surgical procedure to restore active elbow extension, such as a biceps or posterior deltoid to triceps transfer.

Serial Casting of the Elbow

Serial casting is a more aggressive intervention used to increase range of motion when moderate to severe spasticity is present. The goal of casting is to gradually decrease tone while increasing range of motion. Casts are often applied for several days to achieve prolonged stretch and reduced tone. Skin tolerance often determines length of casting. Casting may often be used in combination with motor blocks, nerve blocks or botulinum toxin injections.[19] Following achievement of maximum range of motion, splints or bi-valve casts can be used to maintain range of motion.[6] Below are examples of serial casing at the elbow, a drop out elbow cast which uses gravity to assist with elbow extension, and a bi-valve night cast.

SHOULDER

0540 PoweRED Arm Support | Partners in Medicine LLC
https://partnersinmed.com/o540-dynamic-arm-support

ELBOW

Pillow Splint

Custom Elbow Extension Splint

Elbow Extension Dynasplint® System

Hinged Elbow Braces

Full Elbow Cast

Drop Out Elbow Cast

Bi-valve Cast

FOREARM

Supination deformities can result from muscle imbalance between voluntary biceps/supinator and weak or paralyzed pronator teres/pronator quadratus. As a result, resting position is a consideration of the forearm to prevent fixed contractures. Supination deformities are most commonly seen in C5, C6 and in some C7 injuries, and often accompany elbow flexion contractures. Additionally, prolonged position of the forearm in supination can adversely affect passive range of motion at the wrist through shortening of the wrist extensor muscles and over-lengthening of the wrist flexor muscles. Good forearm range of motion and promoting a resting positioning in pronation is essential for nearly all functional activities, especially personal ADLs such as feeding and grooming.

Supination/Pronation Straps

Supination and pronation straps are useful for supination deformity that can be passively corrected and has not developed into a fixed joint contracture. The straps are made from a semi-elastic material such as neoprene and extend proximally from just above the elbow and wrap around the forearm in the direction of pronation. The distal end of the strap extends past the wrist and is attached with velcro to a neoprene thumb sleeve. These straps can be incorporated with an elbow extension splint to maintain neutral or pronated position of the forearm. The distal portion of the strap can be attached to wrist stabilization splint if necessary.

Custom Neoprene Forearm Strap

The straps may also be fabricated with or without a wrist splint to be positioned in pronation.

Static Pronation Splints

These are a better alternative for supination deformities that require more force to be passively reduced, or are starting to become a fixed joint contracture. For individuals with high cervical injury and significant paralysis in the shoulder and upper arm, proper positioning of the elbow and forearm in the wheelchair is paramount to provide support and prevent adverse positioning. Examples of wheelchair armrests can be found in the Wheelchairs and Seating chapter.

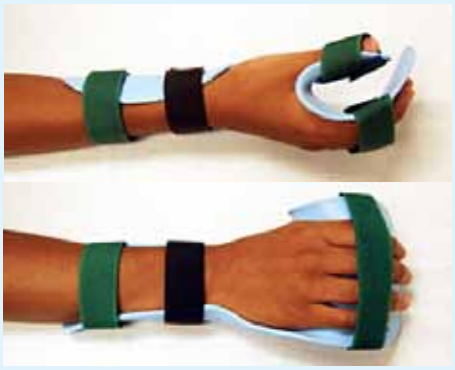
WRIST AND HAND

The wrist and hand are closely related when it comes to functional ability in cervical spinal cord injury. When wrist muscles are weak or completely paralyzed, it is important to support the wrist and hand both at night and during the day to prevent contractures from occurring. When wrist extension is active, the individual can achieve function with a tenodesis grasp, even without active hand and thumb motion.

A tenodesis grasp takes advantage of biomechanical properties of the hand. For example, active wrist extension passively tightens the finger and thumb flexors, and passive (gravity-assisted) wrist flexion tightens the finger and thumb extensors. The result is passive hand closing with active wrist extension, and passive hand opening when the wrist is flexed. An important concept to consider when splinting for an effective tenodesis grasp is tendon tightness. Splinting can encourage tendon shortening, or tightness to maximize function. For example, shortening the finger and thumb flexor tendons can provide stronger passive grasp with wrist extension. Care should be taken to preserve joint mobility and avoid joint contractures. Conversely, splinting the fingers in extension will shorten the extensor tendons, encouraging hand opening with passive wrist flexion. Clinical judgment, hand resting posture/physical characteristics, and participant goals dictate whether splinting goals focus on encouraging passive grasp or release.

When hand musculature is returning, it is important to maintain equal length on both flexors and extensor muscles again both in day and night splinting. In all stages, it is important to encourage proper positioning of the wrist and hand to prevent secondary injuries such as compression of the carpal tunnel (PVA guide) or adverse shortening or lengthening of muscles which can limit function. Spasticity and tone may influence choices of both the day and night splints. These principles along with clinical judgement should be considered when choosing splints and orthotics for optimal wrist and hand function.

NIGHT SPLINTING



Custom Molded RHS

INTRINSIC PLUS SPLINTS

Volar Intrinsic Plus Splint

Dorsal Based Intrinsic Plus Splint

ANTI-SPASTICITY SPLINTS

Custom-Fabricated Anti-Spasticity Splints

SERIAL CASTING

Serial Casting of the Wrist and Hand

NIGHT SPLINTING

Resting Hand Splints (also known as resting pan splints)

This splint encourages a natural position of the hand and thumb that allows for a tip pinch to pick up light objects by placing the thumb and finger in a "tong" position.[18] To initially achieve this position, a resting hand splint places the wrist in 0-20 degrees wrist extension, 20-30 degrees MCP flexion, 10-30 degrees PIP flexion and slight DIP flexion with the thumb in slight extension and abduction.[10] Modifications can be made to encourage more flexion or extension of the fingers and thumb, depending on clinical goals.

Prefabricated options are available. Some have a thermoplastic base that can be adjusted with a heat while those made from padded stainless steel are available and can be easily shaped to fit the wrist and hand without heat. Another option is to fabricate custom molded resting hand splints from low temperature thermoplastic materials).

Intrinsic Plus Splints

This splint positions the wrist in 10-20 degrees extension in combination with MCP in 80-90 degrees of flexion, IP joints in full extension and thumb aligned in neutral position of lateral pinch position. This splint will often help with edema as it allows for maximum tightness in the extensor mechanism which allows the viscoelastic properties of flexor muscles of the to cause a pumping action to move edema from the hand.[3]

Anti-Spasticity Splints

The anti-spasiticty splint is often utilized as tone increases or hand function is returning. This splint positions the wrist and hand in functional position and abducts the thumb and fingers. The position is known to decrease tone as well as place stretch on dorsal interossei, palmar interossei and lumbricals.[10] This splint can disrupt tenodesis or counteract tenodesis splinting therefore it is often used as recovery of the hands is noted. The separation of the fingers and strapping may vary based on patient need. Custom and pre-fabricated options are available.

Serial Casting of the Wrist and Hand

As with the elbow, a more aggressive approach with serial casting can be employed for the wrist and hand. Consideration of wrist positioning and hand range must be taken into consideration for maximum effect. Upon final serial cast, one of the above night splints can be incorporated.

Dynamic Splints

Dynasplint This splint is often used when a low load constant stretch theory is needed. The Dynasplint is available for both wrist flexion and extension contractures. There are a variety of hand pieces that can be added to match a patient's need. A few examples are at the bottom of the page.

DAY SPLINTING

When active wrist extension is absent, wrist support is recommended during the day to prevent overstretching of the wrist extensors.[12]

Wrist Supports

Volar or Dorsal wrist supports are used to support the writ, leaving the thumb and fingers free. This type of splint is often used during the daytime for functional activities, as it contains an adaptive slot for utensils or other items for daily activities. Dorsal long based splints also protect the integrity of wrist joints.[3]

Wrist Extension Dynasplint with ASB Hand Piece

Alternate Hand Pieces Attachments

DAYTIME SPLINTING



Custom Fabricated Volar Wrist Cock Up Splints

Custom Fabricated Dorsal Wrist Cock Up Splint


The Green Splint – North Coast Medical and Rehabilitation Products – www.ncmedical.com


Custom Fabricated Thumb Spica Splints

The Green Splint is a common dorsal wrist splint that is pre-fabricated. The Green splint is designed to place the wrist in a stable neutral position,[13] however the splint can be bent to allow some wrist extension.

At times wrist splints are fabricated volarly or dorsally with a variety of cut-outs to accommodate thumb position. A universal cuff can be used over the custom fabricated splint as well. With fabricated wrist splints, the angle of the wrist can be adjusted for progression with the patient's phase of recovery.

Long Opponens Splints

Long opponens splints are important for pre-tenodesis function, as they maintain support of the wrist and place the thumb in a functional position. This splint is incorporated in an individual who lacks antigravity wrist extension.[13] While stabilizing the wrist, it positions the index finger as a stable post against which the laterally-positioned thumb can achieve a functional key pinch position.[3] Because this splint is used when aggressive thumb positioning is needed, custom splints are widely used in clinical practice although

pre-fabricated splints which include universal cuffs slots for functional use are also available.[12] Below are examples of custom fabricated and pre-fabricated splints.

SPLINTING TO FACILITATE TENODESIS GRASP FUNCTION

Tenodesis splints are useful to facilitate picking up and releasing objects.[13] Tenodesis Trainer Splints (also known as RIC Tenodesis Splint) can be helpful to encourage functional use of the hand as wrist extension returns. They are also useful for determining whether a more permanent (and more costly) wrist driven flexor hinge splint (see below) is of interest to the patient and worth the financial investment. Kits are available to guide fabrication, as seen below.

Wrist Driven Flexor-Hinge Splint

This device uses wrist movement to generate finger flexion and extension forces. If wrist movement only exists in one direction, springs can be added.[13] Prefabricated models can be ordered, however, a local orthotics and prosthetics company can provide a customized fit.

Short Opponens Splints

Short opponens splints are utilized for individuals who have anti-gravity wrist extension, however, are unable to produce a productive tenodesis pinch. This splint promotes tenodesis grasp by aligning the thumb in a functional pinch position against the index finger.[3] This splint can be incorporated when an individual is able to maintain a stable wrist against gravity and against additional forces but assistance is needed in positioning of thumb to allow for pinch/grip of objects.[13] These splints are often used to prevent overstretching of the thumb during functional tasks.[12] Below are examples of prefabricated and custom fabricated splints. Note that many prefabricated splints may also include universal cuffs slots for function.

A wrist cock up with MCP pull downs can be incorporated when the MCP tightens in extension and the tenodesis flexion or lateral pinch is not aligning well. The MCP pulls apply a gentle force to increase joint mobility when the motion is limited by extensor tightness. As function returns, the tension on the pull system can be increased to active as an active assistive motion.[6]

SPLINTING FOR RETURNING HAND FUNCTION

Ulnar Gutter Splints

As the hand regains function, an ulnar gutter splint can be used to stabilize the wrist for opening and closing the hand, thus allowing the intrinsic and extrinsic muscle to work together and strengthen. This splint is incorporated when sufficient strength exists to break the use of tenodesis grasp.

Weight Bearing Splints

The weight bearing splint can be used to inhibit increasing flexor tone.[10] When hand function is returning and residual tightness remains, the weight bearing splints can be utilized to provide a stretch prior to active motion and activity of the hand.

MCP Blocking Splint

MCP blocking splints can be incorporated for emerging grasp when intrinsic hand weakness leads to MCP hyperextension and a claw hand position thus losing posture needed for cylindrical grasp.[12] Care should be given not to overstretch the thumb (CMC) during fabrication.[3]

Finger and Thumb Hyperextension Blocking Splints

As hand function returns, imbalance between intrinsic and extrinsic muscles can occur leading to finger and thumb deformities. A common emerging deformity is a swan neck deformity. When this occurs, a PIP hyperextension blocking splint is used to restrict the undesired motion. The splint can position the PIP joint in slight flexion, which allows full hand closure without a catch motion.[10] There are prefabricated Oval 8 splints as well as custom molded splints. Consideration should be given to custom fabrication of this splint as adjustments of the angle of the joint can be easily made as muscle strength returns.

SPLINTING TO FACILITATE TENODESIS GRASP FUNCTION

Wrist-driven Flexor Hinge Orthosis
https://jaecoorthopedic.com/product/wrist-driven-flexor-hinge-w-mapel/

Custom Fabricated Short Opponens Splint

Static Progressive Wrist Cock Up with MCP Pulls

SPLINTING FOR RETURNING HAND FUNCTION

Ulnar Gutter Splints

Weight Bearing Splints

MCP Blocking Splint

Norco® Soft MP Ulnar Drift Support

Oval 8 Splint

Custom Molded Splint

RESOURCES FOR SPLINTS AND SPLINTING SUPPLIES

(adapted from Deshaies 2008)

Alimed, Inc.
Phone: 800-225-2610
www.alimed.com

Bioness, Inc.
Phone: 855-902-5252
www.bioness.com

DeRoyal
Phone: 888-938-7828
www.deroyal.com

Dynasplint
800-638-9530
www.dynasplint.com

Jaeco Orthopaedic
Phone: 501-623-5944
www.jaecoorthopedic.com

Joint Active Systems, Inc.
Phone: 800-879-0117
www.jointactivesystems.com

North Coast Medical, Inc.
Phone: 800-821-9319
www.ncmedical.com

Otto Bock Medical
Phone: 800-328-4058
www.ottobockus.com

Performance Health
Phone: 800-323-5547
www.performancehealth.com

Restorative Care of America, Inc.
Phone: 800-627-1595
www.rcai.com

Saebo, Inc.
Phone: 888-284-5433
www.saebo.com

Silver Ring Splint Company
Phone: 800-311-7028
www.silverringsplint.com

3-Point Products
Phone: 888-378-7763
www.3pointproducts.com

UE Tech
Phone: 800-736-1894
www.uetech.com

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WHEELCHAIRS AND SEATING

INTRODUCTION

As of 2020, the most recent data available from the National Spinal Cord Injury Statistical Center (NSCISC) reports that there were 17,810 new cases of Spinal Cord Injury (SCI) within the United States in the previous year – which equals about 54 cases per million. The estimated number of people with SCI living in the United States is ~294,000[1,2,3].

After the onset of a SCI, the initial acute care stay is approximately eleven days. After an acute care stay, clients with significantly impaired mobility often transfer to an inpatient rehabilitation facility (IRF) for acute inpatient rehabilitation (AIR) where the same individuals have an average length of stay of approximately thirty-one days3. It is common during AIR that a client is evaluated for a wheelchair to use after discharge. Early mobility is critical for clients with SCI. A majority of clients with a SCI experience a change in functional status as a result of their injury and transition to using a wheelchair for mobility-related activities of daily living (MRADL). Having an appropriate wheelchair is critical to assist with early mobilization[4,5].

The process of acquiring a wheelchair is complex and requires a team effort. Service delivery models have been documented in the literature and involve the client, provider and a number of system level factors.[6] Upon admission to AIR, the medical team recognizes the need for a wheelchair and the physician enters a prescription for wheelchair evaluation. Then, the client is scheduled for an appointment with two required individuals, a physical or occupational therapist and an Assistive Technology Professional (ATP) from the company that will be providing the wheelchair. An ATP is someone who has advanced education in selection, delivery and training for manual and power wheelchairs, who is employed by a wheelchair supplier. The ATP has passed a national certification exam to obtain this designation. The certification that they hold is awarded by the Rehabilitation Engineering and Assistive Technology Society of North America (RESNA)[7]. The supplier involved with the evaluation may be determined by the insurance company, a third-party payer, availability of the supplier, convenience, and/or client/family request. It is important to mention, that if the client is going to discharge to another facility prior to discharge, such as a Skilled Nursing Facility (SNF), the wheelchair order cannot be completed until they discharge from the facility. If the client wants to proceed with an evaluation at the SNF, they can feel free to do that. However, if they wish to complete the evaluation with the original clinical team, then they can contact the supplier, arrange for a temporary (loaner) wheelchair to meet their needs until an evaluation with the therapist and ATP can be completed and the new (definitive) wheelchair.

Wheelchair Evaluation Process - The therapist and ATP work with the client/family/caregivers to collect information about the client's functional level, home/vehicle/work/school accessibility and the client's goals for mobility. At this appointment, the therapist and ATP will facilitate a discussion about the various types of technology that are appropriate, safe and available to the client to help meet their goals. In order to assist with determining whether a specific manual or power wheelchair is recommended for a client, there are multiple clinical factors, including client function, body dimensions, cognition, safety awareness and prognosis, which are weighed by the team involved in the recommendation[8]. Wheelchair trials may take place to allow the client to experience the various features of different make and models of wheelchairs. The chair that is recommended and ordered is, as described earlier, the definitive wheelchair. Once recommendations are finalized, the therapist writes a letter of medical necessity, which is signed by the physician. The physician-signed letter of medical necessity and order forms, along with any additional signed forms are sent to insurance for approval. It should be stated that different payer

sources have different requirements for determining medical necessity of recommended equipment, however, many sources use Medicare Guidelines to make the determination.[9]

While the client is waiting for insurance approval, they will likely use a loaner wheelchair that is provided to the client by the supplier. A loaner wheelchair is a chair for temporary use by the client, which is the closest match to the size and type of definitive wheelchair that has been ordered for the client. The client uses this wheelchair while they are waiting for the insurance to approve, the manufacturer to ship, and the supplier to assemble their definitive wheelchair. If there is an insurance denial of parts or the entire chair, a peer-to-peer physician call can be set up, an appeal letter can be drafted by the therapist for the insurance company to consider, or the client can decide to pay out of pocket. Once the chair is delivered and fitted, the client can take their chair home, and the process of wheelchair acquisition is complete.

Once the wheelchair is ready for delivery, a fitting appointment is scheduled in the seating clinic. With a client that is seen in the outpatient setting, the process is almost identical, however, the client is coming from home, instead of AIR, and the client may have more of an idea of their preferences/setup with their future chair, due to previous use or exposure. They still need to have an appointment with the ordering physician with a resultant progress note, explaining the need for a wheelchair and a prescription for a manual or power wheelchair.

Delivery of the Wheelchair – During the fitting appointment, when the wheelchair is delivered, a review of the original order is done, components of equipment are fitted and adjusted, and potentially programming of the wheelchair is completed by the therapist and ATP with the client. After this appointment is completed, the client may take their chair with them. For patients who have a power or manual wheelchair recommended, 62% report receiving the wheelchair by discharge from AIR and 98% report receiving it at 6 months post discharge[10].

Follow-up Needs – Any repairs should be referred to the supplier, and any medical/functional/physical changes may warrant a re-evaluation of needs with the therapist and ATP present. If the client's power chair needs programming – it may warrant a clinic visit, but could also be done via a service visit by the supplier in the home.

MANUAL WHEELCHAIRS

A manual wheelchair may be recommended for a client that has mobility needs that cannot be met within the home by an assistive device alone, and is required to perform Mobility-Related Activities of Daily Living (MRADLs).

Manual wheelchairs are coded (K0001-7) by dimensions, weight, seat-to-floor height, types of back/seat options, weight capacity and chair weight.

While a therapist/ATP can recommend any of these types of chairs, we will focus on the K0004-7 grouping; these wheelchairs are more frequently recommended in the clinic setting. Justifications listed may vary by a client's individual insurance plan coverage.

K0004 – High-Strength Lightweight Manual Wheelchair

For a client that requires a manual wheelchair that is lighter than a K0001-3, may require a semi-adjustable axle, may require an angle adjustable back rest, may require a unique seat to floor for sit-stand transition for foot propulsion or hemi-propulsion

Required for Justification:

- Client's mobility is limited and requires a wheelchair to perform one or more Mobility-Related Activities of Daily Living (MRADLs) – toileting, feeding, dressing, grooming, bathing in typical locations in home, in a timely manner, without potential for harm
- Mobility needs cannot be met by a cane or walker and K0001-3 manual wheelchair
- Client will require the wheelchair on a regular basis within the home
- Client is capable (physically, safety awareness, cognition) of safely propelling chair, or has assistance available to help aid propulsion
- Client has not expressed an unwillingness to use the wheelchair provided, in the home.
- Home is determined accessible to recommended wheelchair

Tilt-in-Space Manual Wheelchair

- Coded similarly to a K0004 Manual Wheelchair
- Has same requirements as a K0004, however, have to justify need for tilt:

Breakdown of Manual Wheelchairs Categories and Corresponding Specifications

Chair Type	Weight Capacity	Seat Width	Seat Depth	Seat to Floor Height	Specific Cushion/ Back Rest	Chair Weight
K0001 – Standard	250lbs	16″ or 18″	16″	19.5″	NO	>36lbs
K0002 – Standard Hemi	250lbs	16″, 18″ or 20″	16″ or 18″	17.5″	NO	>36lbs
K0003 – Lightweight	250lbs	16″, 18″ or 20″	16″ or 18″	17.5″ or 19.5″	NO	<36lbs
K0004 – High-Strength Lightweight	250lbs	16″, 18″ or 20″	16″, 18″ or 20″	15.5″, 17.5″, 19.5″, (13.5″, 14.5″, 16.5″ Special Order)	YES	<34lbs
K0005 – Ultra Lightweight	250lbs	Custom	Custom	Custom	YES	<30lbs
K0006 – Heavy Duty	250-300lbs	20″, 22″ or 24″	18″	17.5″, 19.5″	NO	N/A
K0007 – Extra Heavy Duty	300lbs +	26″, 28″, 30″ or Special Order	20″ or Special Order	19.5″	NO	N/A

May require tilt for dependent pressure reliefs

And/or requires tilt for repositioning and/or transfers

And/or requires tilt for edema/blood pressure management

And/or requires for rest breaks

K0005 – Ultra-lightweight Manual Wheelchair

Lightest and most customizable manual wheelchair – can be folding or rigid frame, but what makes it different from K0001-4 is its weight and it's **fully adjustable axle** – which is important for safe and efficient manual wheelchair propulsion[11]

Required for Justification:

- Client meets all requirements for a K0004, except they also require an even lighter wheelchair and fully adjustable axle

Therefore, the client must be capable of propelling self, and is not dependent on others for propulsion

- Client requires fully adjustable axle for:

Limiting/preventing upper extremity pain

Improving ability to reach wheel for efficient self-propulsion

Creating smaller turning radius for improved accessibility

Performing advanced wheelchair skills – ex. Bumping curbs, wheelies and navigating cracks/ gaps in sidewalks

Managing stability of the chair due to unique weight distribution needs – ex. Lower extremity amputation

K0004 Manual Wheelchair Tilt in Space Manual

K0005 Folding

K0005 Rigid

Pediatric Folding Manual

Pediatric Rigid Manual

Bariatric Manual Wheelchair

Pediatrics

Manual wheelchairs tend to be a Tilt-in-Space, or K0005, due to sizing/ weight of chair.

Justification is similar to previously stated requirements for Tilt-in-Space or K0005, however, school setting requirements should be included:

- Client needs a wheelchair to get from class to class, reduce fatigue during the school day, which would improve school performance, and/or is required for school trips and transportation.

It is mandated by insurance companies to make recommendations that demonstrate the potential for frame/chair growth. Without demonstrating the potential for frame/chair growth, it is unlikely that funding will be approved.

School settings typically require a headrest, seat belt, transit tie downs and straps to secure feet for safe school transportation

Bariatric – K0006-7

Justification requirements are similar to K0004 manual wheelchair, however the client must weigh between 250-300lbs for a K0006 and >300lbs for a K0007

POWER ASSIST/POWER ADD-ON DEVICES FOR MANUAL WHEELCHAIRS

Requires justification in addition to justification for a manual wheelchair for why client cannot maintain ability to safely and independently perform MRADLs in home without power assist or power add-on device

Need to check compatibility of manual wheelchair frame with power assist or add-on device

There are many different devices that can be placed on a manual wheelchair to assist with mobility:

Power-Assist Push Rims – Push rims are connected to sensors, motors that propel wheels and batteries for additional power with propulsion for short bursts indoors/outdoors

Pros
Can easily be used in home setting, therefore easier to justify to insurance

Can be switched out for typical manual wheels at any time

Cons
Wheels contain batteries and motors – Can be very heavy to lift

Limited by battery life

Each individual wheel can be programmed to accommodate the client's weaknesses/strengths

Rear-Mounted Power Assist – Client controls the speed of a drive wheel that can connect to the frame underneath the seat to aid with propulsion – can be used for acceleration and maintained speed indoors for longer, straight paths and outdoors in open spaces

Pros
Can easily be placed/removed on client's wheelchair by self or with assistance

Does not require constant pushing from client, however, client needs to still steer the chair

Cons
Sometimes challenging to control on declines or with larger bumps/cracks/gaps

Certain device controls are counter-intuitive when it comes to use

Joystick-Controlled Power Add-on – Client controls speed/direction of the drive wheels that are mounted on a manual wheelchair via a mounted joystick. Battery, drive wheels and joystick are a part of the system.

Pros
Allows client to propel a manual chair without the weight of a power wheelchair

Limits the need for an accessible vehicle for transportation, since chair can be collapsed and stored in a typical passenger vehicle

Cons
Takes some effort to transition chair back to a manual propulsion setup

Sometimes heavy, due to weight of battery and wheels – may be difficult to independently pickup/load

Power Assist Push Rim

Rear Mounted Power Assist

Joystick Controlled Power Add-On

Bariatric Folding Manual Chair

Pediatrics

- Power assist or power add-on can be recommended, but safety, behavior and cognition should be considered
- 22" push rims are available for push rim power assist

Bariatric

- Need to check for each client device for weight capacity – can vary ~300lbs – 375lbs

Outdoor/Unlevel Surface Mobility

- There are a number of power and non-power add-ons for manual wheelchairs that lift up the front end/casters of the manual wheelchair on a single wheel, which is secured to the frame.
- This type of add-on device allows for improved stability and reduced difficulty accessing areas on compliant or uneven surfaces.
- Insurance approval for this type of device is variable, however, a case can be made in a letter of medical necessity, if the device improves independence while around the home, possibly in a less densely populated area (rural, trails or outdoor camping, etc), or if it facilitates one's ability to perform required work activities.

POWER WHEELCHAIRS

Wheelchair Base

- Front wheel, mid-wheel or rear wheel drive

  Drive type is determined by position of drive wheel in relation to the front/rear of the wheelchair
- Front/Rear Wheel Drive – Provides greater ability to power up/down variable terrain/hills/ramps, larger turning radius
- Mid-Wheel Drive – Provides smaller turning radius than front/rear wheel drive systems, does not do as well with variable terrain/hills/ramps – may be more intuitive to control than a front/rear-wheel drive
- Client preference may play a large role in this decision

Controlling a Power Wheelchair

- Is variable, based on client functional status – what device provides an independent, safe, comfortable and consistent method of controlling the chair.
- Joystick, mini-joystick, head array, sip/puff, chin stick, eye gaze
- Location of control system is dependent on consistent access

Seat Functions

- Tilt, recline, elevating leg rests, seat elevator or standing function
- Based on client needs for pressure relieving, positioning in chair, performance of ADLs or need to attain a functional position.
- Seat elevators and standing function are not frequently approved by insurance

Seating

- Varies, based on group of power wheelchair. Will get into detail when discussing power wheelchair groups, as well as seating and positioning section

Considerations for Justification of Power Wheelchair Mobility Device

- To justify a power wheelchair, one must determine that use of assistive devices and manual wheelchair mobility cannot meet the client's needs of safe, independent functional mobility

  Examples – Client cannot propel manual wheelchair due to upper extremity weakness, pain with propulsion, lack of endurance, lack of coordination to perform manual wheelchair mobility, etc
- Insurance requires that the client has a diagnosis that is neurological in nature
- Must determine ability to access/enter home and transportation with this equipment
- A headrest, seat belt, chest support, and approved lock or tie down system may be recommended for any client who will be transported in a wheelchair.
- Client must be able to maintain safe positioning in the selected device able be able to transfer, by self or with assistance, safely in/out of device
- Client must have sufficient strength/endurance/coordination/safety awareness/cognition to be able to control safely

Special Populations for Power Wheelchair Mobility

Pediatric

- Self-mobility has been linked to a child's cognitive and psychosocial development[12,13,14,15,16], including spatial cognition, emotional skills, self-awareness, increased independence and the development of ability to deal with environmental stressors[17,18,19,20].
- There is no set age to begin power mobility training, however, recent research has shown that clinicians are willing to train power mobility with augmented controls, as early as 8mos old[21].
- Typically, multiple therapy sessions are necessary in order to demonstrate consistency with control and safety

Bariatric

- Typical weight capacity for a power mobility device is ~300lbs
- Heavy-duty power mobility devices can have varying capacities of 450-550lbs

Groups of Power Wheelchairs

- There are multiple groups of power wheelchairs – each has different capabilities/attributes that separate it from the others categorized between Group 1-5 Power wheelchairs.
- In order to justify a group of chair for your client, you must eliminate manual wheelchairs ***and*** the lower groups of power wheelchair and explain why it does not meet the client's needs

Group 1 – Power Wheelchairs – Power Operated Vehicle (POV)/Scooters			
Seating	**Wheelchair Features**	**Performance**	**Important Considerations**
Has basic seating with standardized sizes	No seat functions (ex. Tilt or recline)	Has limited speed and battery life	Higher tipping-over potential than other groups of power wheelchairs
No skin protection or positioning cushions – no off the shelf/3rd party cushions and/or back rests	No programmability	Less maneuverable compared to other groups of power wheelchairs	Choices of models of devices may be limited by type of insurance
	Very limited or no suspension	Good for mobility on level, hard surfaces without elevation or surface variability	

Group 2 Power Wheelchairs		
Seating	**Wheelchair Features**	**Performance**
Has limited seat sizes and tends to come with captains seat	Can have tilt/recline added – dependent on device	Increased speed, power and stability compared to a group 1/POV/scooter
However, with certain models, can order skin protection and positioning seating, if compatible	May have very basic programmability	Increased ability to drive up inclines and navigate minimal variability of surfaces
	Suspension is more advanced than group 1 power wheelchair	Can handle obstacles ~1.5inches high and can handle inclines up to 6 deg
		Minimum top speed 3mph
		Longer battery life than a group 1/POV/scooter – minimum of 7 miles from one full charge

Group 1 Power Wheelchair/Scooter

Group 2 Power Wheelchair

Group 3 Power Wheelchair

Group 3 Power Wheelchairs		
Seating	**Wheelchair Features**	**Performance**
May use almost any type of seat cushion and/or back rest, including custom molded devices	Can have recline, tilt, elevating leg rests and seat elevator	Much more powerful and faster than group 1 and 2 chairs.
	Significant amount of programmability available	Much longer battery life than group 1 and 2 chairs – minimum of 12 miles from one full charge
	Can have advanced control interfaces – Head array (Figure 14), sip/puff, sip/puff and head array combo (Figure 15) chin drive, etc	Can handle obstacles up to 2inches high and inclines of up to 7.5deg
		Superior suspension compared to group 1 and 2 chairs
		Minimum top speed of 4.5mph

Group 4 Power Wheelchair			
Seating	**Wheelchair Features**	**Performance**	**Important Considerations**
Similar to group 3 wheelchairs	Has similar seat function potential (recline, tilt, elevating leg rests and seat elevator) of group 3 wheelchairs	More powerful and faster than group 1-3 chairs	While the benefits of standing have been documented for physical, psychological and social well-being, the group 4 power wheelchair and standing features have proven difficult to acquire through insurance reimbursement
	Advanced seat functions available include: partial and full standing	Improved stability/ balance for advanced seat functions and improved suspension for navigating more challenging terrains	

Group 5 Power Wheelchair			
Seating	**Wheelchair Features**	**Performance**	**Important Considerations**
Similar to group 3 wheelchairs	Has similar features/ capabilities of group 3 power wheelchairs		Group 5 power wheelchairs are designed for clients that are expected to experience significant growth during the life of the chair
			Client must weigh <125lbs
			Wheelchair will have lower seat to floor heights to allow for improved ease of transferring in/out of the device.

SPECIALTY WHEELCHAIRS

- Due to the pressure from wheelchair users and with improvements in technology, we have seen a significant amount of progress with the creation of reliable and increasingly more affordable wheelchairs that can function in more demanding environments – such as off-road/backwoods or the beach.
- For beach environments, there are chairs with wide bases and large/wide tires that can keep the client from being bogged down and tipping on the compliant surface of sand.
- For off-road/backwoods environments, there are tracked vehicles (commonly called "tank chairs") that can provide a powered method of exploring the outdoors or for going hunting/fishing with a decreased potential for getting stuck or tipping.
- For various wheelchair sporting activities specialty chairs may be required.
- While these chairs are incredibly useful in restoring independence in more demanding environments, it is rare that insurance will see the medical need for these devices and may not authorize payment for the equipment.

SEATING AND POSITIONING

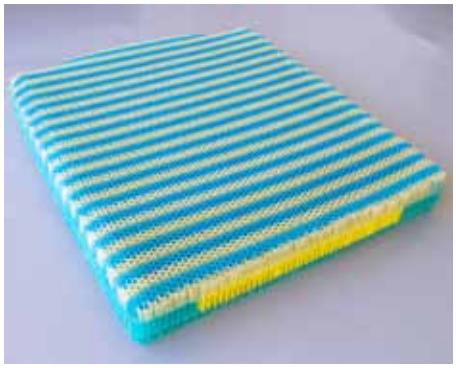
- Includes supports, strapping and cushioning to keep clients positioned properly, comfortable and functional.
- Includes: Backrest, seat cushion, head support, pelvic positioning belt, chest strap/harness, upper/lower extremity supports, hip guides, trunk laterals, foot/ankle holders/straps, trays, arm troughs, etc
- Supports client in safe, comfortable and functional position while in wheelchair
- Varies based on client needs – ex. Fabric sling back, rigid back, custom seating, pressure relieving and/or positioning cushion

Materials

Foam – Durable, lightweight and stable for sitting. Can have multiple layers of foam with different viscoelastic qualities.

Urethane/Honeycomb – Durable, may or may not be heavier than foam, may or may not have better

Foam Cushion



Urethane Cushion

Fluid Cushion

Air Cell Cushion

Hybrid Cushion

Off-Loading Foam

pressure relieving than some foam cushions. Stable sitting surface.

Fluid (Gel) – Designed for improved pressure relief, may have some maintenance for fluid redistribution, heavier than foam or rubber/honeycomb, fluid packet may be ruptured/punctured with rough handling.

Air Cells – Designed for optimal pressure relief, has maintenance for air pressure in cushion, lighter than fluid (Gel), air cells can be torn or punctured, may be less stable for sitting

Hybrid – (Foam with Air or Fluid) – Designed for pressure relief of ischial tuberosities in the rear of cushion with fluid (gel) or air cells, and can have foam contour for improved positioning. Has similar durability concerns as fluid (gel) and air cells alone. More stable than air cells alone. Helps with stability of cushion for transfers.

Off-loading Foam – Designed for pressure relief by off-loading/floating the ischial tuberosities and supporting the weight of the person on non-boney structures, such as adipose tissue and muscle in the client's thighs and buttocks.

Alternating Air Pressure Cushion – has a motor and battery to move air around the cushion and provide the highest level of skin protection. Limited instances of reimbursement. Have to monitor battery levels to keep device from turning off, leaving the client without the same level of pressure relief

Goals for Seat Cushions

- General Use – Built for client comfort, however, does not have significant additional contours to keep the client in one position
- Positioning – Built for client comfort and proper positioning. Necessary if client tends to move into unsafe or uncomfortable/painful positions
- Skin Protection – Built for client comfort, proper positioning and also limits cushion pressure against skin to limit skin breakdown
- Custom Needs – Client's needs are not met by off-the-shelf cushions and requires one that supports the client in the safest, most functional and comfortable position

Important Considerations

- One must justify the type of cushion, based on the goals for the cushion – ex. Client is unsafe without proper positioning support and/or skin protection from the cushion

BACK RESTS

Materials

Foam – Lightweight, durable, easy to position, limited to no maintenance

Air Cells – Lightweight, requires adjustment/ maintenance of air pressure, good for backs with protruding bony prominences

Goals for Back Rest

General Purpose – Limited contour, limited adjustability, used for comfort with limited additional postural needs

Lateral (Contoured) Support – Moderate to significant contour, may have adjustment options based on model, designed for keeping client in upright/midline when lacking the ability to do so while in the wheelchair

Custom Needs – Client's body shape is unique and positioning needs are not met by off-the-shelf back rests and requires one that supports the client in the safest, most functional and comfortable position

HEAD RESTS

- Can vary based on client needs/requirements
- May be simple flat pad, contoured, or have a tri-planar setup

Flat Pad – Minimal support and can be present, simply for supporting head in tilt/recline or for safety during transportation while in chair

Contoured – Moderate amount of support, used for supporting head in tilt/recline or safety during transportation while in chair, and may help with keeping client's head in upright and midline while in upright

Tri-Planar – Pad posterior and bilateral support for head. Significant amount of support, more aggressive than contoured head rest, significantly limits head movement.

Neck Support Devices – There can be instances where the client cannot keep head in upright/midline with previously mentioned head rests, alone, and padded neck support devices can be added in addition to a head rest

ELEVATING LEG RESTS/RESIDUAL LIMB SUPPORTS

- Elevating leg rests and residual limb supports can be used to position the lower extremities in a safe and supportive fashion.
- Various designs and support, based on client needs

TRUNK LATERALS/HIP GUIDES

- Trunk laterals can be placed on the sides of the client's wheelchair frame, to keep client in upright/ midline – can be flat or contoured, and of various sizes, based on client needs
- Hip guides are pads that are attached to the chair at the sides of the seat to keep the client's legs from sliding into hip abduction or to limit pelvic movement in sitting.

UPPER EXTREMITY SUPPORT

- Clients with limited ability to position their upper extremities in a safe, functional location may need additional support for their arms – ex. flaccid upper extremities from a spinal cord injury or brain injury
- A therapist may recommend either an arm trough, hemi-tray (Figure 31) or full tray, with padded/ unpadded surfaces or with or without specific shapes/contours/built-up supports.

Air Cell Integrated Back Rest

Lateral Contoured Support

Contoured Head Rest

Tri-Planar Headrest

Trunk Laterals

Hip Guides

Arm Trough

Full Tray

Hemi Tray

WHEELCHAIR ACCESSORIES

- The client may have individual needs and requirements that need to be addressed with additional medically-necessary items
- A non-exhaustive list of these items: Ventilator tray, brake extensions, hill holders, anti-tippers, IV pole, oxygen tank holder, under chair netting for carrying medical necessary equipment or supplies

Ventilator Tray

Anti-Tippers

Brake Extension

Oxygen Tank Holder

CONCLUSIONS

Acquiring a wheelchair is a complex process that involves a number of different individuals. Just because a wheelchair is delivered to a client, it does not mean an end to the work involved with keeping a client moving. Regular maintenance is required for any type of wheelchair. Basic maintenance can be performed by most clients and/or family/caregivers (ex. Replacement of flat tire tubes, removing hair from casters or keeping axles lubricated and rust-free). Suppliers may be able to provide repairs with no additional cost to the client. These repairs can include, but are not limited to: tire/caster replacement, bearings or motors, caster forks, anti-tippers, batteries, joystick panels, worn cushions, backrests and head rests. If something changes with the client, such as function, body shape, height/weight or new onset of pain or wounds, a new evaluation is recommended prior to making any changes to the chair. While many clients have access to purchasing equipment online, it is still recommended that the client be re-assessed by a therapist and ATP before making purchases that would modify their wheelchair. As clients age with a disability, their needs may change, and previous equipment may no longer be meeting their needs, yet again a full evaluation is recommended to facilitate a safe selection of equipment to keep the client safe and independent. It is our hope that you have gained a better general understanding of wheelchairs, and the process for acquiring a wheelchair. This is not an exhaustive source of information when considering wheelchair recommendations. New equipment and processes are always evolving and require a sharp clinical mind to keep up-to-date with what will help us best serve our clients. Please consult your clinical team, ATP, and equipment supplier for recommendations based on one's individual needs as you age with use of your wheelchair.

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HEALTH, WELLNESS, FITNESS AND THE REHABILITATION CONTINUUM

INTRODUCTION

Achieving health, wellness and fitness for the SCI/D population is an important goal to improve quality of life and counter the effects of a sedentary lifestyle post injury. Inactivity increases the risk for preventable cardiopulmonary and metabolic diseases, contributes to multi-system medical complications, activity limitations and accelerated aging.[1,2,3,4]

Addressing current barriers and providing structured guidance may motivate wheelchair users to improve attitudes toward physical exercise and encourage them to engage in regular exercise whether it be at home, public gyms or within the community.

This chapter aims to help educate individuals, families, health care providers, and third party payers in regards to exercise benefits, current guidelines and exercise prescriptions, aspects of a structured fitness program, and provide information on adaptive equipment, sports and recreation for people with spinal cord injury.

BENEFITS OF EARLY MOBILIZATION AND EXERCISE

Acute

In the acute setting, educating patients on the risks of prolonged bed rest is important to understand the benefits of early mobilization after SCI. The complications of acute immobility for the general population include rapid loss of muscle mass,[5] cognitive and psychological issues, difficulties with mechanical ventilation weaning and increased length of stay. Muscle weakness after intubation and bedrest occurs first to the respiratory muscles and then to the peripheral muscles which can contribute to prolonged disability.[6] Muscle weakness of the diaphragm, intensive care unit-acquired weakness, critical illness polyneuropathy and critical illness myopathy are all associated with mechanical ventilation and immobility in the ICU. These conditions correlate with prolonged mechanical ventilation and ICU length of stay, increased costs of hospitalization and increased long term morbidity and mortality.[7] In addition, prolonged bed rest results in increased fluid losses which can contribute to decreased stroke volume, cardiac output, and peak oxygen uptake.[8] Other adverse events reported include ventilator acquired pneumonia, hospital-acquired pneumonia and the development of pressure ulcers.[10] The pulmonary risks for those with acute spinal cord injury are exacerbated by spinal shock and its deleterious effects on pulmonary function including worsening ventilation, increased work of breathing, atelectasis, and poor secretion management.

The benefits of early mobilization include improved ventilation, functional capacity, perfusion, muscle strength and reduction in hospital acquired infections.[9,10] It has also been associated with decreased duration of mechanical ventilation and delirium, improved functional outcomes at hospital discharge, contributed to shorter duration of both ICU and hospital stays, and decreased one-year mortality rates.[10,11,13,14]

In a retrospective chart review, Ronnenbaum et al reported that implementation of a mobility protocol resulted in an average of 11.6 days fever days in the ICU and a $22,000 savings per patient.[15]

Chronic

The health benefits of implemented regular exercise are multifaceted, influencing physical well-being and overall psychosocial function.[16,17,18] There is consistent evidence that a regular fitness program for individuals with SCI has the following positive effects:

- Cardiac/ Respiratory
  - Decreased levels of inflammatory markers (IL-6 and CRP) resulting in reduced risk of CVD rates (paraplegia>tetraplegia)[19]

- Improved overall functional capacity including VO2peak and power output [20]
- Improved cardiac autonomic balance[21]
- Decreased platelet aggregation and blood coagulation[22]
- Improved lipid lipoprotein profiles[23]
- Decreased LDL and Total cholesterol[24]
- Decreased vascular resistance and increased muscle blood flow both at rest and with aerobic activity[25]
- Increased peak exercise tolerance[26]
- Increased peak oxidative metabolic cellular changes[27]
- Improved vital capacity and increase in maximum volume of expired air when exercising[28]
- Increased FVC, FEV1, and PEF[29]
- Improved FVC, FEV1, FEV1/FVC, and FEF[30]

- GU
  - Increased bladder capacity, voiding efficiency and detrusor contraction time[31]
  - Decrease in voiding pressure[31]
  - Decrease in frequency of nocturia and urinary incontinence[31]
- GI/ Metabolic
  - Decreased total serum cholesterol, body fat and BMI
  - Reduced harmful low density lipoprotein cholesterol, and increased high-density lipoprotein cholesterol
  - Improved glucose homeostasis and insulin sensitivity
  - Increased fasting insulin concentrations and reduced insulin resistance
  - Improved hepatic insulin sensitivity[20]
  - Improved glucose homeostasis preventing or reversing Type 2 Diabetes Mellitus[32]
- Skin
  - Maintained skin integrity and prevented pressure ulcers, which results in savings between $124,000-$129,000[33]
- Bone
  - Improved bone mineral density reducing incidence of osteoporosis in SCI[70]
- Neuro/MSK/Spasticity
  - Improved sitting posture, wheelchair propulsion which leads to improved mobility and functional independence
  - Improved balance and gait
  - Decreased shoulder pain from shoulder instability related to muscle weakness[35]
- Psychosocial
  - Improved overall quality of life through reduction of stress, pain, anxiety, and depression as well as enhanced self confidence, self-image, and energy leading to better community reintegration – needs superscript citation[4,36,37]

MEDICAL CONSEQUENCES OF SCI

It is important that persons with spinal cord injury be aware of the physical changes, complications and injuries that could affect their fitness program. The level and type of spinal cord lesion determines the extent of the physiological changes that occur though muscle weakness is consistent across all individuals with SCI/D.[1,38] While an in-depth explanation of the medical consequences of spinal cord injury is beyond the scope of this chapter, we will highlight the most significant changes that should be considered when designing, instituting, or performing any exercise program. We recommend that individuals with SCI/D should speak to their physicians for more information.

Autonomic dysreflexia (AD) is a dangerous, and potentially lethal clinical syndrome which may occur for individuals with SCI/D above T6 resulting in acute, uncontrolled elevation in blood pressure. It can be triggered by ill-fitting equipment or machines that utilize electrical stimulation causing a painful stimulus. Persons with SCI/D should watch for signs of AD during exercise and stop the activity if symptoms develop. Equipment that is ill-fitting can also lead to pressure induced skin injuries therefore close monitoring of skin and pressure areas after use is also essential along with frequent pressure breaks every 20-30 minutes during exercise.

Individuals with SCI/D are at higher risk for osteoporosis and bone fractures after injury. Due to this, any standing exercises or activities should first be cleared by their physician. A dual-energy x-ray absorptiometry (DEXA) scan may be indicated in order to stratify fracture risk.

Heart rate may also be affected in individuals with SCI/D especially with cervical or high thoracic injuries. They may experience an inadequate rise in heart rate (may plateau at 120 BPM) and oxygen intake during exercise. Rather than using heart rate to measure exercise intensity, other measures such as the Borg Rating of Perceived Exertion Scale or the Modified Borg Dyspnea Scale may be more indicative of the exercise intensity for an individual with SCI/D than heart rate alone.

Finally, when exercising, persons with SCI/D should be aware of the potential for thermal dysregulation. Especially for those with dysfunction of the spinal cord T8 and above, they may not be able to adequately sweat or cool off appropriately during exercise. Persons with SCI/D should ensure adequate room temperature and fluid intake to support vigorous exercise.

OTHER BARRIERS TO PHYSICAL ACTIVITY FOR SCI

Psychological barriers also exist for individuals with SCI including lack of motivation, reduced energy, depression, lack of self confidence, fear and concern about physical limitations which make participating in a fitness program difficult.[39] Many of these psychosocial challenges are further exacerbated by lack of accessible gyms with wheelchair equipment, lack of SCI experienced trainers at fitness centers, financial barriers, lack of transportation to gyms and exercise facilities, and general lack of awareness of exercise and adaptive sports programs.[40,41,42,43] It is important that individuals with SCI/D are encouraged and provided the opportunity to get involved in the fitness community including sports and recreation. Education on the benefits of exercise and providing exercise guidelines for this population should start from the point of rehabilitation and continued throughout their lifetime. Providing available information on adaptive equipment and adaptive sports will be beneficial in countering some of these perceived limitations and barriers.

EXERCISE COMPONENTS AND PRESCRIPTION

Although exercise programs are highly variable, the core components should be consistent. The FITT protocol was developed to ensure completeness when prescribing or incorporating an exercise program. The FITT protocol is composed of Frequency, Intensity, Time and Physical Activity Type. Frequency, intensity and time are variable and are discussed in further detail in Exercise Guidelines. Physical activity types include aerobic exercise, resistance training, and flexibility.

Individuals with spinal cord injury are at a heightened risk of cardiovascular disease, therefore cardiovascular training is essential. However, an aerobic program should be tailored to the individual's specific capabilities and should consider the previously mentioned risks that individuals with SCI/D face. Aerobic exercise may include activities such as arm-crank ergometry, swimming, and adaptive exercises. In addition, if appropriate, people with SCI/D may benefit from a locomotor training program that includes body weight supported treadmill training with either hands-on facilitation or robotics. Standers/ standing frames can additionally provide weight bearing for individuals with SCI/D. Benefits include countering osteoporosis, improving bowel/ bladder, improving spasticity, promoting and maintaining range of motion throughout the lower extremities, preventing contractures and improving psychological

well-being. Many of these standing frames can be utilized to perform upper extremity exercises and some have gliding functions for both upper and lower extremity training.

A comprehensive exercise program should also include resistance training and muscle strengthening. Upper extremity (UE) strengthening should focus on elbow extension, shoulder flexion and horizontal adduction, scapular protraction and depression, and trunk musculature as these muscles play an integral role in performing most functional activities in complete injuries. All UE exercise programs should take into account the increased incidence of shoulder pain and injury following SCI/D and work on balancing musculature as well as scapular and shoulder stabilization. Strengthening the lower extremities may improve ambulation outcomes, promote ease of transfers, and can address motor control and endurance impairments. Abdominal and trunk/core muscle strengthening may also ease transfers, improve sitting balance, and improve stability for ambulation.

Strengthening and resistance training can be achieved without equipment using proprioceptive neuromuscular facilitation (PNF), isometric, eccentric, concentric, and isokinetic strengthening exercises. Dumbbells, wrist and ankle cuff weights, weighted dowels, therabands, weighted balls, sled machines, press machines, and/or tubing can be used in resistance programs. In addition, there are multi-station resistive exercise machines as well as some cardiovascular equipment that can confer strengthening benefits. Counterbalance arm slings and arm skates can help assist with strengthening and neuromuscular reeducation if a patient has motion in an indicated muscle but not enough strength to perform against gravity or resistance.[44,45]

Flexibility exercises are also important in the setting of spasticity and muscle imbalance and can help prevent contracture, maintain joint range of motion, and protect from overuse injuries. Flexibility exercises may include activities like adaptive yoga or passive and active stretching. Stretching can also protect the ability to use a tenodesis grip in individuals without active wrist and finger extension. Individuals who may have a difficult time carrying out a stretching program on their own due to their level of injury, can enlist the help of a therapist, aide, family member or friend.

In addition to the cardiovascular, strengthening, and flexibility exercises outlined above, individuals with SCI/D may also have weakened respiratory musculature and cough strength. Respiratory muscle training for both inspiratory and expiratory muscles has been shown to improve respiratory muscle strength and lung volumes.[46,47,48] Therefore, breathing exercises should be incorporated into a patient's program as early as they are able to improve respiratory function. Some exercises can be done without equipment such as deep breathing, triple breath holds, number counting, quick breaths, and coughing. There are also small handheld devices which can be used for respiratory muscle training at home with or without assistance.

EXERCISE GUIDELINES FOR SCI

The American College of Sports Medicine49, The World Health Organization50, and the US Physical Activity Guidelines Advisory Committee51 have all provided systematically developed, evidence based guidelines regarding activity requirements to maintain physical health and reduce morbidity and mortality for the general population (**Table 1**). However, these guidelines were not tailored specifically for individuals with SCI/D. Therefore, researchers are working to

Table 1: ACSM Physical Activity Recommendations

American College of Sports Medicine Physical Activity Recommendations			
	Cardiovascular (Aerobic) Training	**Strength Training**	**Flexibility Training**
Frequency	≥ 5 days per week ≥3 days per week	≥ 2 days per week	N/A
Intensity	Moderate Vigorous		
Duration	≥ 30 minutes ≥ 20 minutes		

Table 2: Dr. Martin Ginis et al Exercise Recommendations

	Cardiovascular Health*	Muscle Strength and Endurance*	Flexibility and Range of Motion
Frequency	Minimum 2 days/week	Minimum 2 days/week	Daily
Intensity	Moderate to vigorous†	8–10 repetitions	30–60 seconds/stretch; gentle , slow, pain free
Duration	20–30 minutes/session	3 sets; 1–2 minutes rest between sets (30–60 minutes total)	2 sets; 5–15 minutes
Activities	Wheeling, arm cycle, sports, recumbent stepper, aquatics, cycling, circuit training, functional electrical stimulation	Free weights, elastic resistance bands, cable pulleys, weight machines, functional electrical stimulation	Standing in standing frame (if medically cleared); passive and active static stretching

* These cardiovascular and muscular strength/endurance recommendations are adapted with permission from SCI Action Canada (www.sciactioncanada.ca/guidelines accessed August, 2014).

† *Moderate intensity:* somewhat hard but can be sustained for long periods without experiencing excessive fatigue; *Vigorous intensity:* very hard, close to maximum and cannot be sustained for long without experiencing excessive fatigue.

develop exercise guidelines specific for the SCI/D population[4,16,52,53,54,55,59,72]. While the exact amount of exercise to provide the optimal reduction of health-related morbidity and mortality for individuals with SCI/D are not known, Ginis et al 2018 showed the minimum frequency, intensity and duration required to maintain or improve physical capacity and muscle strength for individuals with SCI compared to sedentary lifestyle (**Table 2**).

EXERCISE AND ADAPTIVE EQUIPMENT

There has been an incredible amount of innovation and advancement in the development of equipment to encourage participation in physical activity for individuals with SCI/D. Equipment ranges from simple to complex and can be used in various standing, sitting, or laying positions. In addition, some pieces of equipment have integrated functional electrical stimulation (FES) in order to increase the cardiovascular and muscle strengthening effect. Finally, newer robotics are now available for rehabilitation and exercise use.

The following are some examples of the types of equipment that SCI individuals can use to maintain fitness. Many of these pieces can be used not only for cardiovascular training but for resistance/ strength training as well. In addition, we have also included equipment used for balance and gait training. While many of the gait trainers may be beyond the scope of DME, and may primarily be seen in inpatient rehabilitation centers, they are included here for completeness.

Alternative Exercise Equipment

- The Burn Machine: https://theburnmachine.com
- Core Stix: https://corestix.com
- Check out their exercise page for ideas on exercise programs!
- Prestige Total Access: Equalizer Exercise Machines: https://www.cybexintl.com/products/prestige-total-access.aspx
- The Equalizer Exercise Machine: http://www.equalizerexercise.com
- The Genesis Dual Cable Cross: https://freemotionfitness.com/strength-machine/dual-cable-cross
- HUR USA Accessible Training Equipment: https://hurusa.com/product-category/purpose/accessible-training
- Wheelchair Fitness Solution: https://www.wheelchairfitnesssolution.com

UPPER EXTREMITY EQUIPMENT

Matrix Fitness Krankcycle

SCIFIT PRO1 Upper Body Exerciser
https://www.scifit.com/product/pro1

Concept2 SkiErg
https://www.concept2.com/skierg/concept2-skierg

Ropeflex Functional Trainer
https://www.ropeflex.com

Vitaglide
https://www.vitaglide.com

Concept2 Rower
https://www.concept2.com/

Invictus Active Trainer
https://www.invictusactive.com/product-category/trainers

Hocoma ArmeoSenso
https://www.hocoma.com/solutions/armeo-senso

Hocoma ArmeoSpring
https://www.hocoma.com/solutions/armeo-spring

LOWER EXTREMITY EQUIPMENT

While the below pieces are primarily lower extremity cardiovascular/ strengthening exercise equipment, many have adaptations to also be upper body trainers. There are also options for supine vs. seated machines, and ones that can be used as a standing frame. Equipment that can be used in the supine position are great options for individuals who have not graduated to the inpatient rehabilitation phase and can be utilized for early mobilization treatments.

MOTOmed loop.la
Copyright of RECK-Technik GmbH & Co. KG
Leg Arm/Upper Body Trainer
https://www.motomed.com/en/products/motomed-loop-la/

NuStep
https://www.nustep.com

GigerMD (supine)
https://www.gigermd.com/en/

MOTOmed layson.la
(expandable chassis)
Copyright of RECK-Technik GmbH & Co. KG.
Supine Position - Bed
https://www.motomed.com/en/products/motomed-layson-a

Cybex Recumbent Bike
https://www.cybexintl.com

Easy Stand Evolv + Glider
https://easystand.com

STRENGTHENING/ RESISTANCE EQUIPMENT

The following are examples of equipment that are readily found in a local gym or rehab center which can be used by individuals with SCI for strengthening exercises. Seating and hand adaptations or modifications may be needed depending on level and completeness of injury. It is important to note that regular weights/ dumbbells and therabands can also be used. See our home work out section for more details.

Freemotion Dual Cable Cross
https://freemotionfitness.com/strength-machines/genesis

Matrix Functional Trainer G3-MSFT300/400
https://www.matrixfitness.com/en/strength/multi-station/g3-msft3-functional-trainer

ADL Leg Press
https://www.adlbalance.com/products/adl-leg-press

ADL Leg Press Photo taken by Madelyn Haas (2018)

Ergo Arm Skate by Therafin
http://www.therafin.com/therapy-exercise.htm

StepOne Recumbent Stepper
https://www.scifit.com/product/stepone

Swedish Sling Counter Balance Arm Support System
https://www.usamedicalsurgical.com/swedish-helparm-swedish-sling-arm-support-system

HOCOMA ERIGO

(Integrated Functional Electrical Stimulation)

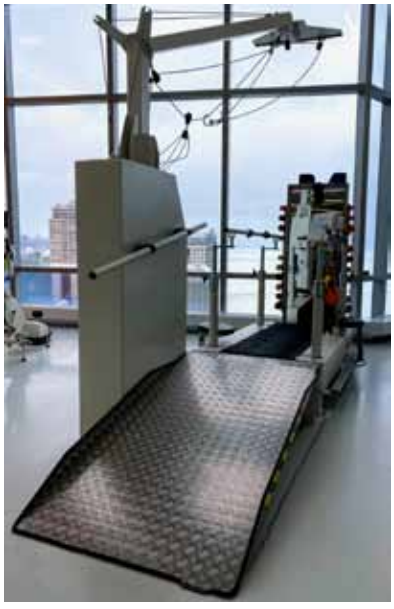
https://www.hocoma.com/solutions/erigo

GAIT TRAINING EQUIPMENT

There are many different devices to provide offloading of body weight in order to facilitate gait training after SCI/D. Below are just a sample of the products available currently on the market. Some are free-standing and some require an overhead track for use. Additionally, some newer systems have integrated dynamic offloading.

Rifton Transfer and Mobility Gait Pacer
https://www.rifton.com

Hocoma Lokomat
https://www.hocoma.com/media-center/media-images/lokomat



Woodway Loko Station
https://www.woodway.com/products/loko-station

Alter-G "Anti-Gravity Treadmill"
https://www.alterg.com

C-Mill
https://www.motekmedical.com

ZeroG Gait and Balance System
https://www.aretechllc.com

Motek Rysen
https://www.motekmedical.com

Rewalk Exoskeleton
https://rewalk.com

Ekso Bionics
https://eksobionics.com

ADAPTIVE EQUIPMENT

Adaptive equipment can be utilized on a variety of machines especially for individuals with tetraplegia who have poor hand function.

Active Hands (Looped Gripping Aid)
https://www.activehands.com/product/looped-exercise-aids

Active Hands (General Purpose Gripping Aid)
https://www.activehands.com/product/general-purpose-gripping-aid

Bike-On.com
https://bike-on.com

BALANCE / STANDING FRAME EQUIPMENT

Biodex Balance System™ SD
Biodex Medical Systems, Inc.
www.biodex.com

Thera Trainer Balo
https://www.thera-trainer.de

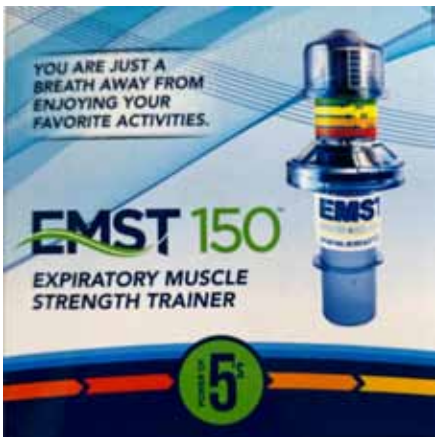
Thera Trainer Verto
https://www.thera-trainer.de

EASY STAND EVOLV

https://easystand.com/product/png50162-evolv-medium

RESPIRATORY MUSCLE STRENGTHENING

In addition to cardiovascular strengthening, respiratory muscle strengthening is essential especially for persons with cervical or high thoracic spinal cord injuries. RMT can improve vital capacity and respiratory muscles strength, and potentially decrease pulmonary infections. In addition, improvement in respiratory function may also improve cardiac and exercise function in general. Some pieces of respiratory strengthening equipment can be used in the hospital or home setting and can target either inspiratory muscles, expiratory muscles, or both depending on the device.



Expiratory Muscle Strength Trainer
https://emst150.com

OTHER RESOURCES

There are a plethora of resources for alternative exercise equipment for individuals with SCI/D. We have highlighted the most commonly seen pieces of equipment at gyms and inpatient rehabilitation centers, but wanted to include other resources that may be helpful for this population. The following links provide information on other available fitness equipment, many of which can be easily added to personal home gyms.

COMPACT FES DEVICES

Bioness H200
http://www.bioness.com/Products/H200_for_Hand_Paralysis.php

Bioness L300
http://www.bioness.com/Products.php

Below are examples of adaptive devices for upper and lower extremity FES cycling that enable targeted selection of muscle groups including the shoulder, upper extremities, core/trunk and the lower extremities.

RT300 for Leg and Core
https://restorative-therapies.com/ifes-systems/rt300-leg-core

MyoCycle by MYOLYN, LLC
https://myolyn.com

FUNCTIONAL ELECTRICAL STIMULATION

Electrical stimulation (ES) has been studied using many different approaches. This section will focus on transdermal electrical stimulation which generates contractions in paralyzed muscles by emitting electrical impulses of varying duration and magnitude via surface electrodes. Functional electrical stimulation (FES) combines electrical stimulation with a functional movement such as walking, grasping, or cycling.[56,57,58] There are many different types of equipment currently out in the market that utilize FES technology and no documented differences in functional outcomes between manufactures. There are compact FES devices with site specific stipulation of muscles in both the upper and lower extremities, and larger pieces of equipment which can be used in conjunction with FES devices in order to allow for leg cycling, leg exercises, rowing, arm ergometry, electrically stimulated standing or electrically stimulated bipedal ambulation with or without an orthosis.[1,59]

There are numerous benefits of a consistent FES exercise programs in persons with spinal cord injury including increased muscle mass, decreased spasticity, improved bone health, increased cardiac mass in persons with tetraplegia, decreased blood pooling in lower extremities, increased blood return to the heart, increased HDL, decreased TG, LDL and total cholesterol, improved gas exchange kinetics with increased oxygen uptake, improved glucose tolerance and insulin sensitivity, and improved self-image.[32,45,59,60,61,62,63,64,65,66,67,68,69,70]

Before embarking on an FES training program, individuals should be evaluated and cleared by a physician and therapist knowledgeable in spinal cord injury and FES as there are some relative contraindications for use. Some of these include placement over implanted devices, placement over blood clots or wounds, fractures, pregnancy, heart failure, metastatic cancer, and lower motor neuron injuries.[71,72]

FITNESS AT HOME, THE GYM, AND THE COMMUNITY

Continuing a fitness regimen beyond the rehabilitation phase is extremely important for SCI individuals. Developing a tailored fitness regimen can be accomplished by creating a home work out plan, going to the gym, taking fitness classes, or participating in adaptive sports and recreation.

HOME WORKOUT PROGRAM

Many of the pieces of equipment listed above may be space or cost prohibitive for individuals to have in their own homes. In addition, many individuals with SCI/D are unable to access fitness centers outside of their home for many reasons including medical limitation, transportation availability, local gym availability, and quarantine. Recently, there has been an explosion of available virtual exercise classes, phone applications, social media instructional videos, and online communities that provide fitness and wellness tips at home. Below are examples of affordable and compact exercise equipment as well as online fitness resources that SCI/D individuals can utilize for their home workout program.

AFFORDABLE HOME EXERCISE EQUIPMENT

Balance Ball
https://shop.lifefitness.com

Bosu Ball
https://www.bosu.com

Balance Disc
https://www.rehabmart.com

Theraband
https://www.theraband.com

Dumbbell
https://www.physicalcompany.co.uk

Synergee Ankle/Wrist Weights
https://iheartsynergee.com/products/synergee-ankle-and-wrist-weights

Table 3: Online and Social Media Resources for SCI Fitness

Here are some tips and resources on how to expand a home based fitness and wellness program with available online resources.

Search for Information on SCI and Fitness from Trusted Sources	• Northwest Regional Spinal Cord Injury System - Get Moving: Exercise and SCI https://sci.washington.edu/info/forums/reports/exercise_2013.asp • The Miami Project - Exercise https://www.themiamiproject.org/resources/healthy-lifestyle/exercise • Shepherd Center - Introduction to Exercise after Spinal Cord Injury https://www.myshepherdconnection.org/sci/home-exercises • National Center on Physical Activity and Disability - 14 Weeks to a Healthier You Program – https://www.nchpad.org/14weeks • The Ohio State University - Arm Exercises for Spinal Cord Injury http://www.sld.cu/galerias/pdf/sitios/rehabilitacion/arm_exercises_for_spinal_cord_injury.pdf • Flint Rehab - The Ultimate Home Exercise Program for Spinal Cord Injury Patients – https://www.flintrehab.com/home-exercise-program-for-spinal-cord-injury • ICORD - Physical Activity Research Centre http://icord.org/parc/exercise-resources/#Guidelines
Explore the Web for Online Health and Wellness Activities and Virtual Community Programs	• Wheely Good Fitness – https://wheelygoodfitness.com • Invictus Active – https://www.invictusactive.com • SCI Total Fitness – https://www.scitotalfitness.com • Gathering Strength – https://gatheringstrength.org
Follow Social Media for Online Videos and Virtual Classes (Look for these across social media platforms!)	• Invictus Active - Youtube Channel – https://www.youtube.com/channel/UC3eMS-zHJlTHw9RkexMyw6w/videos • Every Body Fitness - Youtube Channel – https://www.youtube.com/channel/UCff18PfI7dsLIZ1mxN8NI-A/featured • Healthy Tomorrow - Rehabilitation Research and Training Center (RRTC) on Secondary Conditions in the Rehabilitation of Individual with Spinal Cord Injury (SCI) - Youtube Channel – https://www.youtube.com/c/HealthyTomorrow/about • Bay Area Outreach & Recreation Program (BORP) Adaptive Sports - Youtube Channel – https://www.youtube.com/channel/UC9_UVGSJAwWcr3zoUJZ9e1g/featured • Shepherd Center -Youtube Channel – https://www.youtube.com/user/ShepherdCenter/featured • Spinal Cord Injury Research Evidence (SCIRE) - Youtube Channel – https://www.youtube.com/user/SCIREWebVideo/videos • Adapt to Perform - Youtube Channel – https://www.youtube.com/channel/UClosZzwrXmjPzDCwD9OcC0A • ICORD - Physical Activity Research Centre- Youtube Channel – https://www.youtube.com/channel/UCvZY8eLLlHWMrYIHtqq1x1w/featured

GOING TO THE GYM

Table 4: Actions to take to find accessible gyms

Looking for a gym with the appropriate adaptive equipment and knowledgeable staff to assist in a gym based fitness program may be a daunting task for individuals with SCI/D. While these are known barriers to physical activity, individuals with SCI/D should be educated on the actions they can take to help them find the gym with the right fit or even encourage policy changes to make local gyms more accessible.

Know your rights	• Be familiar with the American Disabilities Act! Look for gyms that not only meet the ADA requirements for sports facilities but go beyond it. The US Access Board is responsible for issuing accessibility guidelines for newly constructed and altered recreation facilities. They establish the minimum accessibility requirements by providing specifications for sports facilities that ensures disabled individuals can utilize the space without any barriers. • Access Board - Sports Facilities website: https://www.access-board.gov/ada/guides/chapter-10-sports-facilities/#introduction • ADA website: https://www.ada.gov

Call your local gyms and ask questions	• Tour the facility!
	• Ask questions to let staff know what your needs are:
	  • Does the gym follow the ADA requirements?
	  • Do they have adaptive equipment?
	  • Are there staff members who are familiar with wheelchair users and their fitness needs?
	  • Are staff members trained on the medical sequelae of spinal cord injury?
	  • Do they have specific trainers who have experience with people with disabilities?

Learn the equipment	• Know the equipment highlighted earlier in the chapter, including what modifications/ adaptations are possible. • Ask if the gym has adaptive equipment available.
Speak up and make changes	• Address the barriers or deficits in services with the staff/ management. • Follow up with specific changes in writing. • Be willing to file a complaint.

If you cannot find an accessible gym in your area, there may be SCI specific organizations like Journey Forward and Next Step Fitness that may provide exercise programs for people with disabilities. Appealing to your local government to include adaptive exercise machines, accessible outdoor spaces, and adaptive sports equipment to municipally owned buildings and programs is another option.

SPORTS AND RECREATION

Fitness may extend beyond the gym setting. Sports for persons with disabilities started in England with Sir Ludwig Guttman at the Stoke Mandeville Hospital, utilizing sporting events to rehabilitate people with injuries from World War II. Since then, the number of both recreation and competitive adaptive sports available for individuals with SCI has grown. Many individuals who were actively involved in sports prior to injury may be interested in a return to sporting. Those who may not have been involved in sports or recreation before may now be interested in becoming more active. Before an individual with SCI gets involved in sports and recreation activities, preparticipation screening is recommended to provide appropriate exercise prescription and to identify any conditions that may require special precautions or modifications to activities. Some individuals may need testing including bone mineral density scans to evaluate for fracture risk, pulmonary function testing, or exercise stress testing. It is important that individuals be counseled on the appropriate exercise prescription, and the risks and medical consequences to monitor prior to starting any sports activities.

Below is a sample list of the many types of sports/ recreation that are available for wheelchair users that can provide opportunities for exercise, wellness, as well as socialization and integration into the community.

Adaptive Sports/Recreation

- Archery
- Basketball
- Bowling
- Billiards
- Canoeing
- Flying
- Golf
- Hand Cycling
- Horseback Riding
- Hunting
- Para Dance Sport
- Power Soccer
- Rock Climbing
- Rowing
- Rugby
- Sailing
- Scuba
- Skateboarding
- Sled Hockey
- Snowboarding
- Snow Skiing
- Softball
- Surfing
- Swimming
- Track and Field
- Water Skiing
- Weight Lifting
- Wheelchair MotoCross
- Wheelchair Racing
- Wheelchair Tennis

Many of these sports/ recreational activities are available through state park programs, as well as community and nonprofit organizations at little to no cost. American public schools are required to offer physical education to every student and information about adaptive sports programs are available through local school districts. In addition, many of these activities can also be pursued on a competitive level, based on functional ability, and individuals with SCI/D, may be able to continue to collegiate or professional level sports.

Table 5 is a list of organizations with their respective websites with information on how to get involved in both recreational and competitive sports, as well as how to connect with companies that can provide adaptive sports equipment. Some other resources that may be helpful include: BlazeSports America (www.blazesports.org) and Adaptive Sports, USA (www.adaptivesportsusa.org), both of which provide information on adaptive sports and recreational programs regionally and internationally. Individuals who need financial support to procure adaptive equipment can go to The Challenged Athletes

EXAMPLES OF ADAPTIVE SPORTS EQUIPMENT

Table 5: Websites for Recreational and Competitive Sports Organizations in the USA

Recreational Sports		**Competitive Sports**	
Sport/ Activity	**Website**	**Sport/ Activity**	**Website**
Aerobics; Disabled, Sports USA; Sailing, National Ocean Access Project	www.dsuas.org / www.dsua.org	US Paralympics Sports Clubs	www.findaclub.usparalympics.org
American Canoe Association	www.acanet.org	Wheelchair Athletics/ Archery/ Table Tennis Federation/ Softball	www.wsusa.org
Bowling, American Wheelchair Bowling Association	www.amwheelchairbowl.qpg.com	National Wheelchair Basketball Association	www.nwba.org
Billiards, National Wheelchair Billiards	www.nwpainc.com	International Wheelchair Basketball Federation	www.iwbf.org
Camping, National Park Services, Office of Special Programs	www.nps.gov	US Fencing Association	www.usfa.org
Flying, International Wheelchair Aviators	www.wheelchairaviators.org	Association of Disabled American Golfers	www.toski.com/golf/adag
Freedom's Wings International	www.freedomswings.org	American Handcycle Association	www.ushf.org
Fishing, PVA	www.pva.com	American Sled Hockey Association	www.sledhockey.org
Handicapped Scuba Association	www.hsascuba.com	US Quad Rugby Association	www.quadrugby.com
Horseback Riding, North American Riding for the Handicapped Association	www.narha.org	International Wheelchair Tennis Federation	www.itftennis.org
Hunting, NRA Disabled Shooting Services	www.nrahq.org	US Wheelchair Swimming	www.usa-swimming.org
Special Olympics International	www.specialolympics.org		
US Rowing Association	www.usrowing.org		
US Wheelchair Swimming Inc.	www.wsusa.org		
Water Sports, American Water Ski Association	www.usawaterski.org		

Foundation (www.challengedathletes.org) and the Kelly Brush Foundation (www.kellybrushfoundation.org) to find information on applying for grants.

In addition to the above sports and recreation activities, there has been a growing interest in other fitness activities like wheelchair yoga, pilates, Tai-Chi, Zumba classes, and more recently, wheelchair dancing. There are now virtual and live community classes as well as programs on social media available as the fitness community continues to integrate with the disability community. The following are resources for more information on these activities.

Wheelchair Dance
Axis Dance: https://www.axisdance.org
Dancing Wheels: https://dancingwheels.org
Full Radius Dance: https://fullradiusdance.org

Wheelchair Yoga
NCHPAD Yoga: https://www.nchpad.org/295/1834/Yoga~for~Individuals~with~Disabilities
Christopher Reeve - Yoga: https://www.christopherreeve.org/living-with-paralysis/health/staying-active/video-series-yoga-for-your-health
Accessible Yoga Association: https://accessibleyoga.org

Adaptive Tai Chi
Adaptive Tai Chi International: http://adaptivetaichi.org

CONCLUSION

Fitness and wellness is an important component of life post spinal cord injury. All health care providers should encourage and educate their patients on the benefits of exercise due the cardiovascular and metabolic sequelae of SCI and early mobilization should be initiated once a patient is stable. As they move through the rehabilitation phase, individuals with SCI/D should be able to recognize the signs, symptoms and physiologic basis of medical consequences like orthostatic hypotension, autonomic dysreflexia, and thermoregulation issues as well as be able to take the appropriate steps to resolving these issues including instructing others in assisting them. In addition, SCI individuals should be educated on the basic principles of fitness and establish an exercise program to which they can adhere. This not only leads to the preventing cardiometabolic risks often seen with a sedentary lifestyle, but also improves overall quality of life. With the advent of new technology, innovation in bringing fitness programs to an individual's home, and the variety of resources on the internet and social media, achieving and maintaining physical fitness for SCI individuals is more possible now more than ever. Ongoing research is needed to define the optimal amount, type and intensity of exercise needed for the best functional outcomes and reduced morbidity and mortality in the SCI/D population.

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SAMPLE LETTERS OF MEDICAL NECESSITY

A letter of medical necessity (LMN) may be required or helpful for both public and private funding sources to justify certain pieces of DME as both medically necessary and/or medically beneficial to an individual. The sample LMNs that are included at the end of this manual are meant to serve as **EXAMPLES ONLY** to help justify specific prescriptions of specialized DME. Each LMN should be individualized to the person being served. LMNs should include information on alternatives tried, why the alternatives are not appropriate, and specific reasons why the piece of equipment and components are necessary. Justification for the need for each component should be included. **These should not be used as "template" letters.**

Recommended Items for Letter of Medical Necessity for Wheelchairs:

- Client Name and DOB
- Therapist and ATP Names, Titles and Organizations/Companies
- Narrative Statement (See Samples Below)
  - Client diagnoses
  - Client functional/ADL independence level summary, including levels of assistance required
  - If applicable - summary and condition of current wheelchair (Frame/Cushion/Backrest/Headrest, etc)
  - Client wheelchair type recommendation (ex. K0005 manual ultralight rigid frame wheelchair)
  - Ruling out of assistive devices as the sole form of safe, independent mobility
  - ADL performance level with and without wheelchair
  - Wheelchair trials – types of chairs, demonstrate safe ability to use of recommended chair consistently
  - Ruling out of lower level manual/power wheelchairs
  - Reasoning for recommended type of wheelchair (ex. K0001-4 or Group 1 and 2 power wheelchairs)
  - Reasoning for type of seating/positioning
- Client measurements – shoulder width, chest width, L/R shoulder height, hip width, top of head from seat, elbow height, upper leg length, lower leg length, foot length
- Summary of body posture – asymmetries, abnormal alignment/positions, spinal abnormalities, pelvic positioning – anterior/posterior, L/R elevation/depression, L/R rotation, anterior/posterior pelvic tilt
- Home accessibility summary
- Manual muscle tests (MMT) results/ROM/muscle tone
- Wheelchair mobility goals – What will the client be able to do once they get their chair
- Wheelchair components and justification for each component (Can list specific maker for each component)
  - Required Information for Power or Manual Wheelchairs

    Wheelchair Manufacturer and Model

    Seat Dimensions – Width/depth/seat to floor height (STFH)

    Back Rest and Cushion – Size, type and make/model

    Back Canes – type – upright/angle and/or height adjustable

    Arm Rests – types, padding type, adjustability, size, additional upper extremity support

    Head Support – type, size and adjustability

    Leg Rests/Hangers – type, angle to lower extremity support

Foot Plates – angle/depth adjustable, material

Lower Extremity Positioning – strapping, sandals

Additional Body Support – ex. pelvic positioning device (seat belt), chest/trunk straps, trunk laterals, hip guides, hip abductor pommel

- **Power Wheelchairs Only**

  Drive Type – for power wheelchairs – front/mid/rear wheel

  Joystick/Control Interface – can include head array, sip/puff, eye gaze

  Seat Functions – tilt/recline/elevating leg rests/seat elevator/standing

  Expandable Controller/Electronics – for three or more seat functions and/or alternative controls (ex. head array, sip/puff, eye gaze)

  Battery and Charger

  Attendant Control

- **Manual Wheelchairs Only**

  Wheels – rear wheel size/mag or spoke/tire type/push rim type/camber, caster size/forks/type

  Frame Angle – For rigid manual wheelchairs – angle of tubing from seat

  Taper – the narrowing of the tubing from seat to foot plate

  Dump – Difference in seat height from front to back of the chair

Sample of Letter of Medical Necessity Narrative Section: Manual Wheelchair

Chief complaint: Evaluation for mobility equipment

Due to the patient's spinal cord injury, they have {upper/lower extremity} motor sensory, integument, musculoskeletal and neurologic deficits as well as decreased cardiopulmonary endurance. They also have other medical sequelae {INSERT HERE} that impair the ability to complete activities of daily living safely at home.

The ability to perform efficient, safe and structured ambulation with a cane or a walker is not possible as a result of the aforementioned sequelae. The patient's {upper/lower} extremity function is sufficient to self-propel an optimally-configured manual wheelchair in the home setting in order to complete mobility-related activities related to daily living in the home.

An optimally-configured manual wheelchair as a mobility device is medically necessary to improve the patient's ability to safely complete ADLs and other activities in their home setting. The patient's living environment is accessible for the use of a manual wheelchair. The mobility device will enable the patient to complete mobility related activities of daily living (MRADLs), including transfers, household and community mobility (which includes but is not limited to safely attending medical appointments independently or with assistance).

Without the prescribed mobility device, the patient is unable to leave and access other rooms throughout the home including possibly remaining in bed only. If the patient is unable to get out of bed, they are at increased risk to develop joint contractures, atelectasis, pneumonia and/or other respiratory complications, pressure sores, muscle atrophy and/or multiple other medical or psychological problems.

I have completed the decision component of the face to face evaluation.

Physician signature with time/date.

continued on next page

XXX is a 60-year-old male with history of a C7 complete spinal cord injury secondary to a motor vehicle accident on July 4th, 2020. As a result of the accident, the client presents to the clinic with quadriplegia, hypertonic lower extremities, neurogenic bowel/bladder, and unresolved neuropathic pain

Because of his injury, XXX has limited upper extremity function and no ability to activate muscles in his lower extremities or trunk. He also has limited to no sensation below the level of his injury. The client is independent with attaining sitting and can maintain sitting at the edge of a mat or bed with bilateral upper extremity support. He can also perform safe transfers to/from a manual wheelchair. XXX cannot safely stand or perform assisted ambulation with or without an assistive device. While in the acute inpatient rehabilitation setting, the client has been using a manual wheelchair for all functional mobility beyond his bed – he is safe and consistent with his ability to control a manual wheelchair. At this time, we are recommending a K0005 rigid frame manual wheelchair for mobility in the home, community and at work. XXX works full-time as an accountant for a local business, a job that requires constant independent mobility to get to/from meetings and other work-related activities. Without this device, the client would not be able to get out bed and participate in Mobility Related Activities of Daily Living (MRADLs), including work, family life and personal care. Client's home is accessible for a wheelchair – no stairs to enter, bedroom is on first floor and both bedroom and bathroom doorways are wide enough for wheelchair access.

XXX does not currently own a wheelchair, since he was independent with all mobility until the time of his injury. The client is unable to functionally use a K0001-4 manual wheelchair due to the additional weight of those devices making independent mobility difficult and could result in shoulder dysfunction and pain. K0001-4 manual wheelchairs also do not have a fully adjustable axle, which is only found on a K0005 manual wheelchair. It is vital for this client to have a fully adjustable axle for his manual wheelchair to facilitate optimal wheel positioning for upper extremity access to the push rims and to limit pathological shoulder kinematics that could lead to a shoulder overuse injury that could be painful and require further medical intervention. The K0005 manual wheelchair is also recommended since it is the only weight of chair that the client can independently breakdown/setup and lift in/out of his vehicle. The K0005 manual wheelchair we are recommending will keep the client safe, functional, independent and will limit pain throughout the life of the wheelchair.

We are recommending a rigid back rest to support the client in a safe, pain-free position while being properly aligned for optimal manual wheelchair propulsion, which cannot be attained by a fabric sling back. The seat cushion we are recommending is a pressure-relieving cushion that positions the client safely in his chair, which is needed due to the client's lack of sensation for the skin of the buttocks, length of time in sitting and decreased level of venous return. Without this cushion, the client is at a very high risk for skin breakdown/wounds and potential infections and hospitalization.

Sample of Letter of Medical Necessity Narrative Section: Power Wheelchair

Chief complaint: Evaluation for power mobility

Due to the patient's spinal cord injury, they have upper extremity and lower extremity motor sensory, integument, musculoskeletal and neurologic deficits as well as decreased cardiopulmonary endurance. They also have other medical sequelae {INSERT HERE} that impair the ability to complete activities of daily living safely at home.

The ability to perform efficient, safe and structured ambulation with a cane or a walker is not possible as a result of the aforementioned sequelae. The patient's upper extremity function is insufficient to self-propel an optimally-configured manual wheelchair in the home setting in order to complete mobility-related activities related to daily living in the home.

A scooter cannot provide independent functional mobility in the home setting because it cannot provide safe seating options to address the current and progressive medical needs of this patient including skin breakdown, neuromuscular scoliosis as well as pelvic obliquity and tilt. Also, due to impaired motor strength and dexterity in the { INSERT JOINTS etc, hands, forearm, shoulder} the patient is unable to reach and manipulate the tiller. They are unable to functionally operate a scooter due to concerns with pressure relief and decreased truncal control and function.

continued on next page

A power mobility device is medically necessary to improve the patient's ability to safely complete ADLs and other activities in their home setting. The patient's living environment is accessible for the use of a wheelchair. The requested power mobility device will enable the patient to complete mobility related activities of daily living (MRADLs), including transfers, household and community mobility (which includes but is not limited to safely attending medical appointments independently or with assistance). Without the prescribed mobility device, the patient is unable to leave and access other rooms throughout the home including possibly remaining in bed only. If the patient is unable to get out of bed, they are at increased risk to develop joint contractures, atelectasis, pneumonia and/or other respiratory complications, pressure sores, muscle atrophy and/or multiple other medical or psychological problems.

I have completed the decision component of the face to face evaluation.

Physician signature with time/date.

Background Information/Medical History and Client/Parental Concerns:

XXX is a 20-year-old individual who sustained a C2 complete spinal cord injury, with concomitant brain injury, with multiple facial fractures and a fracture in bilateral forearms, due to an unprovoked assault on her university campus, where she was pushed down a flight of stairs in a parking garage in October of 2020. As a result of the spinal cord injury, she has no motor function or sensation below the level of her injury. The client presents with quadriplegia, and has no ability to move her arms or legs. XXX is unable to stand, ambulate or sit – she is dependent on others for all functional mobility without a power wheelchair. XXX has a tracheostomy and is ventilator-dependent for respiratory function. The client has been an inpatient at our inpatient rehabilitation facility for the past 8 weeks, and has a supportive family that is safe and comfortable with ventilator use, suctioning and tracheostomy care. XXX has demonstrated the ability to maintain upright while using a power wheelchair for over eight hours a day, while performing safe power-tilt facilitated pressure reliefs every 20-30mins. She has worked extensively with her therapy team to practice power wheelchair mobility with a sip/puff device, and she has demonstrated independent, safe and consistent control of the chair during daily sessions of 1-3 hours a day and is independent on the inpatient unit at all other times while the client is awake and active. The client has made multiple out-trips with her therapists, and has demonstrated safe use over uneven surfaces, ramps, cross walks and entering/exiting accessible vehicles. XXX's family has purchased an accessible rear-entry vehicle. They have made modifications to their family home, including their bathrooms, doorways and her personal bedroom. The house has no stairs to enter.

We recommend a group 3 power wheelchair for XXX with sip/puff control, power tilt, recline, and elevating leg rests. XXX has no upper or lower extremity function and would not be able to propel a manual wheelchair. The group 3 power wheelchair would allow her to be independent in the home, at university (she plans on returning to school, this upcoming fall) and in the community. The client would be unsafe in a group 1 or group 2 power wheelchair due to lack of the ability to maintain sitting balance in either device, the lack of necessary seating functions or appropriate wheelchair suspension. The client would not be able to control either group 1 or 2 due to lack of lack of ability to integrate a sip/puff system into those types of devices. The client requires multiple seat functions (tilt/recline/elevating leg rests) for safe pressure relieving, independent repositioning, dependent ADL performance/clothing changes, edema management and rest breaks.

XXX requires a deep contoured back rest with a horizontal chest strap to keep her in upright and limit her falling out of the wheelchair. A multiple-chamber air-filled seat cushion is recommended for the client, since she is in the chair for 8+ hours a day, she has insensate buttocks, and cannot sense potential skin breakdown. While XXX is meticulous with her pressure breaks, she is still at a very high risk for skin breakdown, and this type of cushion would help mitigate the potential of open areas/wounds, which may lead to infections and potential additional medical care. XXX also requires bilateral arm troughs with raised hand supports to limit discomfort/pain from potential progression of subluxation with bilateral upper extremities.

Sample of Letter of Medical Necessity: Power Wheelchair

To Whom It May Concern:

Ms. XXX is a 47 year old female with spinal cord dysfunction related to a cervicothoracic astrocytoma. She has paraplegia, scoliosis and spasticity as a result of her spinal cord involvement. In addition, she has polyradicular weakness on the right arm and a median and ulnar neuropathy on the left.

She requires the use of a custom power wheelchair due to weakness in the upper and lower extremities resulting in the ability to safely ambulate. She is unable to accomplish basic in-home activities of daily living such as safely getting from the bedroom to kitchen for meals or bathroom for toileting/hygiene. She is unable to use a cane/walker or self-propel any type of manual wheelchair due to her upper and lower extremity weakness, poor balance and poor endurance. She is unable to operate a scooter safely due to her weakness, scoliosis and spasticity. She requires significant assistance to transfer in/out of her wheelchair.

She requires a custom seat for positioning, pressure relief and spasticity management. She also requires a custom seat back and headrest. She is able to operate a joystick for control with the left hand. Tilt in space and adjustable seat lift are needed for pressure relief and activities of daily living. She requires a backup camera for safety.

I can be reached for any questions or concerns. Please extend every courtesy of coverage.

Sincerely,

Sample of Letter of Appeal: Power Wheelchair

To Whom It May Concern:

I am writing this letter of appeal on behalf of Mr. XXX. He was notified that the following procedure codes were not covered for his motorized wheelchair, E2377, E2313, E2300, E2311.

The power adjustable seat height (E2300 and E2311) allows for vertical adjustment of the seat height, increasing reach and providing independence for ADLS. It promotes safety with and improved lateral transfers by allowing a level transfer or transfer from a higher to lower surface, which is gravity assisted. It also facilitates forward transfer by allowing legs and hips to be more extended.

Mr. XXX has limited assistance at home, primarily from his wife who works. Elevation of his wheelchair would allow him to transfer at a modified independent level to and from his wheelchair and bed as well as to his shower chair and commode. In addition, it would allow him to reach for items safely in his medicine cabinet in the bathroom for grooming and hygiene. Elevation would allow him to reach light switches throughout his home given their height from the floor. It would allow him to perform meal prep independently and safely. The elevation feature would allow him to reach items in cabinets and microwave or freezer safely. Finally, the power seat elevation would allow Mr. XXX to have eye contact with others and will reduce cervical strain and thoracic pain he experiences from poor positioning. It also provides him psychological benefits of speaking eye to eye with family members and colleagues.

The expandable controller (E2377) is the power module located in the base of the chair that allows the input device to communicate with the drive motors and gearbox. The harness (e2313) is required with the expandable controller and provides the necessary connections for operations. These are necessary given Mr. XXX's wheelchair requirement of a multi-switch hand control interface to achieve the functions of drive, tilt in space, recline, power leg elevation and seat elevation. He requires the tilt in space feature for swelling and to prevent skin breakdown. He has already been hospitalized for pressure related skin injuries over the past year. He requires the tilt feature for orthostasis related to his spinal cord injury. He requires leg elevation for swelling and seat elevation for the reasons above. In addition, although he has hand function, his upper extremity function is limited by pain and his trunk control; therefore, when in recline or tilt he would have trouble navigating a multi-switch hand control.

I can be reached for any questions or concerns. I have included all prior documentation regarding Mr. XXX's wheelchair for reference. I ask you extend every courtesy of coverage for him.

Example LMN for a Standing Frame:

XXX is a 21 year old female with a diagnosis of a traumatic brain injury due to being hit by a car on XXXXX, who has been under our care here at (facility name.) Prior to her injury, Patient x was independent in ambulation and all activities of daily living. She was diagnosed with a left intracranial hemorrhage and underwent a left hemicraniectomy by the neurosurgeon, Dr. x at X Hospital. In addition, she also suffered a right femur fracture which was surgically fixed on (date.) The remainder of her acute care course is significant for placement of a tracheostomy and PEG tube. Initial rehabilitation course was significant for the treatment of spasticity and heterotopic ossification in the right hip. After that initial rehabilitation course, she was discharged home from (facility name) on (date). After several episodes of increased storming and increased spasticity, she was referred to (facility name) and was admitted on (date) for spasticity management. While at (facility name,) she was started on several different medications for spasticity management and to promote neurorecovery. The patient was transferred to X Hospital and had an intrathecal baclofen pump placed by Dr. X on (date.) During her rehabilitation stay, she has trialed and utilized the EasyStand standing frame and her mother has received hands on education in assisting with transfers as well as set up and take down of (patient name) in the standing frame. Patient x caregiver is proactive in her care and is independent with assisting Patient x in all areas of activities of daily living. Functionally, Patient x is dependent and requires assistance for all functional mobility due to the effects of her traumatic brain injury.

The EasyStand will allow Patient x to transfer from a sitting to a fully upright standing position while keeping her fully supported. During physical therapy sessions, she tolerates up to 25 consecutive minutes in a full standing position and is able tolerate full standing without any signs or symptoms of distress or hypotension.

The medical benefits of a standing program include:

- Improvement of range of motion through prolonged lower extremity stretching for prevention of contractures in hips, knees, and ankles, which are commonly associated with prolonged sitting
- Prevention of pressure injuries by allowing for an alternate pressure relief position
- Improvement of cardiovascular/respiratory systems
- Improvement of kidney, bladder, and bowel regularity and function
- Improvement in trunk control and posture to assist with balance
- Decreased spasticity and pain

For these reasons, it is highly recommended that Patient x utilize the EasyStand standing frame safely at home to optimize her positioning and upright tolerance.

Sincerely,
(Physician and therapist names and titles with signature lines)

Sample LMN for a Mobile Arm Support

To Whom it May Concern,

XXX has received outpatient occupational therapy services under my care from [DATE] to present. He sustained a [level] spinal cord injury due to XXX. He is now dependent for all of his care, except for self-operated power wheelchair due to the result of his injuries.

This letter serves as documentation of medical necessity for bilateral mobile arm supports (specifically, JAECO/Rancho MuliLink Mobile Arm Supports). XXXhas poor trunk, deltoid, bicep control due to the high level of his spinal cord injury. Although he is developing some tenodesis and active hand grasp and release, this is essentially ineffective for function without a mobile arm support, as he cannot bring his hands together and can only momentarily lift a hand from his lap.

With the right mobile arm support, XXX has demonstrated the ability to eat with a built-up spoon with minimal assistance, allowing him dignity and higher level of independence, lessened burden of care, and further strengthening and neuromuscular healing of his entire UE. He has recently developed active flexion as well as improved tenodesis in his left hand. Trials with the left mobile arm support have allowed the patient more successful active positioning of the left UE in the workspace for right hand self-assist.

continued on next page

XXX is a XXX. Regular use of bilateral mobile arm supports along with additional training in therapy sessions will allow this patient to better participate in his training, including management of tablet and electronic tools for delivery of educational content.

Please contact me if further documentation is needed for this patient.

Sincerely,

Sample LMN for a Shower Commode Chair

Statement of Medical Necessity:
(Spinal Cord Injury)

Mr./Ms. [Patient's name] currently presents with a neurogenic bowel, which is a direct result of **[His/her] [Diagnosis]**. Neurogenic bowel is a condition that must be managed using a specialized bowel program designed to assist with the elimination of solid wastes. In order to successfully complete [His/her] bowel program, **Mr./Ms. [Patient's name]** must rely upon specialized mechanical stimulation techniques, pharmacological interventions, dietary changes, and specialized durable medical equipment. The absence of any of these critical bowel care components could lead to excess stool in the rectum. Excess stool in the rectum can cause bowel impaction leading to costly and unnecessary re-hospitalization or autonomic dysreflexia, a potentially life-threatening emergency medical condition. In addition, without these critical bowel care components, **Mr./Ms. [Patient's name]** will be at risk for skin breakdown and pressure ulceration secondary to an increase in the duration of the bowel care routine and/or more frequent bowel accidents.

The recommended **[Name of commode chair as written on prescription]** commode chair was trialed and selected specifically in order to allow **Mr./Ms. [Patient's name]** to safely and appropriately manage **[His/her]** neurogenic bowel. The duration of **Mr./Ms. [Patient's name]** bowel program can be as long as 45 minutes. During that time period it is critical for **Mr./Ms. [Patient's name]** to remain in an upright and supported position. An upright position is important, in order to take advantage of gravity assisted emptying of the lower bowel. **Mr./Ms. [Patient's name]** is currently **[Patient's level of assistance]** for all toileting and bathing tasks. In addition, **[He/she]** is unable to utilize standard commodes due to absent or limited trunk control. A custom commode chair equipped with an adjustable seat to back angel, external postural supports, and tilt in space feature is necessary in order to provide the necessary postural stability that is required for increased safety and fall prevention while completing bathing and toileting tasks. In addition, padded seat and back surfaces are required in conjunction with the chairs tilt in space function in order to assist with pressure relief and to prevent further skin breakdown. A u-shaped commode opening oriented to the **[Direction of opening]** is necessary in order to allow a trained health care provider or care giver to appropriately complete all of **Mr./Ms. [Patient's name]** bowel management needs. Adjustable angle footrests are necessary for appropriate lower extremity positioning and accommodation of limitations in ankle range of motion. ***[If applicable]*** An Otto Bock headrest is necessary for appropriate head positioning during tilt in space for pressure relief. ***[If applicable]:*** **(one or two)** Otto Bock padded arm(s) are necessary for stability and fall prevention during toileting and transfer completion. [If applicable]: Lateral supports are necessary for postural alignment and stability as well as fall prevention during toileting [and/or] bathing. ***[If applicable]:*** **Seat and/or Chest belt(s) is/are** necessary for enhanced safety and fall prevention with toileting.

Mr./Ms. [Patient's name and family member/caregiver (if appropriate)] has trialed and has been successfully trained in the safe and effective use of the prescribed **[Name of commode chair as written on prescription]** commode chair. The recommended commode chair is an integral part of the long-term treatment of **Mr./Ms. [Patient's name]** 's medical condition and is considered medically necessary.

OT: _____

License #: _____

Date: _____

Sample LMN for a Hospital Bed

Rx:
Semi-electric hospital bed-quantity 1
Gel overlay-quantity 1
ICD 10/Diag
HT/WT
LON-99 months

For the hospital bed the patient must meet the below criteria and the MD note must contain language similar to the following. The MD note must specifically say the pt need a semi-electric hospital bed because:

A hospital bed is covered if one or more of the following criteria (1-4) are met:

1. The patient has a medical condition (specify condition) which requires positioning of the body in ways not feasible with an ordinary bed. Elevation of the head/upper body less than 30 degrees does not usually require the use of a hospital bed, ***or***
2. The patient requires positioning of the body in ways not feasible with an ordinary bed in order to alleviate pain, ***or***
3. The patient requires the head of the bed to be elevated more than 30 degrees most of the time due to congestive heart failure, chronic pulmonary disease, or problems with aspiration. Pillows or wedges must have been considered and ruled out, ***or***
4. The patient requires traction equipment which can only be attached to a hospital bed.

Additional Phrases:

The patient has a medical condition **[Diagnosis]** which requires positioning of the body in ways not feasible with an ordinary bed, and requires frequent changes in body position. ***or***

The patient requires positioning of the body in ways not feasible with an ordinary bed in order to alleviate pain due to **[Diagnosis]**, and requires frequent changes in body position. ***or***

The patient requires the head of the bed to be elevated more than 30 degrees most of the time due to **[Diagnosis]**. Pillows or wedges have been considered and ruled out, and requires frequent changes in body position. ***or***

The patient requires traction equipment, which can only be attached to a hospital bed and requires frequent changes in body position.

Sample LMNs for Pressure Reducing Surfaces:

Group 1 support surfaces: Foam, air, water or gel mattresses or mattress overlays and pressure pads.

Group 2 support surfaces: Powered air flotation beds, powered pressure reducing air mattresses, and non-powered advanced pressure reducing mattresses.

Group 3 support surfaces: air-fluidized beds.

Below you will see criteria which currently need to be met for each group. This should be documented in your LMN and supported by the medical record. Please see CMS.gov for updated criteria and further details on devices in each category as they can change.

Group 1 Support Devices:

Medical Necessity: Must meet the following criteria

A. Criterion 1, or

B. Criterion 2 or 3 and at least one of criteria 4-7
   1. Complete immobility: The individual cannot make changes in body position without assistance
   2. Limited mobility: The individual cannot independently make changes in body position significant enough to alleviate pressure
   3. Any stage pressure ulcer on the trunk or pelvis
   4. Impaired nutritional status
   5. Fecal and/or urinary incontinence
   6. Altered sensory perception
   7. Compromised circulatory status

continued on next page

Group 2 Support Devices:

Medical Necessity: Must meet the following criteria

A. Criteria 1 and 2 and 3, or

B. Criterion 4, or

C. Criteria 5 and 6

1. Multiple stage II pressure ulcers located on the trunk or pelvis
2. Individual has been on a comprehensive ulcer treatment program for at least the past 30 days
3. The ulcers have worsened or remained the same over the past month
4. Large or multiple stage III or IV pressure ulcer(s) on the trunk or pelvis
5. Recent myocutaneous flap or skin graft for a pressure ulcer on the trunk or pelvis (surgery within the past 60 days - note: usually considered medically necessary only up until 60 days past surgery)
6. The individual has been on a group 2 or 3 support surface immediately prior to a recent discharge from a hospital or nursing facility (discharge within the past 30 days)

Group 3 Support Devices:

Medical Necessity: Must meet ALL of the following criteria

1. The individual has a stage III or IV pressure injury or is status post muscle/skin flap repair of a stage III or IV pressure injury.
2. The individual has limited mobility and is unable to ambulate
3. In the absence of an air-fluidized bed, the individual would require institutionalization
4. A written order from the treating physician based upon a comprehensive assessment and evaluation of the individual after completion of a course of conservative treatment designed to optimize conditions that promote wound healing
5. The length of conservative treatment needs to be at least one month in duration without progression toward wound healing.
6. A trained adult caregiver is available to assist the individual with all activities of daily living and comprehensive wound care management as well as training in the management and proper use of the air-fluidized bed.
7. A physician directs the home treatment regimen and re-evaluates and re-certifies the need for the air-fluidized bed every three months
8. All other alternative equipment has been considered and ruled out.

Use of a group 3 support surface (air-fluidized bed) is considered not medically necessary under any of the following circumstances:

A. The individual has coexisting pulmonary disease (the lack of firm back support makes coughing ineffective and dry air inhalation thickens pulmonary secretions)

B. The individual requires treatment with wet soaks or moist wound dressings that are not protected with an impervious covering such as plastic wrap or other occlusive material

C. The caregiver is unwilling or unable to provide the type of care required by the individual on an air-fluidized bed

D. Structural support is inadequate to support the weight of the air-fluidized bed system (it generally weighs 1600 pounds or more)

E. Electrical system is insufficient for the anticipated increase in energy consumption

F. Other known contraindications exist

Rx
Type of Mattress, quantity 1
Diagnosis
Ht/Wt
Length of need: 99 months

Sample LMN for Exercise Equipment

A letter of medical necessity may be necessary for SCI individuals to get exercise equipment covered by insurance. We include it here for reference only and should be individualized to the needs of the person and type of equipment prescribed. It has several components:

1. Identifying information
    a. Name of insured
    b. Date of Birth
    c. Policy Number
    d. Group Number
    e. Medicaid number (if applicable)
    f. Physician's name
    g. Date
2. Date of last physical/ medical evaluation
3. Diagnosis of medical condition (be specific)
4. Pertinent medical history
    a. Describe if the disability is temporary or permanent and its evolution over time
    b. Describe the rationale for the equipment
    c. Describe how the equipment will improve functional abilities or improve the individual's disability
5. Document why the equipment is medically necessary
6. Physician's signature, professional qualifications, and contact information

NOTES

GUIDELINES FOR USE OF

DURABLE MEDICAL EQUIPMENT

FOR PERSONS WITH SPINAL CORD INJURY AND DYSFUNCTION

Created by Experts in the field of Spinal Cord Injury Medicine and Rehabilitation

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AMERICAN SPINAL INJURY ASSOCIATION

9702 Gayton Rd, Suite 306

Richmond, VA 23238