

# Basic Manual Wheelchair Adjustments:

A H A N D B O O K



A Guide for  
Wheelchair  
Adjustments to  
Affect Positioning,  
Performance,  
and Accessibility

WOODROW WILSON  
REHABILITATION CENTER  
ED SHORT PT



## **BEFORE MAKING ANY ADJUSTMENTS TO A WHEELCHAIR PLEASE READ THIS:**

### **Disclaimer**

Each wheelchair is different, and the suggestions contained in this handbook may or may not work on a particular wheelchair.

Any adjustment made to a wheelchair may void the wheelchair manufacturer's or wheelchair supplier's warranties, guarantees or other representations made in respect to any particular wheelchair. You must check with the wheelchair manufacturer or supplier, and the owner's manual to determine the effect any adjustments suggested in this book may have on any warranty, guarantee or representation made in respect to the wheelchair by its manufacturer or supplier.

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*Wheelchairs used in this handbook are 1999 or earlier models. From time to time manufacturers change the hardware on wheelchairs, which can affect how adjustments are made. If changes to the hardware have been made, contact the manufacturer or a local vendor with any questions concerning adjustments to the wheelchair.*

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by Ed Short P.T.

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## Additional Information

**Ed Short**, the author, graduated from Loma Linda University in 1983 with a bachelor of science in physical therapy. His physical therapy experience includes acute care, rehabilitation, home health care, and private practice. Mr. Short developed his expertise in wheelchair configuration and its integration with the user through his work at Woodrow Wilson Rehabilitation Center. He joined the WWRC Physical Therapy Department in 1992 and has been an annual guest lecturer for the WWRC Spinal Cord Injury Conference since 1993.



sufficiency and optimum independence through comprehensive rehabilitation and vocational training. Since 1947, WWRC has been a state and national leader in spinal cord injury (SCI) rehabilitation. WWRC was funded as one of the first model SCI rehabilitation systems in the nation in 1972 and developed the first statewide SCI program in 1984. The Virginia General Assembly funded the Virginia SCI System from 1984 -1986 as a cooperative program including WWRC, Eastern Virginia Medical School, Medical College of Virginia, and the University of Virginia Hospital. The state program continued through 1998.

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The Woodrow Wilson Rehabilitation Center

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Suggestions for improvements, changes, additions or corrections to this manual are welcome. Please contact the Woodrow Wilson Rehabilitation Center Foundation, Inc. at 1-800-345-9972 (ext. 7905) or P.O. Box 1500, Box W-131, Fishersville, Virginia 22939.

*"To my children, Erik and Austin, for the love and joy you bring to my life."*



**Ed Short PT**

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# Introduction

## Purpose

Mr. Short, a senior physical therapist at the Woodrow Wilson Rehabilitation Center, was inspired to write this book when he found himself repeating the same information and demonstrations to countless wheelchair users and new physical therapists.

The purpose of this handbook is to provide written and visual instructions for the adjustment of lightweight manual wheelchairs and to make this information available to a wider audience. This handbook is by no means the only way to perform these adjustments, nor does it include all of the adjustments that can be made. It provides information on **basic** manual wheelchair adjustments, and their effect on performance, accessibility and positioning. It is not a handbook on wheelchair repairs. It is intended for use by therapists, vendors, and wheelchair users to gain better performance and seating through adjustment of the wheelchair itself.

Advancements in technology mean frequent changes in wheelchair components, as well as new wheelchair designs. This handbook will give you the fundamental information on wheelchair adjustments and the rationale for making those changes. Once these are understood, you should be able to transfer the use of this information to new wheelchair designs.

The ease of performing wheelchair adjustments will depend on the amount of experience you have had working with wheelchairs. Although there are many sources of information, the best way to learn is by doing the adjustments yourself. Even if you have had little or no experience, with practice you will be able to perform most of these adjustments. More importantly, you will increase your understanding of how to configure wheelchairs to meet individual positioning, mobility, and accessibility needs.

## How This Book is Organized

The first section of the handbook, Basic Manual Wheelchair Adjustments, covers how to make adjustments on modern, lightweight manual wheelchairs. A working knowledge of various makes and models of wheelchairs is helpful in understanding the applications discussed. Basic manual wheelchair adjustments are explained as simply as possible, using diagrams or photos for illustration. The colored tabs on the side of each page serve as navigational tools, enabling you to flip to the section you need. The handbook's wire binding allows you to lay the book open for easy reference while you work.

The second section of the handbook, Positioning and Performance Adjustments, presents the theory and reasons for making adjustments. It addresses the needs of the individual with limited capacity or special needs.

The third section of the handbook, New Technology, describes advances in wheelchair technology and some of the adjustments possible on these new wheelchairs.

## Tools

You will need the following tools (Fig. A) to make adjustments on most lightweight wheelchairs:

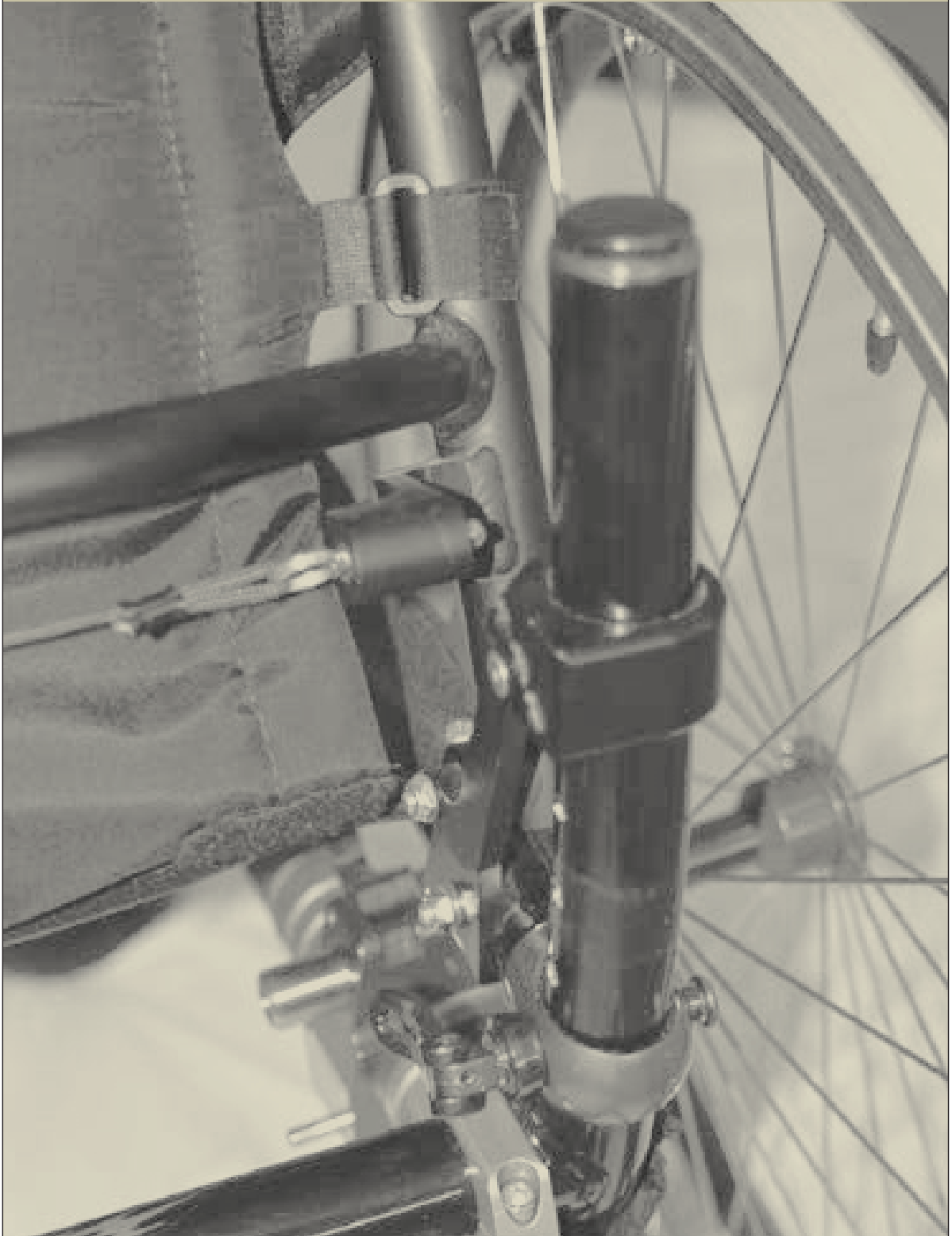
- Set of allen wrenches (both American and metric standards)
- Large crescent wrench (adjustable wrench)
- Screwdrivers (Phillips and flathead)
- 3/8, 7/16, 1/2, 5/8, 3/4 - inch wrenches
- 8mm, 9mm, 10mm wrenches for E&J™ Vision™ chairs
- Ratchet and sockets of the above sizes
- Level or square
- Tape measure
- Rubber hammer
- File
- Tire pump
- Vise
- Vise grips
- Hacksaw or tube cutter



Fig. A



## Basic Manual Wheelchair Adjustments



## Footrest Length

### Considerations

When adjusting footrest length, consider how much space you want between the footplate and the ground. The amount of space will affect outdoor accessibility more than indoor, especially when negotiating the edges of ramps, thresholds, and uneven ground. Normally, you will need a minimum of 2 inches of clearance (Fig. 1-A). Also, the height/thickness of the cushion and the type of shoes/braces that a wheelchair user wears may affect the desired footrest position.

The length of the footrest will also affect positioning of the lower extremities in the wheelchair. If the footrest is too high, wheelchair users will experience increased pressure over their ischial tuberosities. This may also increase external rotation of the hips or cause their legs to be windswept to one side due to poor thigh contact with the cushion or seating system. If the footrest is too low, wheelchair users may experience decreased circulation in their lower extremities and difficulty keeping their feet on the footplates.



Fig. 1-A Two inches of footplate-to-floor clearance needed.

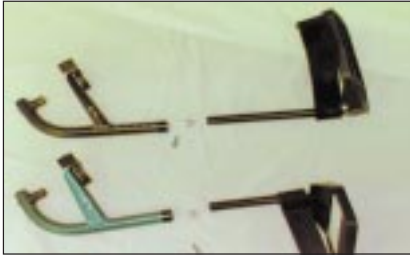


Fig. 1-B Different length footrest extension tubes.



Fig. 1-C Plug with "O" ring.



Fig. 1-D Allen wrench used to adjust footplate on Action™ Pro-T.



Fig. 1-E The footplate tubes do not line up with the openings in the front of the frame in wheelchairs with tapered front rigging.



Fig. 1-F It will take some force to align the footplate tubes with the openings in the front frame.

### Adjustments

Some companies make adjustable footrest extension tubes (short, medium, long) (Fig. 1-B). You will have to determine which size is most suitable. If someone is between two different lengths and you are unsure which one will work, order the longer one. If it later becomes necessary to shorten the footrest, you can cut the tube to the length you need with a hacksaw or tube cutter and re-drill the opening for the hardware (as long as it is not a tapered footrest). Other companies have multiple holes in the footrest tube, as well as in the hanger, which allow for a range of adjustability.

You also may find threaded plugs or inserts inside the footrest tube, with an "O" ring that holds the plug in place. You may need to reposition the "O" ring as you adjust the length (Fig. 1-C). To reach and adjust the plug position, use a long bolt that threads into the top of the plug, and reposition the plug to the desired opening on the footrest tube. This is what holds the footrest tube in place on the hanger/front rigging of the wheelchair.

The holes of the footrest tube with the plug inside and the frame of the wheelchair may not line up exactly. Be careful not to crossthread the bolt, as this will ruin the threads of the plug. If this does happen, rotate the plug 180 degrees and use the opposite opening of the plug, or if the plug has multiple threaded holes, use a different hole.

Other wheelchairs have set screws holding the footrest tubes in position. These require an allen wrench (hex wrench) to adjust footrest length (Fig. 1-D).

On rigid chairs with a tapered front end, it may be difficult to adjust the footplate to its most lengthened position. This is because the top of the footrest tubes (which are wide) get pinched at the bottom of the rigid hangers (which are narrow). This adjustment usually requires some force to accomplish (Figs. 1-E and 1-F).

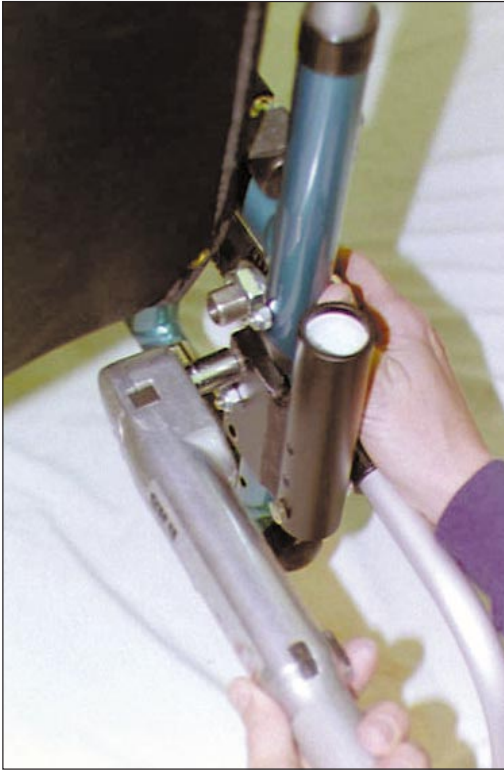


Fig. 2-A

### Armrest Height (swingaway L armrest)

This type of armrest has a holder located on the lower rear frame opposite the axle plate (Fig. 2-A). These armrests can be adjusted by moving the armrest holder up and down on the frame, or on some chairs by adjusting the placement of a bolt in the holder itself.



Fig. 2-B

E&J™ Vision L armrest (Fig. 2-B) height is adjusted by performing the following steps:

1. Remove the bolt on the end of the armrest.
2. Move the outer sleeve up or down the armrest.
3. Align the sleeve opening with the desired armrest opening.
4. Replace the bolt.

## Positioning and Performance Adjustments

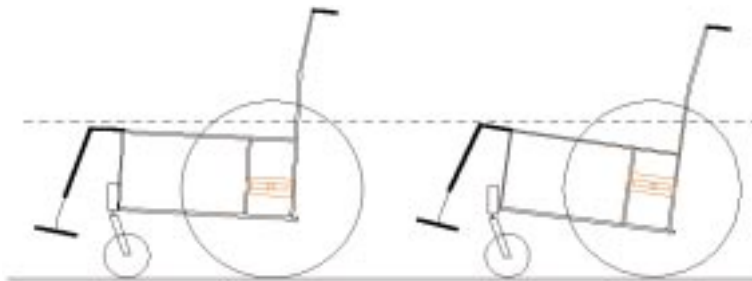


## Tilt in Space

Providing tilt in space in a wheelchair increases balance for wheelchair users with poor trunk control. The effects of gravity push the wheelchair user's trunk against the back upholstery to increase upright stability in the wheelchair. Adding tilt in space can be accomplished by changing different components of a wheelchair. It is important to remember that creating tilt in space in a wheelchair can affect performance, positioning and mobility: 1) it positively or negatively affects cervical alignment; 2) transfers out of the wheelchair will be more uphill; 3) it increases the tendency of the wheelchair to tip backwards.

### Moving rear axle up vertically on the frame (See page 22)

- Alters the relationship between hand and pushrim, which can affect push stroke length, making it more or less efficient to propel the wheelchair, depending on the wheelchair user's arm length and body build.
- Creates more tire to lift over during transfers, as well as less seat area in front of the tire to go ahead of during lateral transfers.

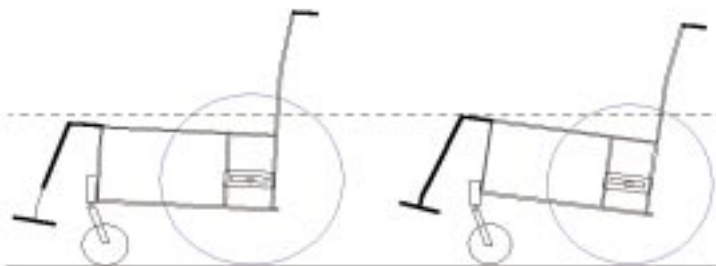


### Lowering seat on an adjustable squeeze frame (See page 12)

- Same as above.

### Changing rear wheel to a smaller size

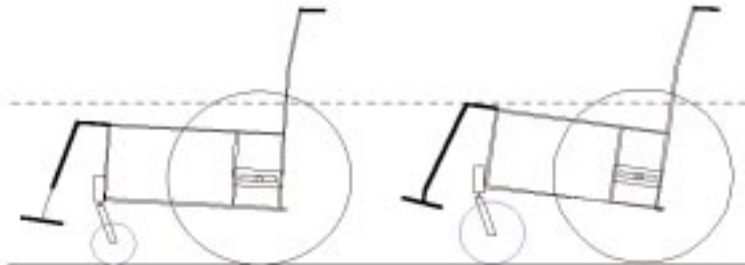
- Allows more seat depth in front of the tire for transfers.
- Decreases overall chair length and decreases turning radius.
- Changes the relationship of the arm to the pushrim, affecting efficiency of propulsion.



### Changing caster to a larger size (See page 14)

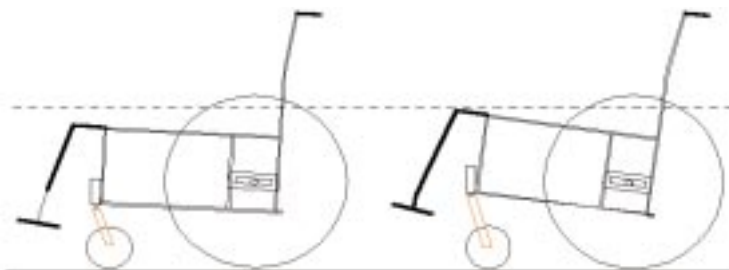
- Decreases the amount of caster/heel clearance.
- Decreases the turning responsiveness of the wheelchair because of the larger turning radius of the caster.
- Increases the front floor-to-seat height of the wheelchair, which will allow greater footplate/ground clearance, but may make positioning under tables or other objects more difficult.
- Enhances ease of propulsion over uneven terrain.

With 70-degree hangers and 8-inch casters, the caster housings will need to be reverse mounted to allow for adequate footplate/caster clearance.



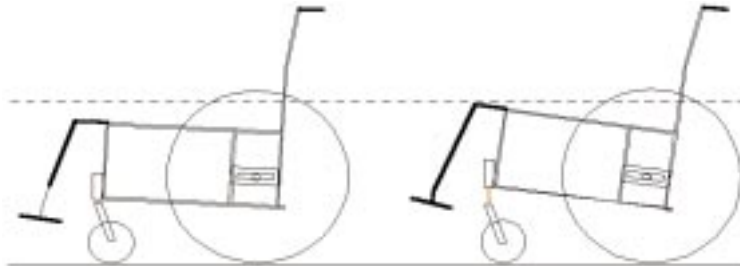
### Changing caster fork length to a longer size (See page 19)

- Decreases the turning responsiveness of the wheelchair, because it creates a larger caster turning radius due to the trailing angle of the caster fork.
- Decreases the caster/heel clearance, again because of the trailing angle of the fork.
- Increases the front floor-to-seat height of the wheelchair and increases the footplate/ground clearance.



### Changing fork stem bolt size to a longer bolt (See page 21)

- Increases the front floor-to-seat wheelchair height and increases the footplate/ground clearance.
- Does not alter the caster/heel clearance or change the turning responsiveness of the wheelchair.



### Moving caster housing down vertically on the frame of the wheelchair

- Increases the front floor-to-seat height of chair without affecting caster/heel clearance, but only a limited number of chairs have this option.

