

**THE SANCTUS PROJECT:
DUAL OFFSET TUBE TRIKE (DOTT)
HIS WHEELS INTERNATIONAL**

**MANUAL FOR FITTING THE
DUAL OFFSET TUBE TRIKE (DOTT)**



Mobilizing God's Work Worldwide

FOREWARD AND ACKNOWLEDGMENTS

The purpose of this manual is to provide instruction and guidance for fitting the *Dual Offset Tube Trike (DOTT)*, a hand-pedaled three-wheeler. It is written for those who may or may not have prior knowledge of seating principles or biomechanics, and who partner with His Wheels International in the Sanctus Project.

I would like to acknowledge Kevin Nikolich for his technical assistance and work in creating and designing the diagrams included in this manual.

I would also like to thank Julie Frakes, OTR/L and Jill Neuenschwander, PT for their professional and editing assistance, and Alice Teisan for her prayer support.

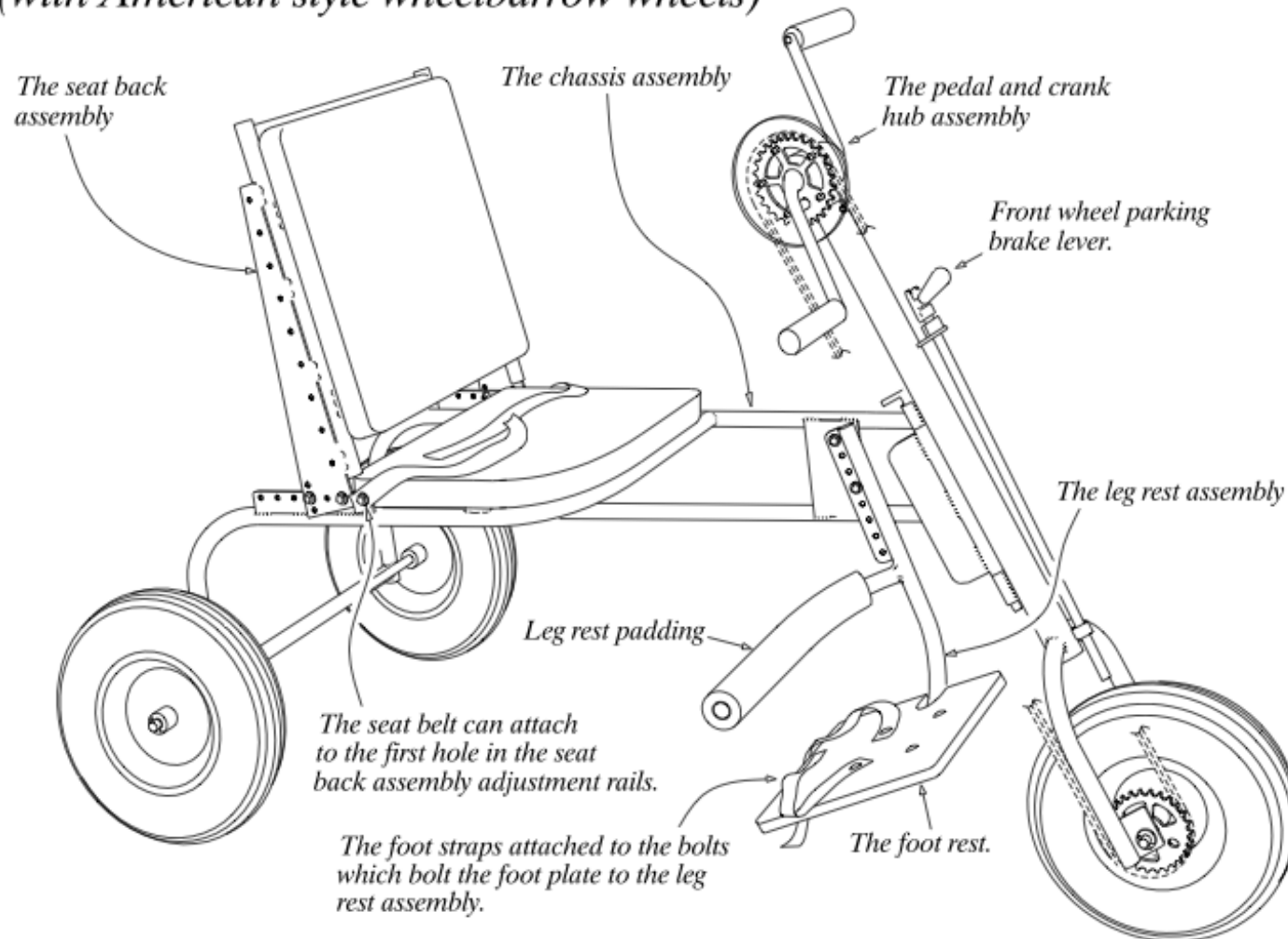
Nancy Biedry, PT
2008 His Wheels International

*Then the eyes of the blind shall be opened,
and the ears of the deaf unstopped;
then shall the lame man leap like a deer,
and the tongue of the mute sing for joy.
For waters break forth in the wilderness,
and streams in the desert;
the burning sand shall become a pool,
and the thirsty ground springs of water;
in the haunt of jackals, where they lie down,
the grass shall become reeds and rushes.*

And a highway shall be there, and it shall be called the Way of Holiness. . .

Isaiah 35:5-8

The Sanctus 358i Dual Offset Tube Trike (with American style wheelbarrow wheels)



*A hand pedaled tricycle designed for the disabled. Drawings and manufacturing information is available by contacting...
HIS WHEELS INTERNATIONAL at www.hiswheelsintl.org or info@hiswheelsintl.org*

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I. BACKGROUND

The purpose of this project is to glorify God, to share the love of Jesus Christ, and to provide a form of mobility for those affected by lower extremity disabilities. The form of mobility offered, the *DOTT* is designed to provide an alternate means of mobility in circumstances where a wheelchair may not be the preferred form of mobility.

From a physical therapy perspective, the design is accessible, ergonomic, stable, and adaptable. Use and control of the head, neck, upper trunk, and arms is required for propulsion, steering, and brake engagement. Safe operation of the *DOTT* requires a degree of cognitive ability, vision, and cardio-respiratory fitness; candidates with impairments in these areas should be individually assessed prior to receiving this form of mobility.

II. SAFETY CHECKLIST

Once fully assembled, perform a safety check on the following *DOTT* components:

1. *Bolts* – all bolts holding the frame together should have lock washers installed beneath the nuts to keep the nuts from rotating loose. Tighten all bolts securely.
2. *Wheels* – cotter pins should hold wheels securely on the axles, yet allow free motion when wheels are lifted from the ground and spun.
3. *Tires* – all tires should be inspected for integrity and proper inflation, if air inflated.
4. *Brake* – the brake handle should face away from the rider when disengaged (during pedaling) and face towards the rider when engaged (when parked); the disengaged brake should not interfere with the front tire during pedaling, and should lock securely to keep the three-wheeler stationary when engaged.
5. *Front Assembly* – locking pin in the steering hinge should fit securely without movement between the front assembly and the chassis. If the chain appears loose at any point in the rotation, retighten it at the point in the rotation where it is loosest.

6. *Chain* – the chain should be taut and without slippage when rotating the crank arms through a complete cycle.
7. *Crank Alignment* – crank arms should rotate smoothly in a parallel plane with the front wheel.
8. *Hand pedals* – grips should be inspected for proper fit and integrity.
9. *Seat Back* – should be secured in place to seat back frame. Inspect for roughness and protrusions; use a file or similar tool to remove them.
10. *Seat* – should be secured in place to chassis. Inspect for roughness and protrusions; use a file or similar tool to remove them. Inspect integrity of seat belt for tears, loose stitching, and secure fastenings.
11. *Leg/Footrest* – should be secured in place and positioned to allow at least 4”/10cm. of clearance from the ground; the horizontal leg support bar should *remain padded* unless modifications require the footrest to be mounted on it. The vertical portion of the leg/footrest should not extend above the chassis bracket. If it does, it is preferable to saw the protruding section off using a common hacksaw. Be careful to file off or remove any sharp edges left from sawing the metal. Finally, inspect the integrity of the foot strap for tears, loose stitching, and secure fastenings.

III. GUIDELINES FOR FITTING

Correctly fitting the *DOTT* hand-pedaled three-wheeler is important in providing this form of mobility for persons with lower extremity disabilities. However, it is crucial to convey the love of Jesus Christ in the time and care you give to the *person* receiving the three-wheeler *during* the fitting process. Remember to give thanks and glory to God alone.

When fitting the *DOTT*, proper positioning of the pelvis will provide stability; proper positioning of the crank assembly/hand pedals will provide efficient, effective propulsion. Correctly fitting the *DOTT* hand-pedaled three-wheeler will maximize safety and comfort and minimize muscle/joint injury.

- A. Interview:** Introduce yourself and greet the recipient; ask the names of recipient and accompanying family/friends. If information is available, clarify diagnosis.

Inquire:

- Can the recipient stand? Walk? Assistance needed?
- How does the recipient transfer in/out of a chair?
- What surface/terrain will the three-wheeler be used on?

B. Assessment: The recipient should be assessed to determine that he/she is an appropriate candidate for the *DOTT*.

1. Assess **ability to know and understand** to determine the recipient's ability to safely maneuver the *DOTT*:

- Is the recipient able to follow instructions?
- Does the recipient demonstrate appropriate judgment/awareness to safely operate this hand-pedaled three-wheeler in various conditions?

2. Assess **sitting balance** to determine whether the person is an appropriate candidate for the *DOTT*. If a person cannot sit without the use of their hands for support, the person may not be an appropriate candidate for using this form of mobility.

Is the recipient able to maintain a sitting position:

- Without using their hands for support?
- Only with the use of their hands for support?

3. Assess **sensation** and **condition of the skin** to determine the appropriate seat/seatback cushion and/or need for a special cushion: (*see Addendum A: "Sensation and Skin Care Guidelines"*)

- Has the recipient ever had a skin sore? If yes, instruct the recipient in performing pressure relief exercises.

4. Assess **arm strength** in the sitting position for the ability to pedal the *DOTT*.

5. Assess for any **limitation in joint motion** that might affect their sitting position and/or hand pedaling. If needed, lay the recipient on a mat.

Assess joint motion of the:

- Shoulders
- Elbows
- Wrists and Hands
- Spine
- Hips

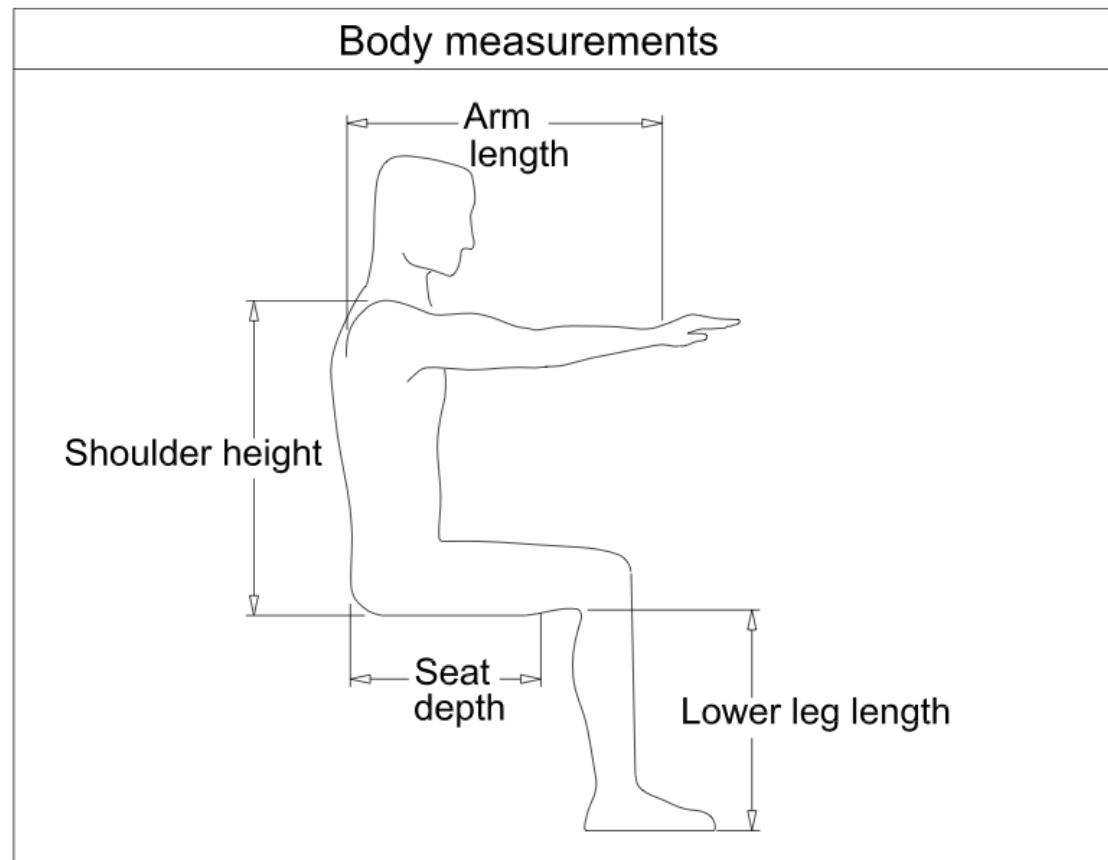
- Knees
- Ankles and Feet

6. Assess **body measurements**, taking into account seat/seatback cushion *thickness*.

With the recipient sitting in a chair, measure:

- **Shoulder height**– seat to top of shoulder.
- **Arm length** – back of shoulder to wrist with arm fully extended and held parallel to the ground (90° angle to the trunk).
- **Seat depth** – back of hips along thigh to back of knee, then *subtract* 3”/7.5 cm.
- **Lower leg length** – back of knee to bottom of heel.

(see diagram at right)



C. Adjustments: Using the body measurements, adjust the components of the *DOTT* for an *approximate* fit. Make adjustments with the front wheel pointing straight ahead. Consider the hand pedaling action through 360° of rotation when viewed from the right side of the Sanctus three-wheeler. **Remember to take into account seat/seatback cushion thickness.**

1. Measure and fabricate the **seat/seatback cushions**; secure cushions in place.

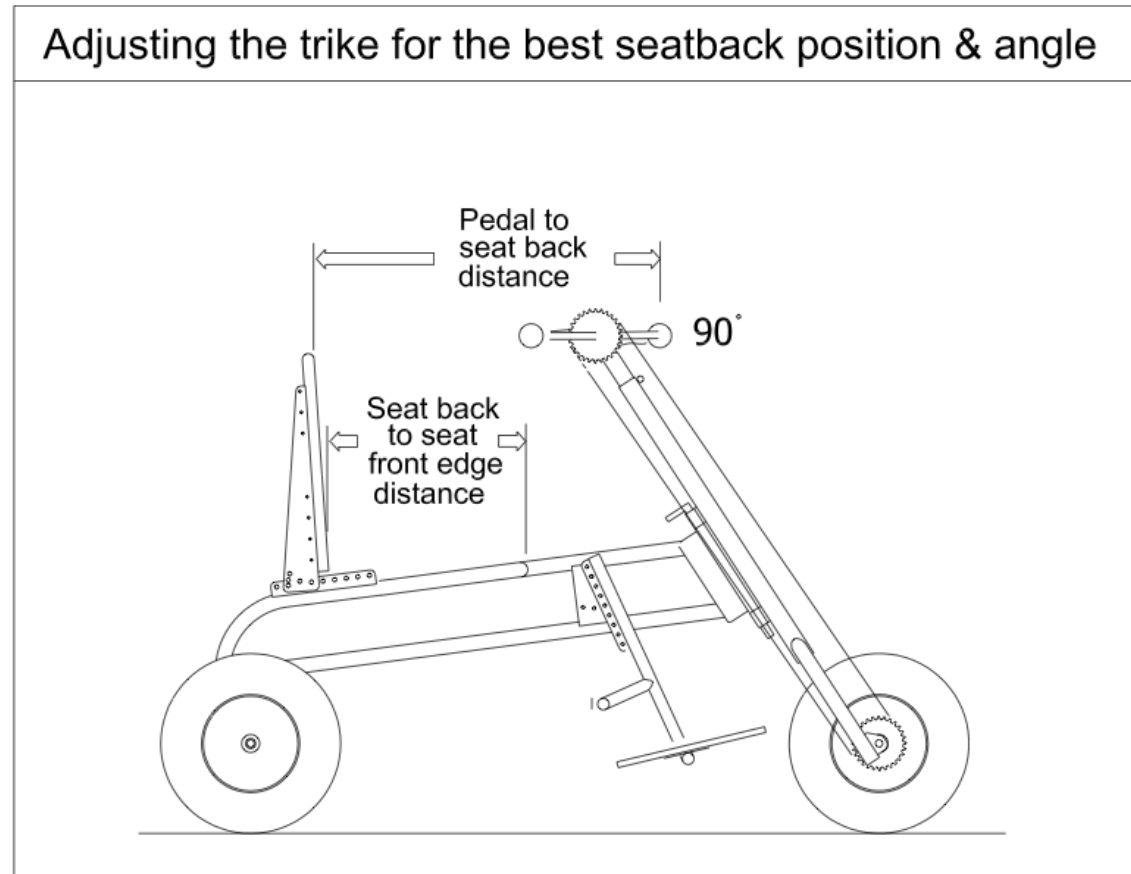
2. Adjust **seat back angle**:

- The *seat back angle* should be placed in the most upright position unless modifications are required to accommodate joint motion limitations.

Adjust **seat back position**:

- The *seat back to seat front edge distance* should equal the **seat depth measurement**.
- When the hand pedal is placed at the 90° position, the *hand pedal to seat back distance* should equal the **arm length measurement**.

(see diagram at right)

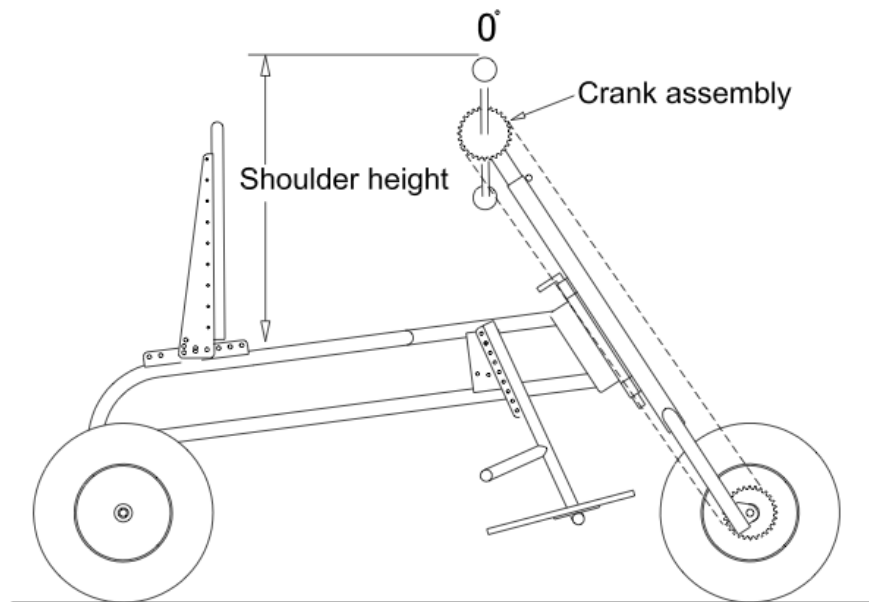


3. Adjust **crank assembly height**:

- When the hand pedal is placed at the 0° position, the *hand pedal* should be the same height as the top of the shoulder (**shoulder height measurement**).

(see diagram at right)

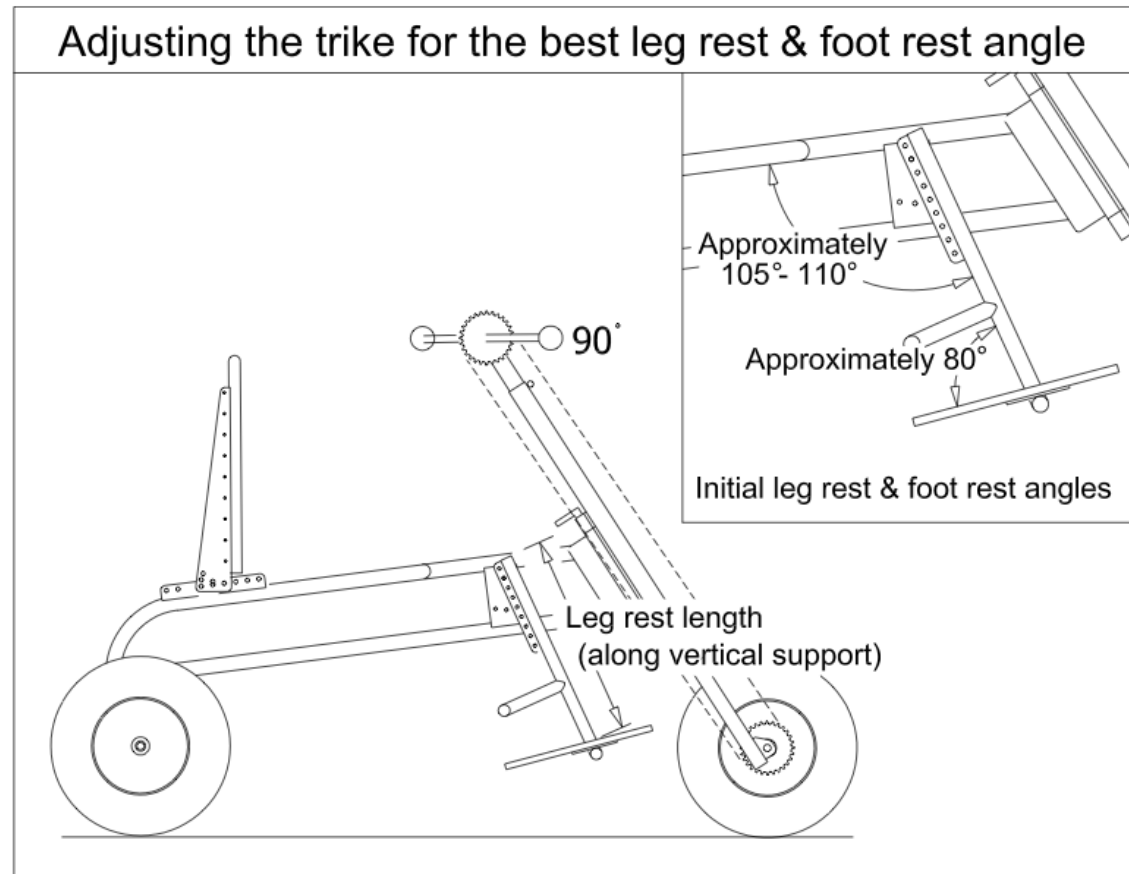
Adjusting the trike for proper pedaling at the 0° position.



4. Adjust **leg rest length** and **leg rest/footrest angles**:

- The *leg rest length* is equal to the **lower leg length measurement**.
- *Angle* the *leg rest* vertical support so the footrest and the seat are approximately parallel, unless modifications are required to accommodate joint motion limitations.

(see diagram at right)



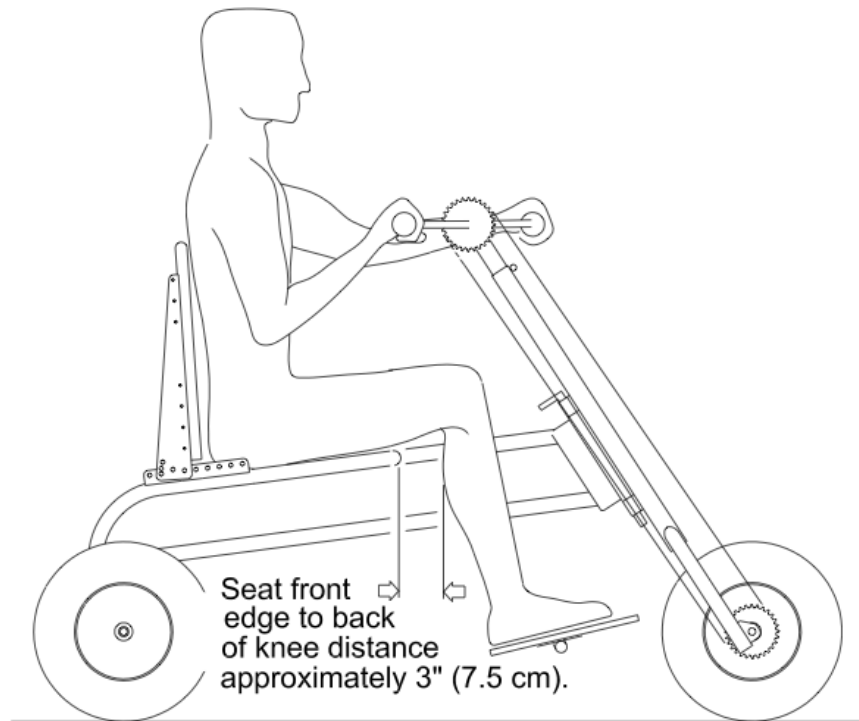
D. Transfers: Position the three-wheeler for a transfer. **Engage the parking brake.** Using the information gleaned from the interview, assist the recipient in a transfer to the three-wheeler. The preferred method is for the recipient to *first* position his/her pelvis on the seat and *then* position his/her leg(s) on the footrest. Instruct the recipient to position their hips against the seat back (or as close as possible), providing assistance as needed.

E. Modifications: With the recipient seated on the three-wheeler, modify prior adjustments as needed to provide the best seating position for efficient, effective maneuverability. With the front wheel pointing straight ahead, instruct the recipient to grasp the hand pedals in their hands.

1. Check the **seatback angle**:

- When the recipient is sitting against the seatback, the recipient should be able to maintain sitting balance *without* hand support.

Modifying the trike for the best seatback position & angle



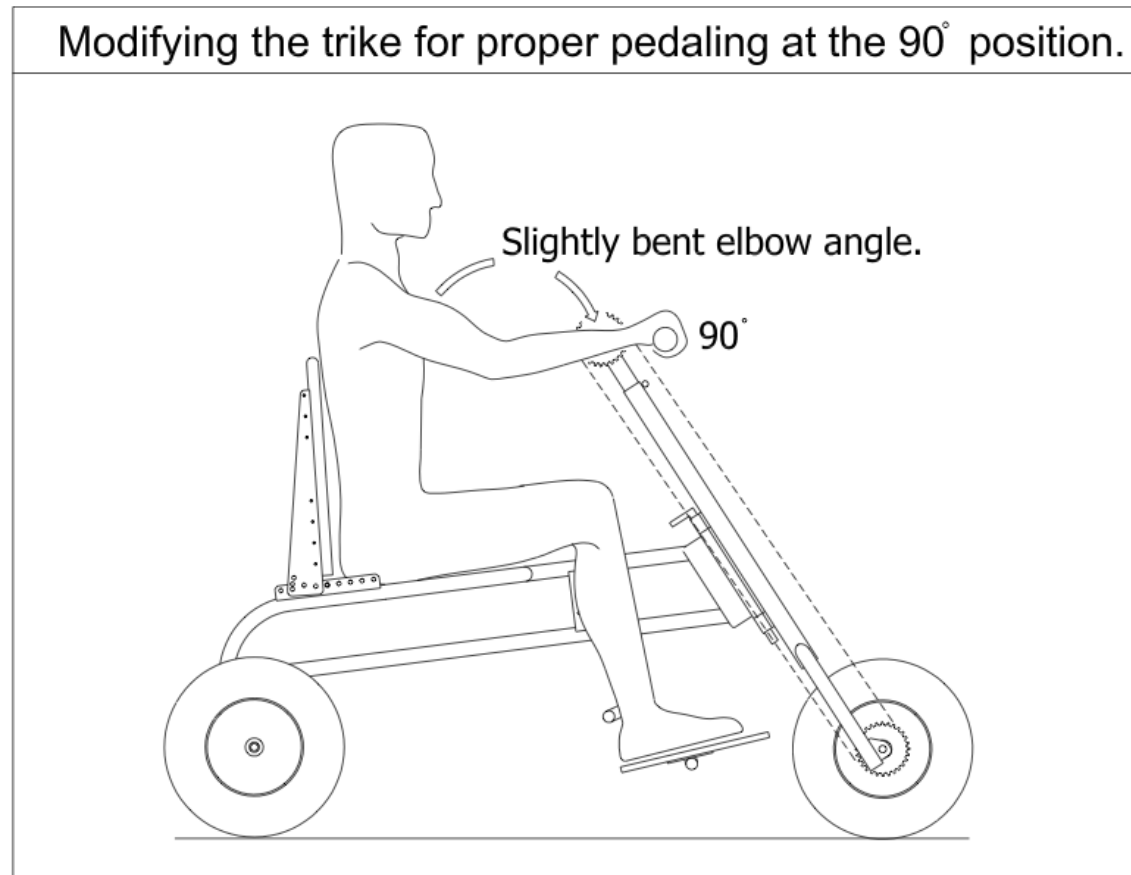
Check the **seatback position**:

- There should be approximately 3"/7.5 cm. (*3 finger widths*) between the seat front edge and the back of the recipient's knee.

(see diagram at right)

- When the hand pedal is held at the *90° position*, the recipient's elbow should have a slight bend.

(see diagram at right)



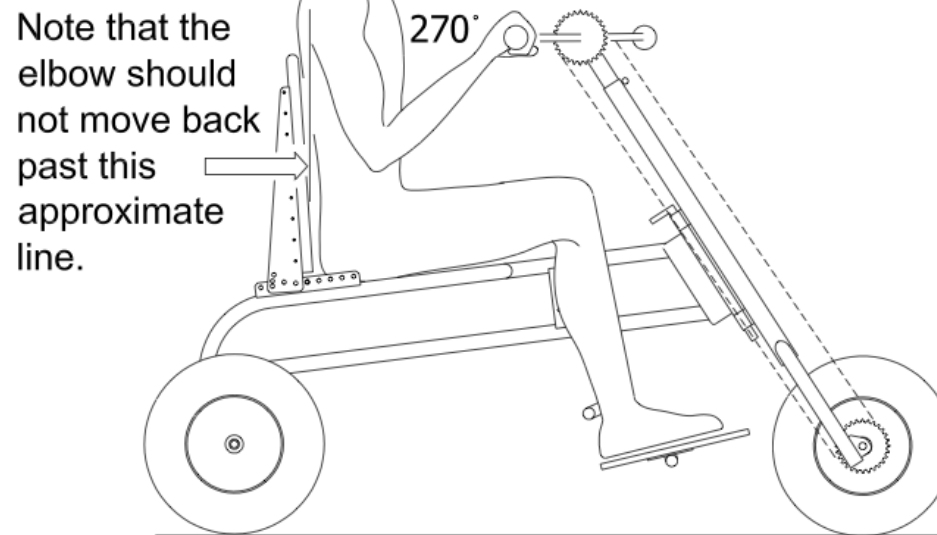
- When the hand pedal is held at the 270° position, the recipient's elbow should not extend behind the trunk.

(see diagram at right)

Instruct the recipient to turn the front wheel to the left 45° and to the right 45° .

- The pedal should have full clearance of the trunk. If not, consider re-adjusting the seatback position.

Modifying the trike for proper pedaling at the 270° position.



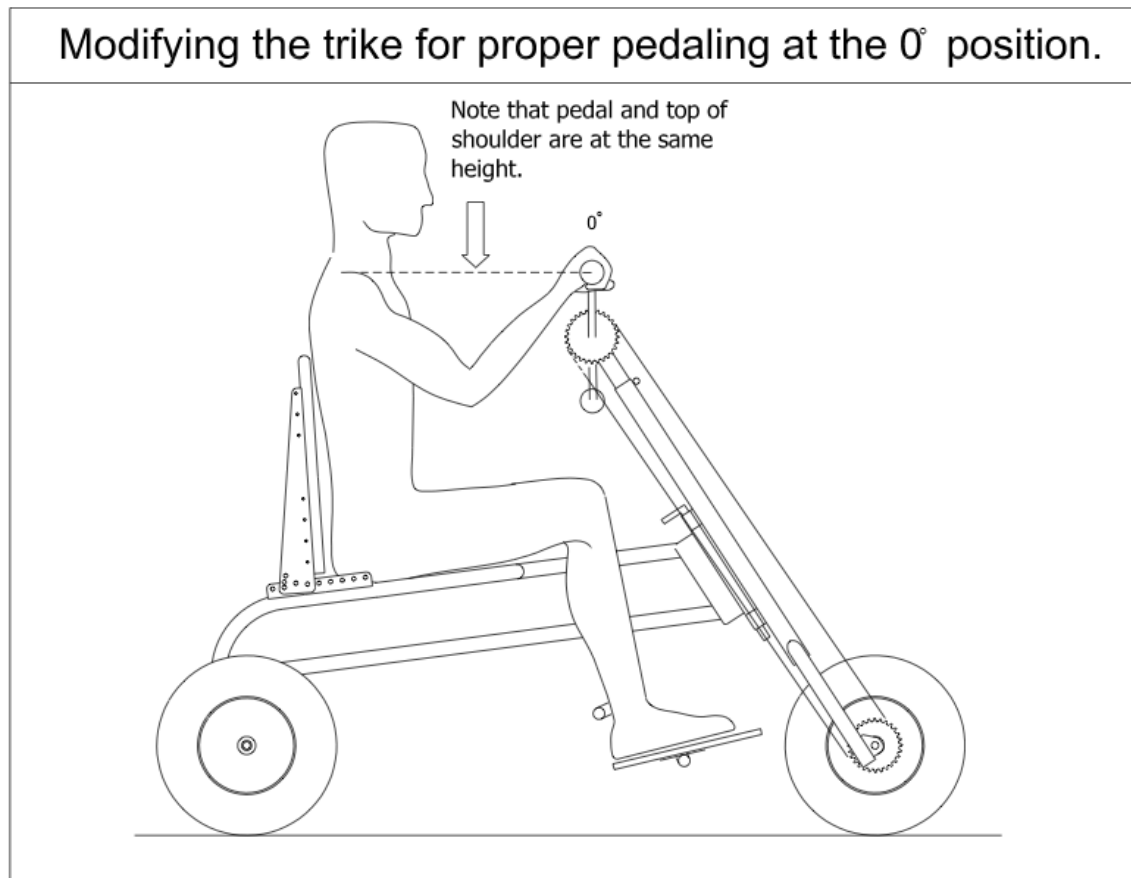
2. Check **crank assembly height:**

- When the hand pedal is held in the 0° position, the hand pedal and the top of the shoulder should be the same height.

(see diagram at right)

- Adjust chain accordingly.

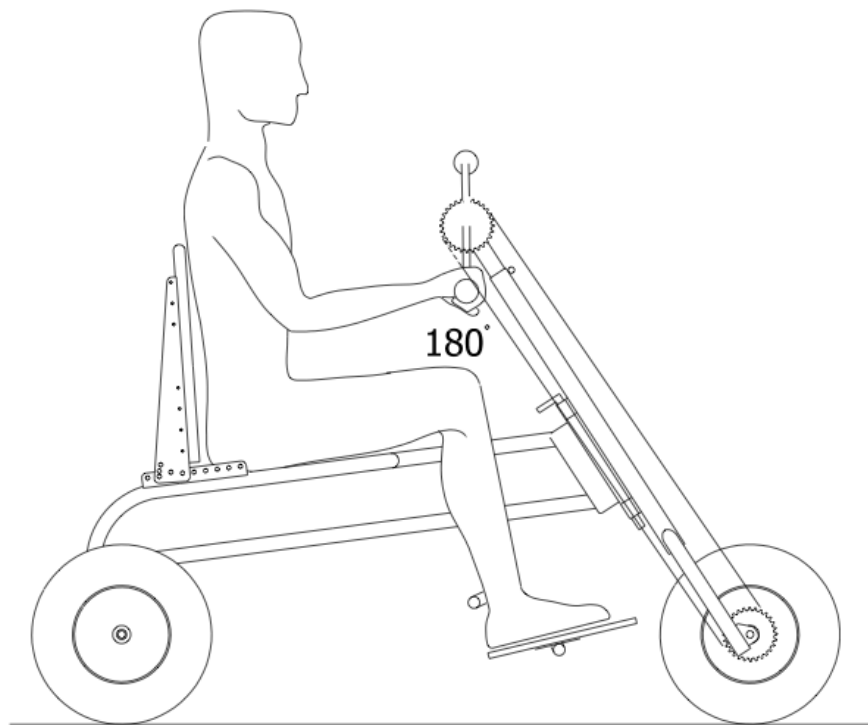
(see Addendum B: "Adjusting the Chain")



Modifying the trike for proper pedaling at the 180° position.

- When the hand pedal is held at the 180° position, the hand pedal should have full clearance of the thighs.

(see diagram at right)



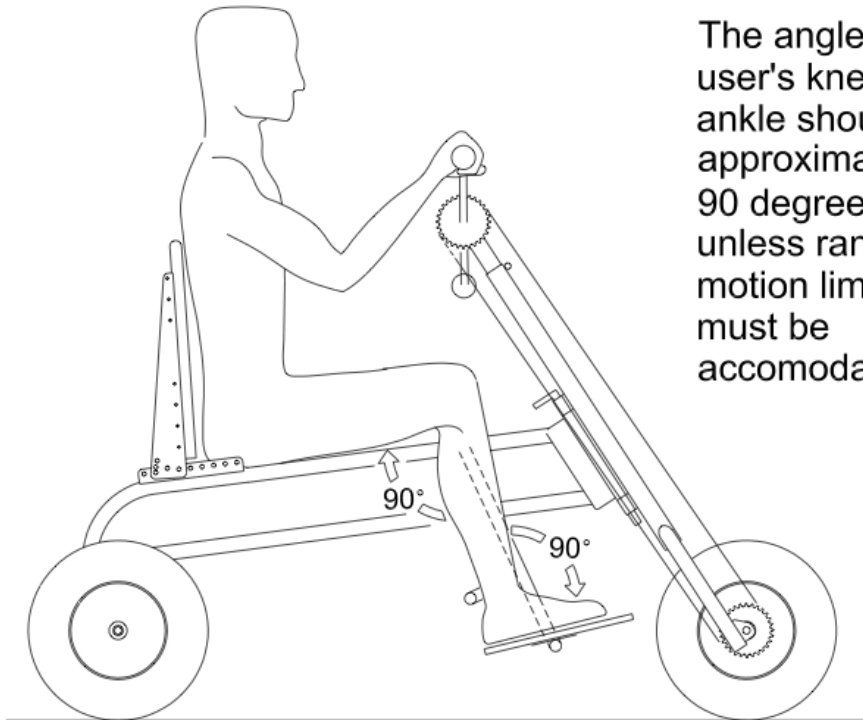
3. Check the **leg/footrest length and angles**:

Unless modifications are required to accommodate joint motion limitations,

- The thighs should be parallel to the seat.
- The *leg/footrest support angle* should provide the recipient with a 90° angle at the knee.
- The *footrest angle* should provide the recipient with a 90° angle at the ankle.
- The feet (with shoes, if available) should be in contact with the footrest from heel to the ball of the foot.

(see diagram at right)

Modifying the trike for the best legrest & footrest angle.

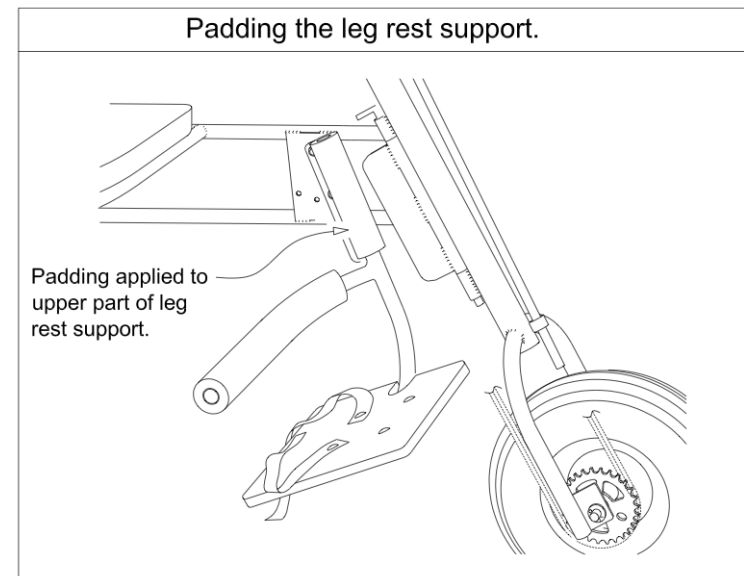


The angle of the user's knee and ankle should be approximately 90 degrees unless range of motion limitations must be accommodated.

If joint motion limitations exist, adjust the leg/footrest angles to insure adequate support and comfort.

- Apply **padding** to the upper *leg rest support* to minimize the effects of prolonged pressure on the left leg.

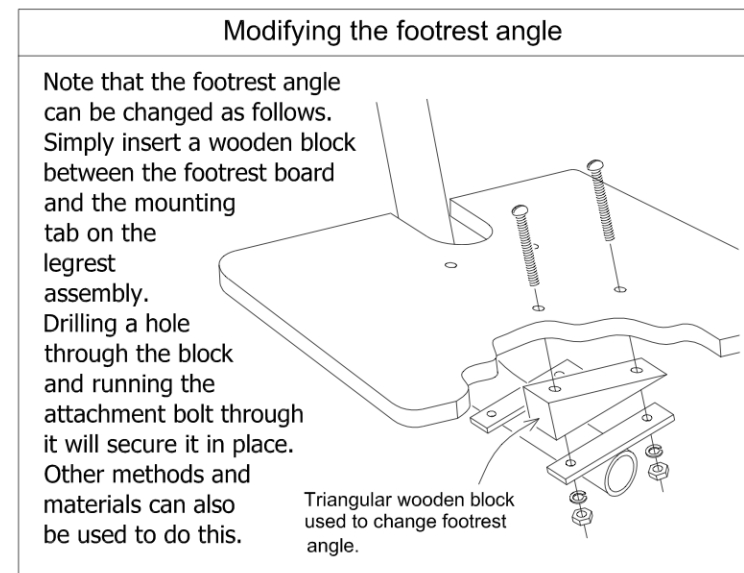
(see diagram at right)



The **footrest angle** can be modified as follows:

- Insert a wooden block between the *footrest board* and the mounting tab on the leg rest assembly.
- Drill a hole through the block and run the attachment bolt through it to secure it in place.

(see diagram at right)



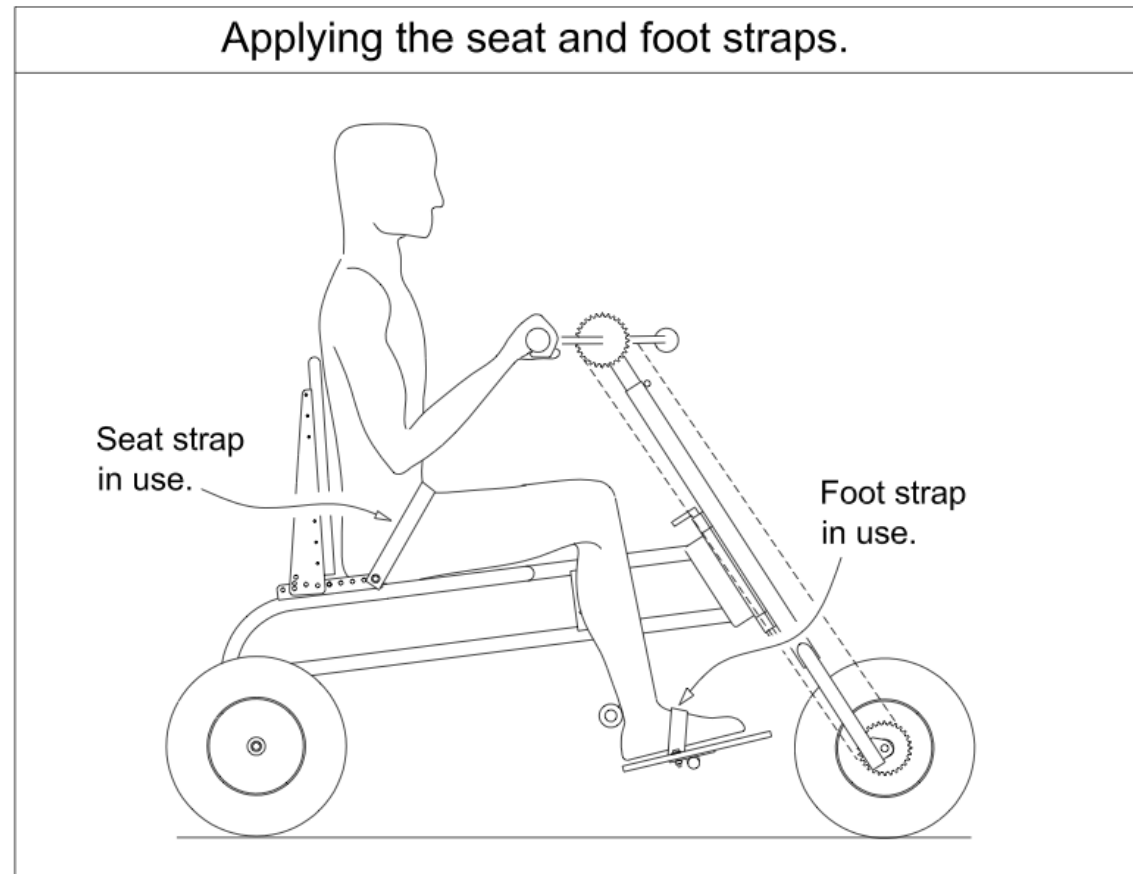
4. Measure, fabricate, apply, and adjust the **seat and foot straps** for a secure fit. To provide proper positioning and stability, especially during considerable exertion, the following straps are important:

- A *seat strap* across the pelvis/hips, attaching at the seat frame bracket.
- A *foot strap* across the midfoot, attaching to the footrest.

(see diagram at right)

5. Depending on the functional needs of the recipient, additional **options** may be suggested at this point. Options may include:

- An awning attached to the seatback uprights
- A cargo crate attached to the chassis behind the seat.



F. Instructions for the User: the recipient and family/friends should be addressed; emphasize proper use for maximum benefit.

1. Instruct in the importance of having the brake *engaged* when transferring in/out of the three-wheeler, and in the correct position of the brake handle when engaged/disengaged. Make sure the recipient can reach and operate the brake while positioned in the seat.
2. Emphasize the safety and efficiency rationale behind use of the seat/footrest straps. Make sure the recipient can *secure* and *release* all straps.
3. Instruct in the combination use of a push out/pull back action for maximum efficiency and power during hand pedaling. Demonstrate the action and allow guided practice.
4. Demonstrate the turning radius of the front assembly; allow guided steering practice in right/left directions. Demonstrate coaster brake action/backhand pedaling, as applicable, and allow guided practice.
5. Explain the importance of maintenance to insure safety and keep the three-wheeler in good working order. Instruct in wheel, chain, and screw tightness checks on a routine basis. Instruct in the method of cleaning all appropriate components. Instruct in proper tire inflation, as applicable.
6. Instruct in use and care of cushions and padding. Teach recipients with loss of sensation/skin integrity how to prevent pressure sores; impress upon them the importance of excellent skin care. (*see Addendum A: "Sensation and Skin Integrity Guidelines"*)
7. Instruct in proper transfer technique; re-emphasize the importance of having the brake engaged when transferring in/out of the three-wheeler. Allow guided practice time with family/friend assisting the recipient as needed.

If circumstances allow and a camera is available, ask permission to take a photo. If appropriate, pray with the recipient and accompanying family/friends, giving thanks and glory to God, and in the hope that the *DOTT* will bring great joy.

And a highway shall be there, and it shall be called the Way of Holiness...
Isaiah 35:8

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IV. ADDENDUM A: SENSATION AND SKIN CARE GUIDELINES

The assessment of sensation and skin integrity is a necessary component of fitting the *DOTT*. If the recipient demonstrates **impaired sensation**, the recipient and accompanying family/friends should be educated in the importance of excellent **skin care** and the prevention of pressure sores. If the recipient has **skin breakdown** at any pressure area, the recipient should be advised to *allow full healing* to occur before using the *DOTT*.

When a person sits or lies in one position for too long, prolonged pressure to areas of the body can occur. The areas of the body most often affected are areas of bony prominence. During prolonged sitting on the *DOTT*, these areas include:

- tailbone (sacrum)
- hips (under and outer surfaces)
- knees (including outer aspect along vertical leg rest support)
- heels
- ribs (if side supports are needed)

Because of impaired sensation in an affected body part, the recipient may be unable to tell when they have been sitting or lying in one position for too long. The resulting prolonged pressure can cause loss of blood supply and the death of soft tissue in that area.

Pressure sores are areas of soft tissue that have decreased blood supply because of prolonged pressure. They occur most frequently over areas of bony prominence. *Signs* of a pressure sore may include:

- reddened or discolored areas that *do not go away* within one hour after the pressure has been relieved
- red areas that don't turn white with finger pressure
- blisters or actual skin breakdown.

Pressure sores are *serious* problems. They can get infected, and those infections can spread to the bone. If not prevented, pressure sores can get deeper than they appear on the surface. They can persist for long periods of time without healing if complete pressure relief is not provided. Even after complete healing occurs, the skin in the affected area remains more susceptible to **skin breakdown** in the future. Pressure sores can limit a person's energy and function. If pressure sores are not addressed, they can even become *life threatening*.

PRESSURE SORES CAN BE PREVENTED! The recipient should be educated in the use of **appropriate seat/seatback cushions**, the importance of **skin care**, and to perform regular **self-inspection** skin checks and **pressure relief** exercises.

Self-inspection skin checks *must* be part of the recipient's *daily* routine. The recipient should be instructed to examine the skin of every affected body part.

- Use of a mirror is helpful to view the back, buttocks, and hips. If that is not an option, the recipient should be instructed to get someone's assistance to faithfully help the recipient with skin inspection.
- Special attention should be given to skin where straps are worn.
- *Gently* massaging danger areas often help stimulate circulation to these areas.
- Avoid skin abrasions, especially during transfers.
- Keep skin clean and dry.
- Use a smooth, non-wrinkled bed and turn side to side every 2-3 hours at night.

Pressure relief exercises are a very effective method of minimizing prolonged pressure while using the *DOTT*. Instruct the recipient with loss of sensation to:

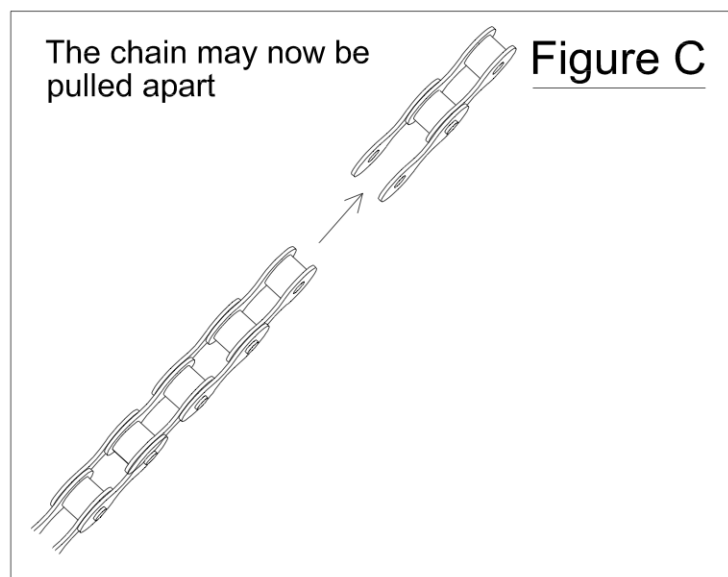
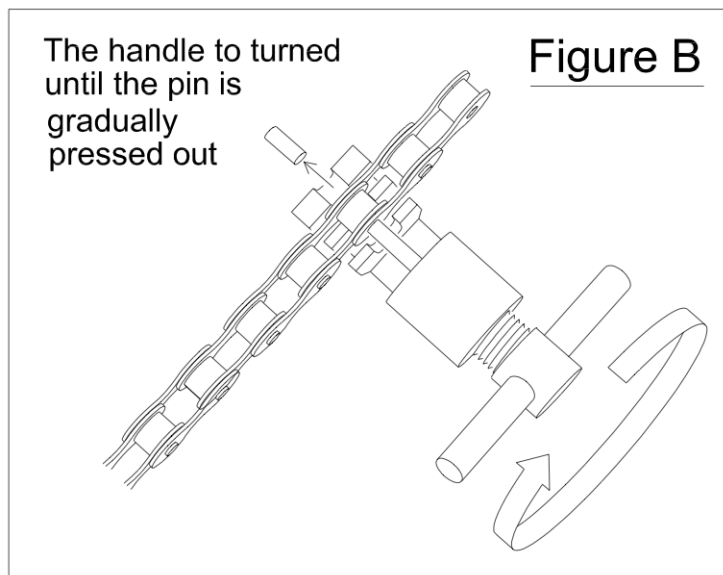
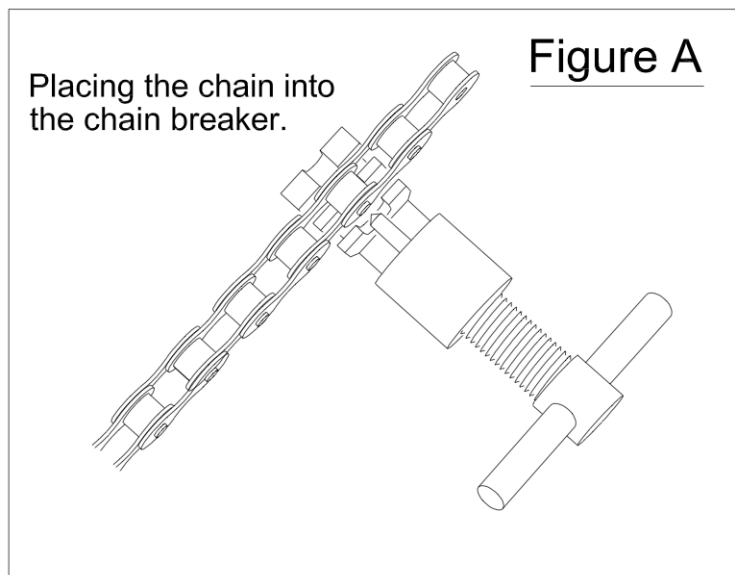
- Engage the *DOTT* parking brake.
- Perform sitting "push-ups" on the seat frame to lift their buttocks off the seat for 30-60 seconds. Alternately, the recipient can lean to one side and then to the other.
- Perform the **pressure relief** exercises every 15-20 minutes.

Cushioning bony prominent areas is also important, and should be used *in addition* to use of the **appropriate seat/seatback cushions**, **self-inspection** skin checks and **pressure relief** exercises.

Seat cushions used with the *DOTT* should meet the World Health Organization guidelines for wheelchair seat cushions.

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IV. ADDENDUM B: ADJUSTING THE CHAIN



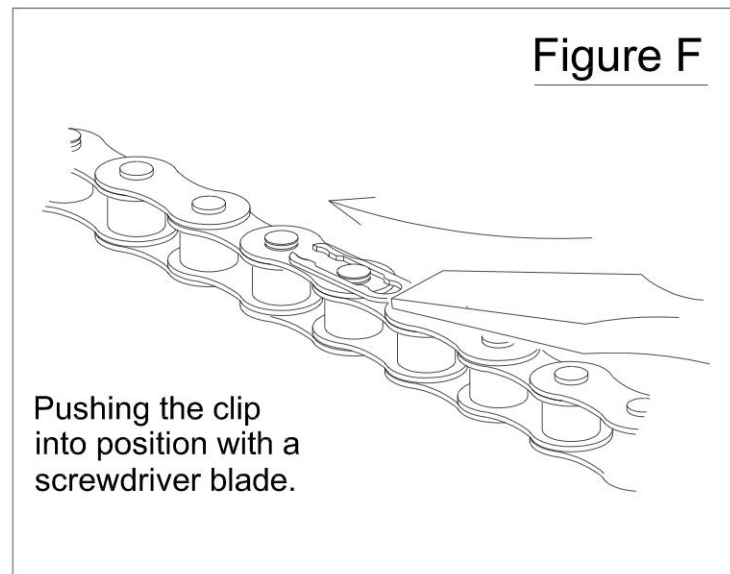
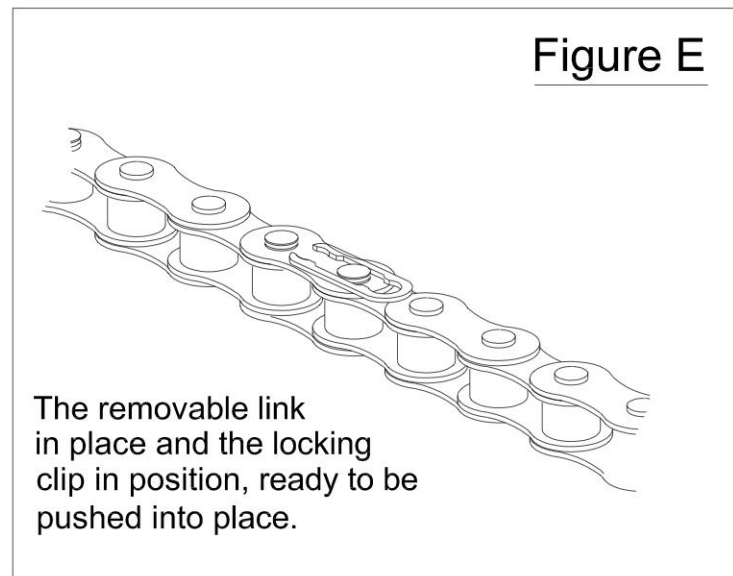
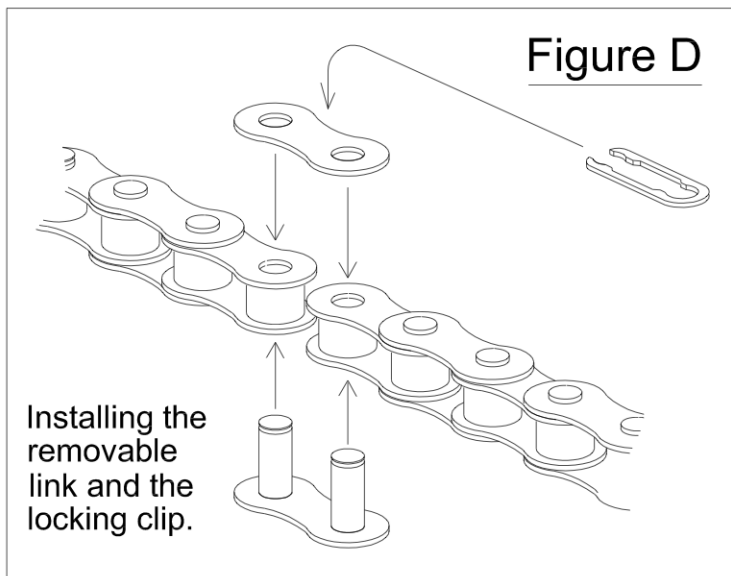
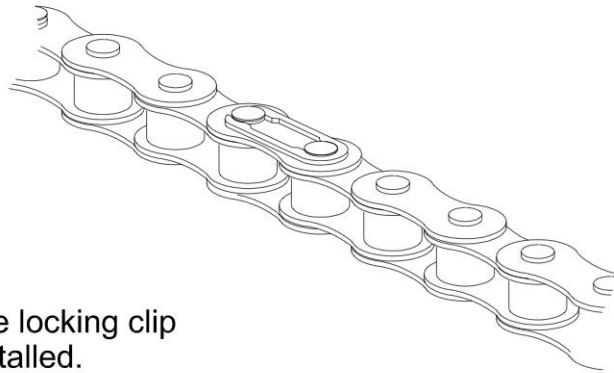
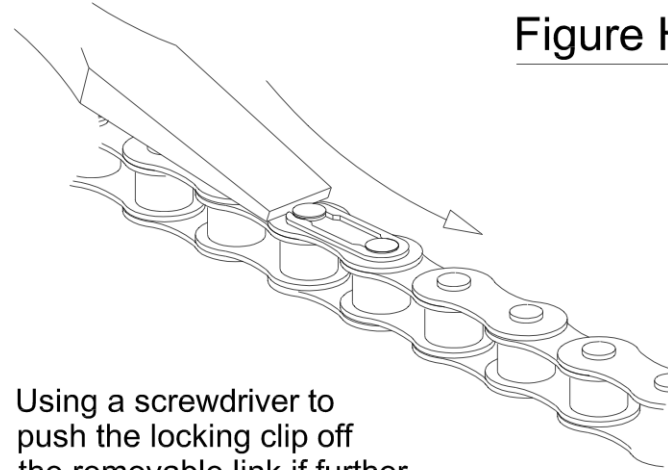


Figure G



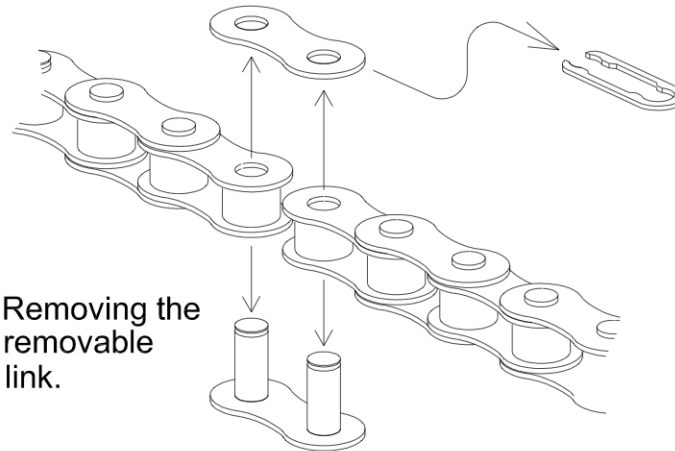
The locking clip
installed.

Figure H



Using a screwdriver to
push the locking clip off
the removable link if further
adjustment is necessary.

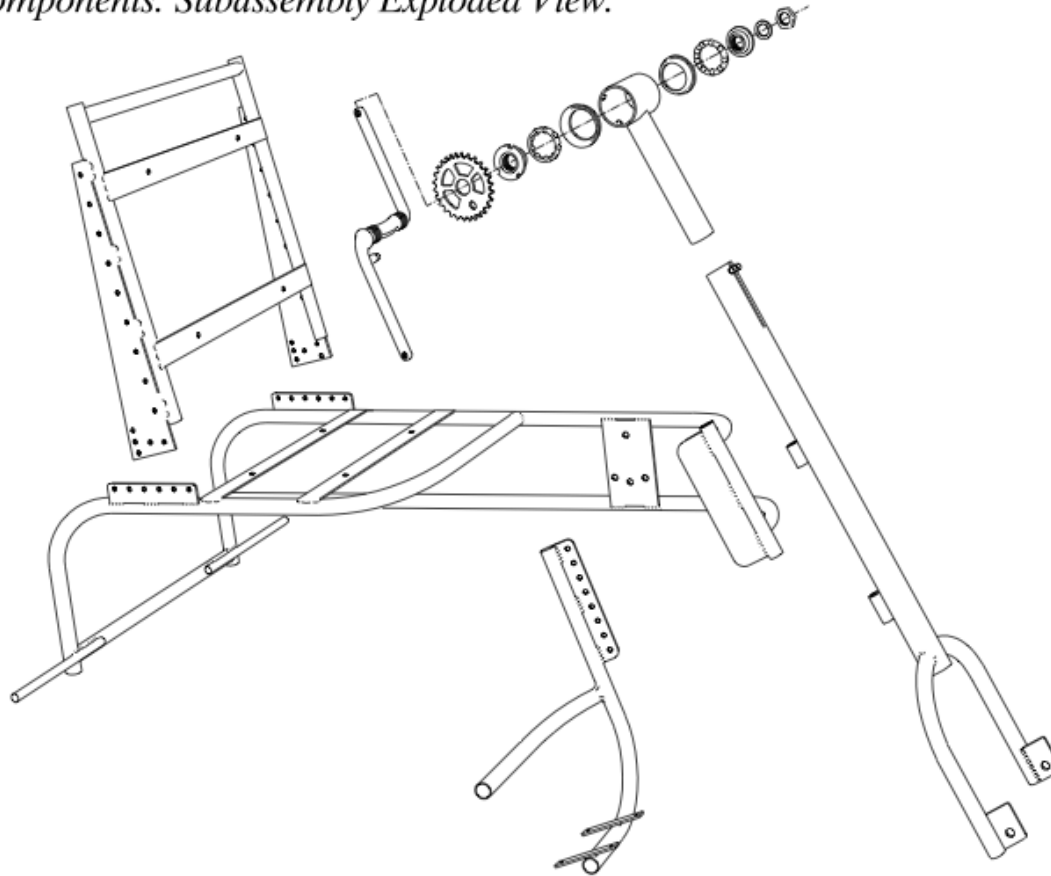
Figure I



Removing the
removable
link.

V. APPENDIX A: DOTT CORE COMPONENTS. SUBASSEMBLY EXPLODED VIEW

The Sanctus 358i Dual Offset Tube Trike
Core Components. Subassembly Exploded View.



A hand pedaled tricycle designed for the disabled. Drawings and manufacturing information is available by contacting...
HIS WHEELS INTERNATIONAL at www.hiswheelsintl.org or info@hiswheelsintl.org

VI. APPENDIX B: SUGGESTED TOOLS FOR FITTING THE *DOTT*

- 1/2" wrench (open box)
- slip-joint pliers (medium size for 1.25" wide nuts) OR crescent wrench (8-12" size)
- needle-nose pliers
- tape measure
- pen/paper
- flat head screwdriver (medium size)
- phillips head screwdriver (medium size)
- chain breaking tool for single speed 1/8 x 1/2" bicycle chain
- bicycle grease (small tube)*

Depending upon the country's climate, consider keeping the bare metal parts oiled or slightly greased to prevent rust and to make later adjustments and removal easier. Occasionally apply a small amount of oil to the bare steel axles and the short tube sections they slide into, as rust might make the axles hard to remove at a later date. Do *not* grease the bare metal of the crank assembly (the short section of bare steel tube that slides into the top of the front assembly); it might slip under tension.

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