

# Tendon Transfer Surgery

In-Depth Information for Clients  
with Quadriplegia



Spinal Cord Injury Program

G.F. Strong Rehab Centre

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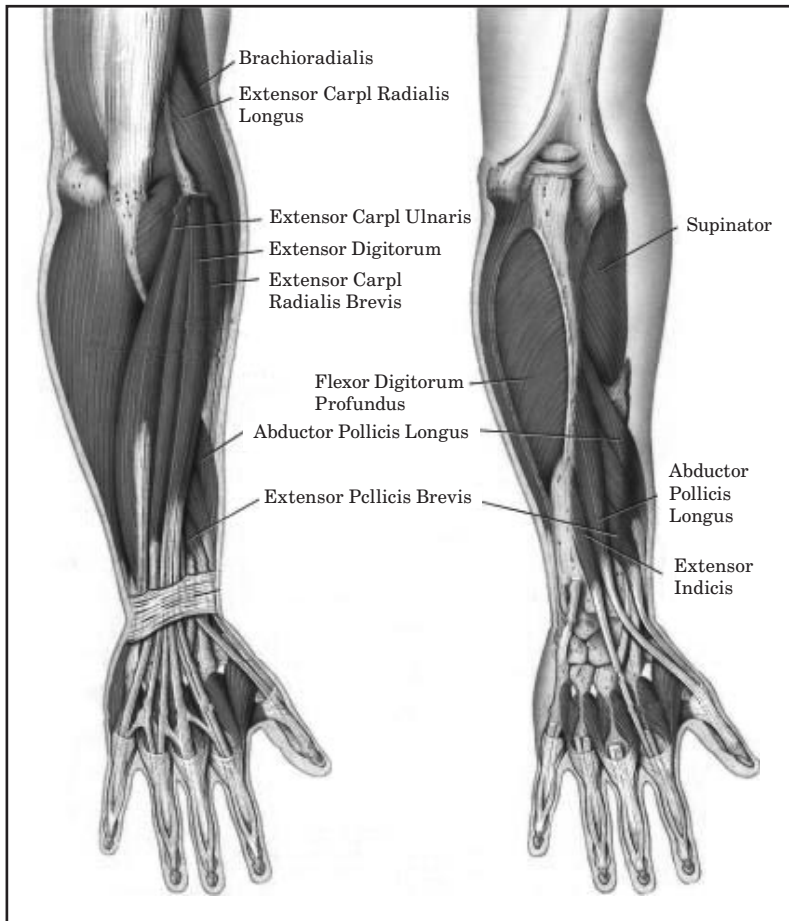
## Introduction

A cervical spinal cord injury generally results in loss of function in the arm and hand. The amount of lost function depends on the level of injury in the cord - the higher the injury the more severe the loss of movement. For instance, a C6 injury results in paralysis of 75% of the arm muscles with approximately 6 muscles remaining active and not paralyzed.

- A surgical procedure known as tendon transfer can improve function in the arm and hand by re-deploying intact, working muscles to act as “motors” for paralyzed muscles.
- A tendon is the part of the muscle that crosses a joint (elbow or wrist) and attaches to bone. When the tendon crosses the joint it helps to transmit muscle action into joint movement. By connecting a strong working muscle to the tendon of a paralyzed muscle, movement across a joint can be restored.
- An active muscle used as a “motor” for a tendon transfer must have a grade 4 assessed strength i.e. it must be able to contract against gravity and resistance placed on it. This is necessary to ensure the transfer will be successful.

## Tendon Transfer Procedures

The following is a summary of the most frequently performed tendon transfer procedures. Level of injury, muscle strength, range of motion and present status of arm function are the principal considerations in determining the best surgical plan. The muscles in the arm that can be used in tendon transfer procedures are shown in diagrams 1 to 5.

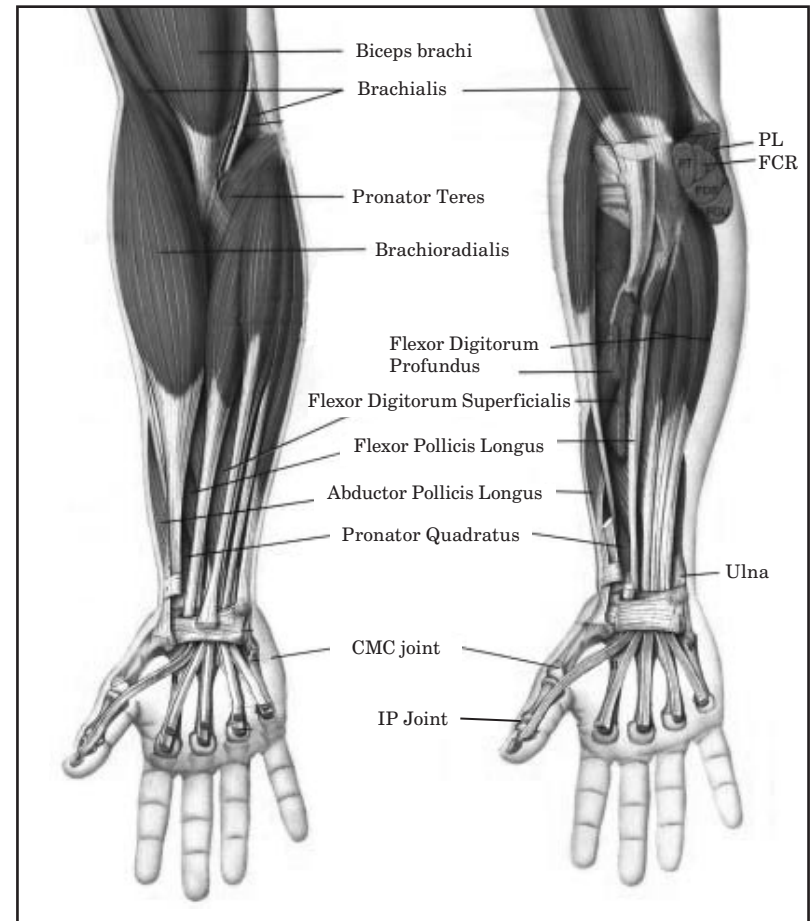


**Diagram 1: Back of arm (palm down position)**

**Tendon transfers can help restore four critical functions for self-care and independence:**

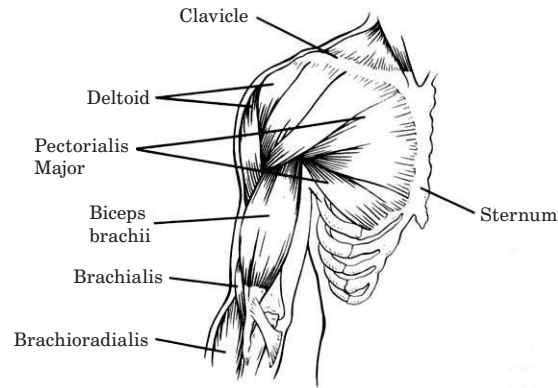
1. Ability to straighten the elbow
2. Ability to extend the wrist
3. Ability to grip with the thumb and fingers
4. Ability to open the hand

**Terms: bend = flex; straighten = extend**



**Diagram 2: Front of arm (palm up position)**

Diagram 3



### Elbow Extension: C5 & C6 Injury Levels

The ability to actively straighten the elbow from a bent position adds greatly to a person's independence. Restoration of elbow extension is cited as one of the most beneficial upper limb procedures in quadriplegia. A **deltoid to triceps** tendon transfer provides a grade 3 to 4 power of elbow extension (movement against gravity & light resistance). Activities such as dressing, reaching overhead with the arm, driving a power wheelchair (or a car) and supporting oneself in sitting become easier as the strong pull of the biceps muscle is balanced by the action of the triceps muscle.

This transfer involves detaching a portion of deltoid muscle at the back of the shoulder and bringing it down towards the elbow where it is sutured (attached) into the triceps muscle. Because the deltoid is not long enough to reach the attachment point of the triceps a tendon graft is taken from a leg muscle. This graft is then used to weave the deltoid & triceps together.

Diagram 4

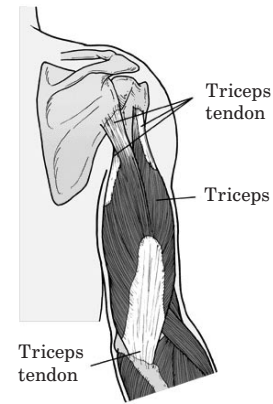
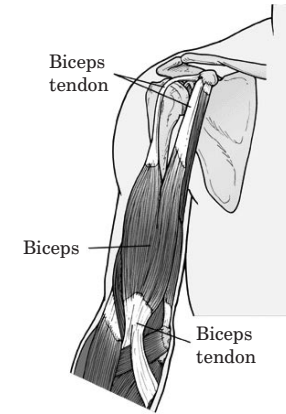


Diagram 5



An **alternate** approach to restore elbow extension (when there is reduced range of motion in the elbow) is a transfer of the **biceps to the triceps** muscle. This transfer improves ability to actively straighten the elbow and reduces the need to use the shoulder muscles and gravity to extend the arm. This procedure is especially effective when there is limited elbow motion and the arms lie in a supinated posture (elbows bent with palms of hands turned upwards).

When the biceps muscle is so contracted (tight) that a tendon transfer cannot be done, a procedure to release the tight elbow and forearm structures is effective in restoring a more functional "palm down" position in the forearm. This procedure, called a **de-rotational osteotomy**, contributes to improved ability to use the hand for activities such as eating and driving a power wheelchair.

### Wrist Extension: C5 Injury Level

The ability to actively extend the wrist removes the need for a wrist orthosis (splint). The **brachioradialis** (an elbow flexor) muscle is used as the "motor" for this transfer. It is woven into the **extensor carpi radialis brevis** to provide sufficient wrist extension strength to support the weight of the hand.

At the same time a procedure to bring the thumb into contact with the index finger is performed by tightening the tendons of the thumb (**flexor pollicis longus and extensor pollicis longus tenodeses**). This “key grip” procedure makes it possible to pick up light objects between the thumb and index finger and to feed oneself with a palmar cuff. Prior to having this procedure it is recommended that a deltoid to triceps transfer be performed to gain active elbow extension and to stabilize the activity of the **brachioradialis** muscle when it is transferred later.

### Thumb and Finger Grasp: C7 & C8 Injury Levels

The ability to hold the thumb against the side of the index finger is known as thumb key pinch (the movement required to turn a key in a door). The **brachioradialis** muscle, used as the motor for this transfer, is attached to the **flexor pollicis longus** muscle. Activities such as eating, writing, picking up and manipulating heavier objects are improved with this transfer. In conjunction with the **key grip** procedure a tendon transfer to enable grasping ability with the fingers is generally performed at the same time. The **extensor carpi radialis longus muscle** is transferred to the paralyzed **flexor digitorum profundus**. These procedures to improve hand grasp and dexterity are particularly useful when there is ability to straighten the fingers but no ability to bend or use the fingers to grasp. Frequently, prior to surgery, both hands may be needed to lift even a light object. After surgery it is easier to grasp and pick up things using just one hand. Individuals who have had these procedures report improved ability with activities such as dressing, grooming, cooking, eating, using hand tools and pushing a wheelchair.

### Thumb Function: C6, C7 & C8 Injury Levels

Stability of the thumb is important for key pinch activities. Paralysis of the muscles controlling the position and stability of the thumb may result in the thumb collapsing into the hand and an inability to contact it to the index finger. Two procedures can be undertaken to overcome this problem. The **carpo-metacarpal (CMC)** and the **interphalangeal (IP)** joints can be fused (stiffened) to better position the thumb for contact against the index finger. These procedures are done in conjunction with the tendon transfers described above.

### Tenodesis Enhancement: C6 Injury Level

Patients who do not have sufficient strength in the muscles required for the tendon transfers described above may benefit from a simple procedure to enhance the natural passive tenodesis of the hand. Contact between the thumb and index finger is enhanced when the wrist is extended so that ability to pick up light objects is improved.

### Hand Opening: C6 & C7 Injury Levels

Severe tightening of the fingers due to spasticity in the hand and/or contracture of the finger joints can make opening of the hand to release objects difficult. This problem may develop years after injury due to tightening of the natural tenodesis of the hand. A procedure that improves passive opening of the fingers when the wrist is relaxed can be done to alleviate this problem. This involves tenodesis of the **extensor digitorum communis**. This "extensor" phase procedure" can be performed, if necessary, prior to active transfers (described above) to improve overall hand dexterity.

## G.F. Strong Upper Extremity Clinic

The GF Strong Upper Extremity Clinic was established to assess and advise people with quadriplegia about surgical procedures to improve arm and hand function. At the clinic clients (patients) are assessed by a medical team that includes a physician, physiotherapist, occupational therapist and hand surgeon. Consultation is provided as to the surgical procedure that would be of most benefit for each individual. The following should be kept in mind when considering surgery:

- ✓ Tendon transfer surgery is indicated for people with a C5-C8 cord injury.
- ✓ Tendon transfer surgeries are not scheduled until approximately one year after injury (to allow for medical and neurological stability to occur) but can be done years after injury with good results.
- ✓ Options for tendon transfer procedure very much depend on the level of the spinal cord injury, the strength of muscles spared by the injury and the arm or hand function lost as a result of the injury.
- ✓ Following surgery, there is a 4 week period of immobilization in a fiberglass cast to allow transferred tendons to heal. After this, gradual mobilization, strengthening and re-training of the limb is undertaken.
- ✓ Full activities are allowed at 10 weeks post surgery. Compliance with post-op rehab is essential for an optimum surgical outcome.
- ✓ Every effort is made to provide patients who live outside of the Greater Vancouver with post- op rehabilitation at a physiotherapy clinic or hospital in their community. However, we recommend that patients attend for treatment when possible at G.F. Strong to derive maximum benefit from surgery.

- ✓ It may be necessary to plan for extra attendant assistance for transfers and self-care after surgery
- ✓ It will be necessary to use a power wheelchair for a 6-8 week after surgery.

At the clinic it helps if you take an active role in your assessment and discuss your needs with the surgeon and the medical team. Asking questions is a good way to gain an understanding of the procedures described so that you are well prepared, should you decide to go ahead with surgery.

### Who can I contact for more information?

- Shannon Sproule: pager 604-871-7947  
e-mail: Shannon.Sproule@vch.ca
- Ann Rae: 604-871-5690  
e-mail: Ann.Rae@vch.ca

See also FM.553.T252 Tendon Transfer Surgery-  
Information for Clients with Quadriplegia

Notes from the Clinic Date: \_\_\_\_\_

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