POST-OPERATIVE REHABILITATION

Katie Walt, PT, DPT

Single-Event Multi-level Surgery

The types and amounts of surgery vary by patient: GMFCS Level, goals, and severity of involvement. Focus on Patellar Tendon Advancement and Distal Femoral Extension Osteotomy.

Function, gait, and strength does not reach full recovery (pre-operative level) until 9-12 months post-operative.


Improvement continues 12-24 months following surgery and improvement was maintained for 5 years post-operatively.


Outline

- Pre-operative Evaluation and Education
- Inpatient Surgical Stay
- 3-6 weeks post-operative
- Inpatient Rehabilitation Stay
- Extended Outpatient Rehabilitation

Pre-operative Patient Education

- SEMLS Manual
- Pre-operative PT Evaluation
- Pre-operative phone calls
- Patient Education Classes
- Training Videos
Patient Education

Typical Rehab Protocol
- Rehab Goals for Inpatient Surgical Stay
- Transportation following surgery
- Inpatient Rehab
- Outpatient Physical Therapy
- Discussion of long-term Rehab

GMFCS Levels I-III

Post-operative Rehabilitation

Stages of Recovery After Surgery

- Healing of bone and soft tissues, prevention of post-operative stiffness: approximately six weeks
- Strengthening of muscles and regaining household mobility: approximately twelve weeks
- Retraining of gait and continued strengthening/endurance: up to twelve months

Surgical Procedures

Focus on Distal Femoral Extension Osteotomy and Patellar Tendon Advancement.

The types and amounts of surgery vary by patient: GMFCS Level, goals, and severity of involvement.

Other Bony Procedures
- Tibial Denervation Osteotomy
- Calcanal Lengthening Osteotomy
- Figure of Eight Staplings
- Other Various Foot Procedures

Other Soft Tissue Procedures
- Psoas Lengthening
- Rectus Femoris Transfer
- Hamstring Lengthening
- Adductor Lengthening
- Gastrocnemius Lengthening
- Posterior Tibialis Transfer
- Anterior Tibialis Transfer
- Other Heelcord variations
**Protocols**

- Inpatient Surgical Stay
  - 0-5 days
  - 0-3 weeks
  - 3-6 weeks
  - 6-12 weeks
  - 3-6 months
  - 6-12 months

- Weightbearing Status, Transfers, Ambulation
- Range of Motion
- Orthoses and Immobilization
- Functional Activity
- Therapeutic Exercise

**Protocols**

- DFEO.pdf
- Tibial Tubercle and PTA.pdf

**Physical Therapy Goals and Procedures: Initial Three Weeks**

- Instill confidence in parents’ ability to care for their child
- Prevent stiffness during the period of immobilization
  - Passive range of motion - performed by caregiver or Continuous Passive Motion (CPM) machine
Continuous Passive Motion (CPM)

- Begin 3 days post-op at 0-30°, gradually increasing amount of motion every few days so that patient is at 70° of knee flexion by 3 weeks post-op.
- CPM is done 3x/day for 30 minute sessions followed by prone positioning.

Positioning

- Prone positioning is encouraged 50% of the time, beginning with 3x/day.
- Femoral Derotation Osteotomies
- Psoas Lengthenings

Positioning

- Short Leg Casts, Knee Immobilizers, and Derotation Bar
- Decrease spasms
- Ease of transfers

Physical Therapy Goals and Procedures: Initial Three Weeks

- Pain issues
- Transportation
  - EZ-on vests
  - Sitting upright, facing forward, with legs elevated
  - Medical Transport/Van in Wheelchair with lock downs
- Transfers
  - Generally dependent lift, large sliding board, or with patient assisting with upper extremities
  - May do stand and pivot transfers with unilateral surgeries
Physical Therapy Goals and Interventions: Three to Six Weeks

• Range of Motion:
derotation bar removed,
Knee immobilizers for comfort
  – Passive and active assisted with no restrictions
  – Focus on maintaining knee extension and increasing knee flexion

Physical Therapy Goals and Interventions: Three to Six Weeks

• Strengthening
  – Isolated exercise and transitional activities based upon selective motor control
  – Focus on activating quadriceps to gain control of the knee

6 week return visit

• Cast removal, X-rays, orthotics, and clinic visit

• Physical Therapy to advance strengthening and mobility.

• Admission to inpatient rehab for 2-4 weeks may also be recommended.

• HEP to continue to work on passive and active ROM;
Continued CPM if significant knee flexion limitations remain.

• Progress to stand and pivot transfers and increase mat mobility as able

• Begin WBAT with or without knee immobilizers and progress standing and/or walking with assistive device

• Outpatient PT 3x/week
Candidates for Inpatient Rehab

- Deteriorating ambulation (household, struggling to maintain community ambulation with or without an assistive device)
- Requires moderate to maximum assist by caregivers for transfers and/or ambulation at 6 weeks post-op.
- Increased size due to age adds to caregiver stress.

Candidates for Inpatient Rehab

- May need temporary or permanent equipment changes to assist with progress (i.e., Standers)
- Would benefit from more intense rehab to help to make significant progress
- Fatigue due to rehab competing with school
- Psychology to assist with coping, anxiety, and depression.

Inpatient Rehab Stay

- 6 weeks post-op
- Length: 2-4 weeks
- PT BID+
- Occupational Therapy
  - ADLs and UE
  - Strengthening
- Therapeutic Recreation
  - Strength and Endurance
- Psychology
  - Coping, Anxiety, and Fear
- Nursing
  - Careplan and Pain Management

Rehab Goals

- Goals for inpatient stay need to be identified.
- Goals that will make a difference when they return home (i.e., transfers, toileting, bathing, in/out of car, stairs)
- Ambulation: short distances (endurance will continue to build over the next months)
- Set-up for success versus waiting for failure
Inpatient Rehab Stay

• PT BID
  – ROM and Strengthening
  – Standing/Transfers
  – Gait Training
  – Robotic Gait Training
  – Pool
  – Adaptive Bike

Passive and Active ROM

Strengthening
Mat mobility and transfers

Weightbearing and Functional Activities

Progress to ambulation

- Ambulation generally begins with KTs on; then gradually weaning off of them one at a time (and alternating legs).

Gait Training

- Robotic Assisted Gait Training
- Partial Weightbearing Gait Training
- “Over the Ground” Gait Training
Use of the Robotic Gait Training may allow SEMLS patients to:

- Participate in locomotor training sooner in their rehabilitation (secondary to body weight support and robotic assistance)
- Participate in task specific training
- Train at higher speeds
- Take more steps per session
- Train for longer durations

---

Physical Therapy Goals and Intervention: 8-12 weeks plus

**Range of Motion**
- Routine stretching program resumed
- May continue with use of knee immobilizers at night

**Strengthening**
- Two to three times per week
- Refer to Progressive Resistive Strengthening protocols
- With the Lever Arm restored, strengthening can be optimized.

---

Physical Therapy Goals and Intervention: 8-12 weeks plus

**Ambulation**
- Progresses by increasing distance and speed
- Improving Balance
- Wean from assistive device, may transition to Forearm crutches or resume independent ambulation

---

Physical Therapy Goals and Intervention: 8-12 weeks plus

**Partial Weightbearing Gait Training**
- Decreases the effects of gravity, promotes better alignment
- Decreased effects of fatigue
- Increased repetitions earlier in rehabilitation process
- Promotes Strength and Endurance
- Increase Speed
“Over the Ground” Gait Training

Functional!!
- Train in the context of the activity
- Different terrain and environments
- Ensure that the activity improves participation
- Be conscious of contextual factors
- ...and motivation!

Physical Therapy Goals and Intervention: 8-12 weeks plus

- Orthoses
  - Solid ankle/Posterior Leaf Spring
  - Floor Reaction AFO
- Need to continue to do strengthening outside of AFO

Discharge from/reduction in Physical Therapy

- Patient has achieved or exceeded pre-operative functional status
- Therapy may continue at the same frequency as before surgery, or discontinued
- Periodic strengthening, ongoing stretching programs and aerobic exercise is beneficial

Summary

- Improved alignment provides better Lever Arm for optimal muscle function and strengthening.
- Pre-operative Planning and Education
- Physical Therapy is essential throughout the various stages of recovery.
- Long Duration of Rehabilitation and Recovery
Thank you!

Katie Walt, DPT
Gillette Children's Specialty Healthcare
kwalt@gillettechildrens.com

QUESTIONS??
### Surgical Procedure: Distal Femoral Extension Osteotomy  
(with Patellar Tendon Advancement)

<table>
<thead>
<tr>
<th>PHASE</th>
<th>WB status/Transfers/Gait</th>
<th>ROM</th>
<th>Braces</th>
<th>Functional Activity</th>
</tr>
</thead>
</table>
| **1. Inpatient Surgical (0-5 days)** | NonWBing  
Dependent Lift or scooting transfer; | Post-op day 3: CPM 0-30°; CPM will be used a minimum of 30 min. 3x/day for each leg. | Knee immobilizers  
Possible SLC with derotation bar. | Prone 3x/day building up to 50% of the time spent in prone. Sponge bath; bed pan |
| **2. 0-3 weeks** | NonWBing  
Dependent Lift or scooting transfer; | CPM: increase 10-15° every 5-7 days as tolerated with the goal of reaching 70 degrees by 3 weeks. | Knee immobilizers  
Possible SLC with derotation bar. | Prone 3x/day building up to 50% of the time spent in prone. Sponge bath, bedside commode. |
| **3. 3-6 weeks** | Begin WBAT  
Stand and Pivot Transfers with Assist standing with or w/o KI; progress to walking with a walker. | Continue with CPM until 90° knee flexion has been achieved. | Begin to wean off KIs to increase knee flexion range of motion and quadriceps strength. | Begin Mat Mobility activities including rolling, sit<>supine, bridging activities. Sponge bath (if still casted), bedside commode. |
| **4. 6-12 weeks** | Full WB  
Sit-to-Stand Transfers up/down stairs, walking with a walker and progressing to least restrictive assistive device. | Obtain full passive and active hip and knee ROM | Solid AFOs or possibly Floor Reaction Braces to facilitate knee extension. | Increase independent functional activity including mat mobility, stairs, toilet and car transfers. May begin cycling when there is available knee flexion. |
| **5. 3-6 months** | Full WB | Full passive and active hip and knee ROM | Solid AFOs or possibly Floor Reaction Braces to facilitate knee extension. | Resume pre-operative functional activity for transfers, self-care, indoor mobility |
### Therapeutic Exercises

#### ACUTE Phase

<table>
<thead>
<tr>
<th>Exercise</th>
<th>Begin Post-op day 3</th>
<th>0-3 weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passive SLR with KI on</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Passive Prone Hip Extension</td>
<td>x</td>
<td></td>
</tr>
</tbody>
</table>

#### SubAcute Phase

<table>
<thead>
<tr>
<th>Exercise</th>
<th>3-6 weeks</th>
<th>6-12 weeks</th>
<th>3-6 months</th>
<th>6-12 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quad sets</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Terminal Knee Extension</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Long Arc Knee Extension</td>
<td>As knee flexion increases</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Straight Leg Raises</td>
<td>Wean off Knee Immobilizer</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hip Abduction</td>
<td>Supine</td>
<td>Sidelying</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hip Flexion</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prone Knee Flexion</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prone Hip Extension</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bridging</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Closed Chain Hip/Knee Extension</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>-step ups, total gym,</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Lite Gait</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Cycling</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Core Strengthening</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Balance Activities</td>
<td>x</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Higher Level Walking/Running</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Surgical Procedure: Distal Femoral Extension Osteotomy (with Patellar Tendon Advancement)

**Rationale:** Correction of fixed knee flexion contracture (the knee is unable to be extended fully) which may be a cause of crouch gait.

**Description:** Just above the knee, the femur (thigh bone) is cut and a wedge of bone is removed to allow straightening of the knee. A metal plate and screws is inserted to maintain alignment until bone healing is complete.
<table>
<thead>
<tr>
<th>PHASE</th>
<th>WB status/Transfers/Gait</th>
<th>ROM</th>
<th>Braces</th>
<th>Functional Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Inpatient</strong>&lt;br&gt;Surgical (0-5 days)</td>
<td>NonWBing&lt;br&gt;Dependent Lift or scooting transfer; sponge bath; bed pan</td>
<td>Post-op day 3: CPM 0-30°; CPM will be used a minimum of 30 min. 3x/day for each leg.</td>
<td>Knee immobilizers&lt;br&gt;Possible SLC with derotation bar.</td>
<td>Prone 3x/day building up to 50% of the time spent in prone.</td>
</tr>
<tr>
<td><strong>2. 0-3 weeks</strong></td>
<td>NonWBing&lt;br&gt;Dependent Lift or scooting transfer; sponge bath, bedside commode.</td>
<td>CPM: increase 10-15° every 5-7 days as tolerated with the goal of reaching 70 degrees by 3 weeks.</td>
<td>Knee immobilizers&lt;br&gt;Possible SLC with derotation bar.</td>
<td>Prone 3x/day building up to 50% of the time spent in prone.</td>
</tr>
<tr>
<td><strong>3. 3-6 weeks</strong></td>
<td>Begin WBAT&lt;br&gt;Stand and Pivot Transfers with Assist standing with or w/o KI; progress to walking with a walker.</td>
<td>Continue with CPM until 90° knee flexion has been achieved.</td>
<td>Begin to wean off KIs to increase knee flexion range of motion and quadriceps strength.</td>
<td>Begin Mat Mobility activities including rolling, sit&lt;&gt;supine, bridging activities.</td>
</tr>
<tr>
<td><strong>4. 6-12 weeks</strong></td>
<td>Full WB&lt;br&gt;Sit-to-Stand Transfers up/down stairs, walking with a walker and progressing to least restrictive assistive device.</td>
<td>Obtain full passive and active hip and knee ROM</td>
<td>Solid AFOs or possibly Floor Reaction Braces to facilitate knee extension.</td>
<td>Increase independent functional activity including mat mobility, stairs, toilet, and car transfers. May begin cycling when there is available knee flexion.</td>
</tr>
<tr>
<td><strong>5. 3-6 months</strong></td>
<td>Full WB</td>
<td>Full passive and active hip and knee ROM</td>
<td>Solid AFOs or possibly Floor Reaction Braces to facilitate knee extension.</td>
<td>Resume pre-operative functional activity for transfers, self-care, indoor mobility</td>
</tr>
</tbody>
</table>
### Surgical Procedure: Tibial Tubercle/Patellar Tendon Advancement

<table>
<thead>
<tr>
<th><strong>6. 6-12 months</strong></th>
<th>Full WB</th>
<th>Full passive and active hip and knee ROM</th>
<th>Solid AFOs or possibly Floor Reaction Braces to facilitate knee extension. NO Hinged AFOs!</th>
<th>Resume pre-operative community ambulation, higher level balance and walking skills</th>
</tr>
</thead>
</table>
**Surgical Procedure: Tibial Tubercle/Patellar Tendon Advancement**

## Therapeutic Exercises

### ACUTE Phase
<table>
<thead>
<tr>
<th></th>
<th>Begin Post-op day 3</th>
<th>0-3 weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passive SLR with KI on</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Passive Prone Hip Extension</td>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>

### SubAcute Phase

<table>
<thead>
<tr>
<th></th>
<th>3-6 weeks</th>
<th>6-12 weeks</th>
<th>3-6 months</th>
<th>6-12 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quad sets</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Terminal Knee Extension</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Long Arc Knee Extension</td>
<td>As knee flexion increases</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Straight Leg Raises</td>
<td>Wean off Knee Immobilizer</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hip Abduction</td>
<td>Supine</td>
<td>Sidelying</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hip Flexion</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prone Knee Flexion</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prone Hip Extension</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bridging</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Closed Chain Hip/Knee Extension</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>-step ups, total gym,</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Lite Gait</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Cycling</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Core Strengthening</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Balance Activities</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Higher Level Walking/Running</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Tibial Tubercle/ Patellar Tendon Advancement**

**Rationale:** Over a long period of time during growth, crouch gait can lead to abnormal elongation of the patellar patella tendon. The patella rests too high above its usual position in the front of the knee (aka patella alta). A lack of knee extension power (related to the elongated patellar tendon and high patella) can contribute to crouch gait. Patella alta may lead to instability (the patella slides sideways) and pain.

**Description:** At or after skeletal maturity, a block of bone with the patellar tendon attached is removed from the upper end of the tibia (shin bone). It is moved downward and resecured to the new position with a metal screw. This repair is protected by a heavy suture (Fibertape).

In skeletally immature children, a growth area at the site of patellar tendon attachment prevents the removal of a bone block. In this case, the tendon is advanced without the removal of a bone block. In that case, the tendon is secured to the bone with sutures. This repair is also protected by a heavy suture (Fibertape).
INSIGHTS BASED ON REVIEW OF COMPLICATIONS

Jean Stout, PT, MS

<table>
<thead>
<tr>
<th>Complication Type</th>
<th>DFEO (N=306)</th>
<th>PTA (N=387)</th>
</tr>
</thead>
<tbody>
<tr>
<td>wound dehiscence/infection</td>
<td>5</td>
<td>16</td>
</tr>
<tr>
<td>loss of fixation</td>
<td>3</td>
<td>34</td>
</tr>
<tr>
<td>nerve stretch/palsy/neuropathy</td>
<td>20</td>
<td>6</td>
</tr>
<tr>
<td>post-surgical deformity</td>
<td>15</td>
<td>1</td>
</tr>
<tr>
<td>non-union/delayed union</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>growth arrest</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>miscellaneous</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>47</strong></td>
<td><strong>72</strong></td>
</tr>
</tbody>
</table>
The most common complications were different between the two procedures.

**PTA**
- Wound infection/dehiscence
- Loss of repair stability

**DFEO**
- Stretch palsy
- Post surg deformity recurrence

### Insights of Complications

#### DFEO: Insights of Complications

**DFEO Operative Insights**

- **Purpose**: The osteotomy site should be as distal as possible, i.e. as close to the epiphysis (or the epiphyseal scar in mature patients) as possible.
  - Avoids: angulation deformity and the potential for neurovascular stretch.

- **Purpose**: Displace the bone posteriorly if size of wedge is greater than 20-30°.
  - Avoids: excessive angulation and potential anterior displacement of the knee joint.

- **Purpose**: Trimming of the posterior bone prominence on the proximal edge of the distal fragment with an oscillating saw prior to wound closure.
  - Avoids: tenting of the neurovascular bundle.

- **Purpose**: Limit retraction for exposure.
  - Avoids: stretch on the neurovascular bundle.

- **Purpose**: Placement of a hemovac drain at osteotomy site.
  - Avoids: hematoma formation at osteotomy site.

- **Purpose**: Removal of a cuneiform wedge or a component of shortening if appropriate.
  - Reduces: potential stretch of the neurovascular bundle.

**DFEO Post-Operative Care Insights**

- **Purpose**: Immobilization in 20-30° of flexion in soft Robert Jones dressing for POD0-POD3.
  - Minimizes risk of neurovascular stretch.

- **Purpose**: Reduce or turn off continuous epidural analgesia at first sign of neurovascular compromise.
  - Avoids: masking of sensation limitation symptoms during time frame of suspicion.

- **Purpose**: Use of a continuous passive motion machine beginning POD3 until 90° of knee flexion is achieved.
  - Provides source of comfort & benefits early return of movement.

#### PTA: Insights of Complications

**PTA Operative Insights**

- **Purpose**: Use a tension-band to secure the repair.
  - Avoids: Loss of fixation caused by early post-operative spasm.

- **Purpose**: Use of fiber-tape tension-band versus wire tension-band.
  - Avoids: Need for a second operative procedure and potential risk of infection from a second procedure.

- **Purpose**: Consideration of simultaneous rectus femoris transfer if previous surgical history does not include global tone management or previous transfer.
  - Avoids: Spasticity of rectus femoris from preventing patella to assume its 'advanced' position and potential loss of fixation.

**PTA Post-Operative Care Insights**

- **Purpose**: Management of post-operative spasms of both knee flexors and knee extensors.
  - Reduces: masking of sensation limitation symptoms during time frame of suspicion.

- **Purpose**: Use of a continuous passive motion machine beginning POD3 until 90° of knee flexion is achieved.
  - Provides source of comfort & benefits early return of movement.

- **Purpose**: Management of post-operative spasms of both knee flexors and knee extensors.
  - Reduces: masking of sensation limitation symptoms during time frame of suspicion.

- **Purpose**: Use of a continuous passive motion machine beginning POD3 until 90° of knee flexion is achieved.
  - Provides source of comfort & benefits early return of movement.
Pain

Pre-Operative Pain status available for 81%

Pain Resolved in 91% of Patients who had Pain Pre-Operatively

90% of those with No Pain remained Pain Free

<table>
<thead>
<tr>
<th>Post-Operative Pain</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>7</td>
<td>88</td>
</tr>
<tr>
<td>No</td>
<td>4</td>
<td>99</td>
</tr>
</tbody>
</table>

WHAT ABOUT THE HAMSTRINGS?

Libby Weber, MD

Old School Thinking:

- Kids with CP sometimes crouch ..... 
- They must all crouch because their hamstrings are too tight..... 
- We should lengthen their hamstrings!

Definition of Crouch

- Excessive KF at terminal swing 
- Excessive KF at initial contact 
- GRF persistently behind the knee 
- Persistent Knee extensor moment 
- However you define it – what’s causing it?
Contributors to Crouch

- Weakness/excessive length:
  - Gluteals
  - Quadriceps
  - Plantarflexors
- Tight or spastic:
  - Hip flexors
  - Hamstrings
- Lever Arm dysfunction

How can we select candidates for Hamstrings lengthening surgery?

Determining Hamstrings tightness

- Increased Popliteal angle

Potential downside to lengthening hamstrings
The role of estimating muscle-tendon lengths and velocities of the hamstrings in the evaluation and treatment of crouch gait

Allison S. Arnold, *, Mary Q. Liu, Michael H. Schwartz, Sylvia Osipow, Scott L. Delb, **
*Department of Orthopedic Surgery, Loma Linda University, Loma Linda, CA 92354, USA
**Department of Orthopaedics, UC Irvine Medical Center, Orange, CA 92868, USA

-152 patients with CP
- muscular tendon lengths
- muscular tendon velocities
- hamstring surgeries
- Patients stratified:
  - 1/3: short and slow
  - 1/3: slow but not short
  - 1/3: appropriate length and velocity → increased anterior pelvic tilt

BEST OUTCOME FOR HAMSTRINGS LENGTHENING SURGERY: PRE-OP SHORT/ SLOW

-51 limbs, 32 patients all with Cerebral Palsy
- Underwent DFEO/PTA (without hamstrings surgery)
- Peak medial hamstrings length and velocity were calculated pre and post op
- 2 SD below the control mean were called short
- Findings:
  - Post operative peak hamstrings length improved from -2.2 (z score) to -0.76
  - Post operative peak hamstrings velocity improved from -3.1 to -1.5
  - 94% good or neutral results for length
  - 80% good or neutral results for velocity correction
  - Crouch improved without posterior pelvic tilt
Conclusion

• The hamstrings do not need to be lengthened concomitantly with DFEO/PTA

Does Patellar Position Change With Growth After Patellar Tendon Advancement In Children With Cerebral Palsy?
Claire F Beimesch, MD; Jean Stout, PT;MS Ranjit Varghese, MD; Mike Schwartz, PhD; Tom F Novacheck, MD

Purpose: What happens to patellar position with further growth?

• For patients who have PTA (with or without DFEO) prior to skeletal maturity,
  – Is patellar position stable with growth?
  – Does patella alta recur?
  – Is patellar baja progressive?