Rehabilitation Protocols After Single-Event Multilevel Surgery

Jean Stout, PT, MS
Katie Walt, PT, DPT

Center for Gait & Motion Analysis; Gillette Children’s Specialty Healthcare
St. Paul, MN USA
Rehabilitation Protocols After Single Event Surgery

Objectives

- Describe how lever-arm dysfunction impacts muscle function and ability to strengthen before surgery
- Discuss specific post-operative for bony & soft-tissue procedures after SEMLS
- Identify patients who may benefit from an inpatient rehabilitation episode of care
- Goal setting

Challenges for Walking and Therapy

Typical Ambulation

- How does movement occur?
  - The skeleton provides the levers required for movement
  - Muscles and ground reaction forces provide the required power
  - The joints serve as the hinges

\[ \text{Moment} = \text{Muscle Force} \times \text{Length of Skeletal Lever} \]

What is a “lever-arm” or “moment-arm”??

- It is one of the components of a moment
- Moment = Force \times \text{lever-arm}
- Lever-Arm is a “distance” from a point to a force
- Perpendicular to line of action of the force

When the direction/position of the force changes...

\[
\begin{align*}
M_1 &= F \times d_1 \\
M_2 &= F \times d_2 \\
M_3 &= F \times d_3
\end{align*}
\]

F constant
\[ d_1 > d_2 > d_3 \]
\[ M_1 > M_2 > M_3 \]
Rehabilitation Protocols After Single Event Surgery

What happens when a child has cerebral palsy?

Why is strengthening so hard?

- either inadequate force and/or “lever-arm dysfunction”
- neurological impairment with loss of strength, selective motor control, spasticity, balance problems, etc
- inability to stretch muscles through nl play
- Muscle contractures
- Abnormal skeletal forces
- Bone and joint deformity

Methods of Strengthening

The ability to produce a moment is what we understand as strength

The moment arm of a muscle varies with the position of the body and the bony geometry.

Flexible Lever-arm:

- Example -- Pes planovalgus
- The rubber crowbar

Malrotated lever-arm:

- Examples
  - External tibial torsion
  - Femoral anteversion
- Effect
  - Primary moment is reduced (knee extension moment)
  - Unwanted moments introduced
    - external rotation
    - valgus
Rehabilitation Protocols After Single Event Surgery

Effects of Femoral Anteversion

Arnold et al., 1997

Neutral Foot Progression

External Tibial Torsion & Foot Deformity (a malrotated lever)

Frequently, lever-arm dysfunction exists at several levels

- Knee is internally rotated to line of progression 2° to femoral anteversion
- External rotation of the foot 2° to tibial torsion &/or pes valgus
- The result is a severe reduction of the magnitude of the plantarflexion/knee extension couple and instability of the knee in stance.

Can We, as Therapists Change Lever Arm Dysfunction?

early time in development when the capital femoral physis grows rapidly (1st 2 yrs of life)
Physiologic derotation occurs and is nearly complete by 3 years of age (but depends on normal biomechanics).
Rehabilitation Protocols After Single Event Surgery

Consequences of femoral anteversion
... Effects on Biomechanics

- internal foot progression angle
- abnormal patellofemoral mechanics
- anterior pelvic tilt to maintain coverage of the femoral head
- hip abductor weakness

Role of Physical Therapy: Torsional Deformity

- Maintain Range of Motion in Young Children
- Important to Assess Routinely
- Limited Effect to Change Once Developed

Orthopaedists as Advocates Not Foes

Thank You!
jstout@gillettechildrens.com
Rehabilitation Following Single-Event Multi Level Surgery

Katie Walt, DPT
Gillette Children’s Specialty Healthcare
AACPDM 2013

Single-Event Multi-level Surgery

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

Function, gait, and strength do 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. 

Limited information available about post-SEMLS Rehab. 
- McGinley, JL, Et al (2012)

Outline

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

Pre-Operative PT Evaluation and Education

- Purpose:
  - Baseline Assessment
  - Patient/Caregiver Education
  - Goal Assessment

Pre-Operative PT Evaluation

- Baseline Assessment
  - GMFCS level
  - Functional Mobility Scale (FMS)
  - Pediatric Evaluation of Disability Inventory (PEDE)
  - Bed Mobility, Transfers, Ambulation, Stairs
  - Pain
  - Quick Screen of ROM, Strength, Tone, Selectivity, Cardiopulmonary

PT Pre-Operative Evaluation

From Baseline Assessment:

- Make recommendations for post-op equipment needs
- Make recommendations for inpatient Rehab @ 6 weeks post-op
- Make recommendations for pre-op consults/interventions (PT, OT, TherRec, Dietician)
Goal Assessment

Canadian Occupational Performance Measure (COPM)

- Self-Care
- Productivity
- Leisure

Clarification of Goals (Caregiver, Patient, Physician)

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

Postoperative 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

Common Procedures

**Boney Procedures**

- Proximal Femoral Derotation Osteotomy
- Tibial Osteotomy
- Calcaneal Osteotomy

**Soft Tissue Procedures**

- Psoas Lengthening
- Rectus Femoris Transfer
- Hamstring Lengthening
- Adductor Lengthening
- Gastrocnemius Lengthening

- Patellar Tendon Advancements
- 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

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)

- Rectus Femoris Transfers: Begin at 20-45° and work towards 0°-90° by 3 weeks.
- Patellar Tendon Advancements and Distal Femoral Extension Osteotomies: Begin at 0-30°, working towards 70° by 3 weeks.

CPM Protocols

- CPM begins 3 days post-op, then gradually increasing amount of motion every few days so that patient is at 70-90° (depending on procedures) 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

Physical Therapy Goals and Interventions: Three to Six Weeks

- Strengthening
  - Isolated exercise and transitional activities based upon selective motor control
  - Focus on proximal musculature for ambulation

Physical Therapy Goals and Interventions: Three to Six Weeks

- 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

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 has become more common.
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.
- May need temporary or permanent equipment changes to assist with progress (ie. 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+

Therapeutic Recreation
- Strength and Endurance

Psychology
- Coping, Anxiety, and Fear

Nursing
- Careplan and Pain Management

Occupational Therapy
- ADLs and UE Strengthening

Rehab Goals

- Goals for inpatient stay need to be identified.
- Goals that will make a difference when they return home (ie. 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

Passive and Active ROM

- PT BID
  - ROM and Strengthening
  - Mat Mobility
  - Standing/Transfers
  - Ambulation/Partial Weightbearing Gait Training
  - Pool
  - Adaptive Bike
Strengthening

Mat mobility and transfers

Standing with KIs

Progress to ambulation

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

Locomotor 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
Balance and Functional Activities

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 improved alignment (Restored Lever Arm), strengthening can be optimized
- Swimming, biking, horseback riding

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

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

9 Weeks Post-op
“Over the Ground” Gait Training

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

Remember to…
- Keep it challenging
- Increase speed
- Allow errors
- Provide feedback
- Maintain high repetitions

Physical Therapy Goals and Intervention: 8-12 weeks plus

- Orthoses
  - Solid ankle/Posterior Leaf Spring
  - Floor Reaction AFO
  - Supramalleolar Orthosis (SMO)
  - 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!
Kate Walt, DPT
Gillette Children's Specialty Healthcare
kwalt@gillettechildrens.com
# Proximal Femoral Derotational Osteotomy

## PHASE 1: Inpatient Surgical (0-5 days)
- **WB status/Transfers/Gait:** NonWBing
- **Dependent Lift or scooting transfer**
- **Dependent transfer for car transfer, pt may be able to assist with UE; may use EZ-on vest for car restraint**

<table>
<thead>
<tr>
<th>ROM</th>
<th>Braces</th>
<th>Functional Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>No passive hip abduction and adduction or internal or external rotation*</td>
<td>Knee immobilizers Possible SLC with derotation bar. Possible hip spica cast.</td>
<td>Prone 3x/day building up to 50% of the time spent in prone. Sponge bath for bathing. Reclined wheelchair. Toileting with bedside commode or bedpan.</td>
</tr>
<tr>
<td>Passive knee flexion &amp; extension, hip flexion to 90° plus as tolerated</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## PHASE 2: 0-3 weeks
- **WB status/Transfers/Gait:** NonWBing**
- **Dependent Lift or scooting transfer**
- **Dependent transfer for car transfer, pt may be able to assist with UE; may use EZ-on vest for car restraint**

<table>
<thead>
<tr>
<th>ROM</th>
<th>Braces</th>
<th>Functional Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>No passive hip abduction and adduction or internal or external rotation</td>
<td>Knee immobilizers Possible SLC with derotation bar. Possible hip spica cast.</td>
<td>Prone 3x/day building up to 50% of the time spent in prone. Sponge bath for bathing. Reclined wheelchair. Toileting with bedside commode or bedpan.</td>
</tr>
<tr>
<td>Passive knee flexion &amp; extension, hip flexion to 90° plus as tolerated</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## PHASE 3: 3-6 weeks
- **Begin WBAT Stand and Pivot Transfers with Assist standing with or w/o KI; progress to walking with a walker.**

<table>
<thead>
<tr>
<th>ROM</th>
<th>Braces</th>
<th>Functional Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ok to begin gentle active ROM</td>
<td>Wean off KIs during day (if no knee procedures)</td>
<td>Begin Mat Mobility activities including rolling, sit&lt;&gt;supine, bridging activities. Resume showering if casts removed &amp; incision healed. <strong>IF SPICA REMOVED:</strong> begin sitting in previous w/c or edge of mat as</td>
</tr>
</tbody>
</table>
## Proximal Femoral Derotational Osteotomy

<table>
<thead>
<tr>
<th>Timeframe</th>
<th>Activities</th>
<th>Range of Motion</th>
<th>Bracing</th>
<th>Additional Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>4. 6-12 weeks</strong></td>
<td><strong>Full WB</strong> Sit-to-Stand Transfers up/down stairs, walking with a walker and progressing to least restrictive assistive device.</td>
<td>Should have full active hip ROM</td>
<td>Continue to sleep with knee immobilizers and can do on one leg and alternate nights</td>
<td>Increase independent functional activity including mat mobility, toilet and car transfers. May begin cycling when there is available knee flexion. Increase independent functional activity including mat mobility, 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><strong>Full WB</strong></td>
<td>Should have full active hip ROM</td>
<td>No bracing</td>
<td>Return to running &amp; jumping (once X-ray confirmation) Gradual return to gym class &amp; sports (PT work to minimize compensatory movements)</td>
</tr>
<tr>
<td><strong>6. 6-12 months</strong></td>
<td><strong>Full WB</strong></td>
<td>Should have full active hip ROM</td>
<td>No bracing</td>
<td>Full return to all activities</td>
</tr>
</tbody>
</table>

* If pelvic osteotomy is also performed, follow pelvic osteotomy protocol.

**Idiopathic anteversion patients may be allowed to WB after 10 days for transfers if parents and child comfortable
Proximal Femoral Derotational Osteotomy

<table>
<thead>
<tr>
<th>Therapeutic Exercises</th>
<th>ACUTE Phase</th>
<th>SubAcute Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Begin Post-op day 3</td>
<td>0-3 weeks</td>
<td>3-6 weeks</td>
</tr>
<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>
<tr>
<td>Heel slides</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Supine hip and knee flexion</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Prone knee flexion</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Ankle pumps</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Quad sets</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Terminal Knee Extension</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Long Arc Knee Extension</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Straight Leg Raisers</td>
<td>Wean off Knee Immobilizer</td>
<td>X</td>
</tr>
<tr>
<td>Hip Abduction</td>
<td>Supine</td>
<td>Sidelying</td>
</tr>
<tr>
<td>Hip Flexion</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Prone Knee Flexion</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Prone Hip Extension</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Heel slides</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Kneeling</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>4 point (crawling)</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Bridging</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Closed Chain Knee Extension</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>-step ups, total gym,</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Cycling</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Proximal Femoral Derotational Osteotomy**

<table>
<thead>
<tr>
<th>3-6 months</th>
<th>6-12 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Return to all activities as able</td>
<td>Return to all activities as able</td>
</tr>
</tbody>
</table>

**Proximal Femoral Derotation Osteotomy**

**Rationale:** Correct abnormal twist in the femur (thigh bone) also known as excessive femoral anteversion. Excessive femoral anteversion causes inward rotation of the knees and intoeing.

**Description:** The bone of the femur is cut just below the hip socket. The bone is untwisted to a normal alignment. A metal plate and screws is then inserted to hold the bone in the proper alignment until bone healing is complete.
Surgical Procedure: Psoas Lengthening—[typical done with PFDO (then follow PFDO chart)]

<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 Surgical</strong></td>
<td><strong>0-5 days</strong></td>
<td><strong>Passive hip and knee flexion; passive hip extension</strong></td>
<td><strong>Knee immobilizers</strong></td>
<td><strong>Prone 3x/day building up to 50% of the time spent in prone.</strong></td>
</tr>
<tr>
<td></td>
<td>NonWBing</td>
<td>Passive hip and knee flexion; passive hip extension</td>
<td>Knee immobilizers</td>
<td>Prone 3x/day building up to 50% of the time spent in prone.</td>
</tr>
<tr>
<td></td>
<td>Dependent Lift or scooting transfer</td>
<td></td>
<td></td>
<td>Sponge bath for incisions</td>
</tr>
<tr>
<td><strong>2. 0-3 weeks</strong></td>
<td>NonWBing</td>
<td>Passive hip and knee flexion; passive hip extension</td>
<td>Knee immobilizers</td>
<td>Prone 3x/day building up to 50% of the time spent in prone.</td>
</tr>
<tr>
<td></td>
<td>Dependent Lift or scooting transfer</td>
<td></td>
<td></td>
<td>Sponge bath for incisions</td>
</tr>
<tr>
<td><strong>3. 3-6 weeks</strong></td>
<td>Begin WBAT Stand and Pivot Transfers with Assist standing with or w/o KI; progress to walking with a walker.</td>
<td>Active assist hip and knee flexion to progress to active; active assist hip extension to progress to active; SLR with KI</td>
<td>No Bracing</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 Sit-to-Stand Transfers up/down stairs, walking with a walker and progressing to least restrictive assistive device.</td>
<td>Active hip and knee flexion; SLR; active prone hip extension</td>
<td>No Bracing</td>
<td>Increase independent functional activity including mat mobility, toilet and car transfers. May begin cycling when there is available knee flexion.</td>
</tr>
<tr>
<td>5. 3-6 months</td>
<td>Full WB</td>
<td>Active hip and knee flexion; SLR; active prone hip extension</td>
<td>No restrictions</td>
<td>No restrictions</td>
</tr>
<tr>
<td>---------------</td>
<td>--------</td>
<td>---------------------------------------------------------------</td>
<td>----------------</td>
<td>----------------</td>
</tr>
<tr>
<td>6. 6-12 months</td>
<td>Full WB</td>
<td>No restrictions</td>
<td>No restrictions</td>
<td>No restrictions</td>
</tr>
</tbody>
</table>

**ACUTE Phase**

<table>
<thead>
<tr>
<th>Therapeutic Exercises</th>
<th>Begin Post-op day 3</th>
<th>0-3 weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passive Prone Hip Extension</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Heel slides</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Prone knee flexion</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Ankle pumps</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

**SubAcute Phase**

<table>
<thead>
<tr>
<th>3-6 weeks</th>
<th>6-12 weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hip Abduction</td>
<td>Supine</td>
</tr>
<tr>
<td>Hip Flexion</td>
<td>X</td>
</tr>
<tr>
<td>Prone Knee Flexion</td>
<td>X</td>
</tr>
<tr>
<td>Prone Hip Extension</td>
<td>X</td>
</tr>
<tr>
<td>Kneeling</td>
<td>X</td>
</tr>
<tr>
<td>Bridging</td>
<td>X</td>
</tr>
<tr>
<td>Cycling</td>
<td>X</td>
</tr>
</tbody>
</table>

**3-6 months**

Return to all activities as able

**6-12 months**

Return to all activities as able
**Psoas Lengthening**

**Rationale:** Contracture (abnormal shortening) of the psoas tendon or spasticity of the muscle prevents full extension of the hip. This results either in forward leaning or increased arching of the low back.

**Description:** Through an incision in front of the hip joint, the tendon is found within the muscle. The tendon is divided allowing it to elongate, but the muscle remains intact. Therefore, power generation and strength are preserved.
<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 Surgical (0-5 days)</strong></td>
<td>WBAT unless done with osteotomies that would require NWB. Dependent Lift, scooting, or stand/pivot depending on WBing status transfer; sponge bath; bed pan</td>
<td>Post-op day 3: *CPM 20-45° increasing to full knee extension over 1-2 days depending on spasms. CPM will be used a minimum of 30 min. 3x/day for each leg. Also instruct in passive prone knee flexion especially if no CPM is ordered.</td>
<td>Knee immobilizers 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>WBAT unless done with osteotomies that would require NWB. Dependent Lift, scooting, or stand/pivot depending on WBing status transfer; sponge bath; bed pan</td>
<td>*CPM: increase 10-15° every 5-7 days as tolerated with the goal of reaching 90 degrees by three weeks. Also instruct in passive prone knee flexion</td>
<td>Knee immobilizers 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 Stand and Pivot Transfers with Assist standing with or w/o KI; progress to walking with a walker and progressing to least restrictive assistive device.</td>
<td>Active (Assisted if needed) Prone knee flexion</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>4. 6-12 weeks</td>
<td>Full WB 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, PLS, or SMO as appropriate</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>---------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------</td>
<td>------------------------------------------------</td>
<td>------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>5. 3-6 months</td>
<td>Full WB</td>
<td>Full passive and active hip and knee ROM</td>
<td>Solid AFOs, PLS, or SMO as appropriate</td>
<td>Resume pre-operative functional activity for transfers, self-care, indoor mobility</td>
</tr>
<tr>
<td>6. 6-12 months</td>
<td>Full WB</td>
<td>Full passive and active hip and knee ROM</td>
<td>Solid AFOs, PLS, or SMO as appropriate</td>
<td>Resume pre-operative community ambulation, higher level balance and walking skills</td>
</tr>
</tbody>
</table>

*If Rectus Femoris is done in conjunction with Patellar Tendon Advancements, follow CPM protocol for Patellar Tendon Advancements.
# 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>x</td>
</tr>
<tr>
<td>Passive Prone Knee Flexion</td>
<td></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></td>
<td>x</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 Raisers</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>3-6 months</td>
<td>x</td>
</tr>
<tr>
<td>-step ups, total gym,</td>
<td>x</td>
<td>x</td>
<td>3-6 months</td>
<td>x</td>
</tr>
<tr>
<td>Lite Gait</td>
<td>x</td>
<td>x</td>
<td>3-6 months</td>
<td></td>
</tr>
<tr>
<td>Cycling</td>
<td>x</td>
<td>x</td>
<td>3-6 months</td>
<td></td>
</tr>
<tr>
<td>Core Strengthening</td>
<td>x</td>
<td>x</td>
<td>3-6 months</td>
<td></td>
</tr>
<tr>
<td>Balance Activities</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Higher Level Walking/Running</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Rectus Femoris Transfer**

**Rationale:** The rectus femoris (a small, but long muscle in the front of the thigh) can be spastic or contracted (shortened). This limits bending of the knee during swing and leads to a “stiff knee gait”. By transferring it from its insertion on the patella (knee cap) to one of the hamstring tendons, its abnormal activity will promote knee bending rather than restrict it.

**Description:** Through an incision just above the patella (knee cap), the tendon is detached from the patella. The muscle is then freed up in the lower thigh to allow it to pass more medially (inner side of the lower thigh) and secured typically to either the gracilis or the sartorius, whichever one is felt to be a suitable site for accepting the transfer.
# Tibial Derotation Osteotomy/Gastroc/Soleus Procedures

<table>
<thead>
<tr>
<th>PHASE</th>
<th>WB status/Transfers</th>
<th>ROM</th>
<th>Braces</th>
<th>Functional Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Inpatient Surgical</td>
<td>NWB</td>
<td>Hip and knee ROM</td>
<td>SLC</td>
<td>Rolling, bed mobility Stand pivot transfer if done unilaterally</td>
</tr>
<tr>
<td>(0-5 days)</td>
<td>Dependent sliding or scooting transfer, single leg transfer if done unilaterally</td>
<td>(active/passive)</td>
<td>With or without KIs</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. 0-3 weeks</td>
<td>NWB for 3-4 weeks</td>
<td>Hip and knee ROM</td>
<td>SLC</td>
<td>Rolling, bed mobility Stand pivot transfer if done unilaterally</td>
</tr>
<tr>
<td></td>
<td>Dependent sliding or</td>
<td>(active/passive)</td>
<td>With or without KIs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>scooting transfer, single leg transfer if done unilaterally</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. 3-6 weeks</td>
<td>WBAT in short leg casts</td>
<td>Hip and knee ROM</td>
<td>Short leg walking</td>
<td>Sit to stand, ambulation with assistive device, stairs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>active</td>
<td>cast, cast boot</td>
<td></td>
</tr>
<tr>
<td>4. 6-12 weeks</td>
<td>WBAT with or without AFOs</td>
<td>Active/passive ankle ROM, resistive ankle exercise, NMES</td>
<td>AFO</td>
<td>Longer distance ambulation, wean assistive device, swimming/pool therapy, biking</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(PLS, solid ankle or</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>dynamic AFO, floor reaction AFO</td>
<td></td>
</tr>
</tbody>
</table>
# Tibial Derotation Osteotomy/Gastroc/Soleus Procedures

## 5. 3-6 months
- **WBAT**
- Ongoing stretching
  - Periodic strengthening
- **AFO**
  - Aerobic exercise, running, jumping as allowed

## 6. 6-12 months
- **WBAT**
- Modify/wean AFO
  - Possible SMO or UCB
- Community ambulation, return to phy-ed, age appropriate gross motor activities

## 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>x</td>
</tr>
</tbody>
</table>

### SubAcute Phase

<table>
<thead>
<tr>
<th>Exercise</th>
<th>3-6 weeks</th>
<th>6-12 weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quad sets</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Terminal Knee Extension</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Long Arc Knee Extension</td>
<td>As knee flexion increases</td>
<td>x</td>
</tr>
<tr>
<td>Straight Leg Raisers</td>
<td>Wean off Knee Immobilizer</td>
<td>x</td>
</tr>
<tr>
<td>Hip Abduction</td>
<td>Supine</td>
<td>Sidelying</td>
</tr>
<tr>
<td>Hip Flexion</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Prone Knee Flexion</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Prone Hip Extension</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Bridging</td>
<td></td>
<td>x</td>
</tr>
</tbody>
</table>
### Tibial Derotation Osteotomy/Gastroc/Soleus Procedures

<table>
<thead>
<tr>
<th>Exercise/Activity</th>
<th>3-6 months</th>
<th>6-12 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Closed Chain Knee Extension</td>
<td>x</td>
<td>x-in AFOs</td>
</tr>
<tr>
<td>-step ups, total gym, Cycling</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>DF and PF ROM NonWBing DF and PF Strengthening</td>
<td>Can begin at 3 weeks if no casts</td>
<td>x</td>
</tr>
<tr>
<td><em>DF and PF ROM Can begin at 3 weeks if no casts</em></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td><em>NonWBing DF and PF Strengthening</em></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td><em>Balance/Proprioception activities</em></td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>* WBing Ankle Strengthening*</td>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>

#### Tibial Derotation Osteotomy

**Rationale:** The tibia is the shin bone. Tibial torsion (abnormal twist) can lead to intoeing or outoeing depending upon whether the abnormal twisting is inward or outward (either of which can occur). This deformity leads to malalignment between the foot and the knee. In addition to causing intoeing and outoeing, it diminishes the potential of the muscles to maintain upright body position and propulsive power.

**Description:** This surgery is performed through an incision on the front of the lower leg just above the ankle. The tibia is cut and the bone is turned to correct the abnormal twist. A metal plate and screws is inserted to maintain proper alignment until bone healing is complete.

#### Gastrocnemius Lengthening

**Rationale:** Overactivity or contracture (shortness) of the gastrocnemius (calf muscle) can lead to toe-walking, a lack of heelstrike, dragging of the toes, or back-kneeling.

**Description:** Through an incision in the mid-portion of the calf, the muscle and its tendon are isolated. The tendon is divided. The knee is extended and the ankle dorsiflexed (toes raised) and the tendon is reattached to the underlying muscle (soleus).