

# Rehabilitation Guidelines for children with a Congenital lower limb deficiency post Anterior Cruciate Ligament reconstruction using a Modified Macintosh Technique

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## Purpose

The purpose is to provide a guideline for the rehabilitation of children with congenital aplasia post anterior cruciate ligament (ACL) reconstruction.

## Intended Audience

The intended audience for these guidelines are Orthopaedic surgeons and Physiotherapists rehabilitating children with a lower limb deficiency post ACL reconstruction.

## Table of Contents

1. Introduction
2. Guideline Content
3. Recommended outcome measures
4. References

## 1. Introduction

### STATEMENT OF PROBLEM

Currently there are no known guidelines or protocols for the physiotherapeutic rehabilitation of children with congenital ACL aplasia post ACL reconstruction.

### SIGNIFICANCE OF GUIDELINE

These children currently do not have a specific rehabilitation program to follow and any adult or adolescent based guideline will not be suitable. This is only a guideline and should be used in conjunction with individual clinical reasoning. Stage progression within the guidelines must be considered based on milestones and the timelines are suggestive only and significant variance will be seen in this patient group.

As an institution, Sheffield Children's Hospital (SCH) is a centre of excellence for the treatment and management of children with congenital limb deficiencies. Due to the paucity in evidence-based practice the current document proposes to establish physiotherapeutic guidelines to treat these patients post ACL reconstruction. The team at SCH will be on hand throughout the rehabilitation process to offer advice and support. These children will be seen in a Consultant clinic by a surgeon and therapist regularly and any pertinent information will be disseminated appropriately.

At SCH, children with ACL aplasia are having reconstruction as definitive management of their ligament absence. This type of surgery is relatively novel, and little is known about how successful reconstruction is at restoring function and stability of the knee over time.

Inclusion Criteria	Exclusion Criteria
Unilateral Proximal femoral focal deficiency (PFFD) ACL reconstruction	Traumatic ACL reconstruction
Unilateral fibular hemimelia ACL reconstruction	ACL repairs
Unilateral Congenital ACL aplasia with good contralateral limb function	All non-congenital ACL reconstructions
	Complex bilateral congenital limb deficiency having ACL reconstruction

### Additional Considerations with rehabilitating children with limb deficiency

- A preoperative period of rehabilitation is advised.
- Set clear goals that are patient centred before surgery.
- Long term bracing is advocated post rehabilitation for two years after ACL reconstruction to protect the knee when child is active.
- All physiotherapy should be supervised by an experienced paediatric physiotherapist
- Home exercise programs (HEP) are advocated but should be regularly reviewed by the physiotherapists and an appropriate adult should be educated on how to monitor movement patterns at home to avoid poor limb positioning.

Rehabilitation Guidelines for children with a Congenital lower limb deficiency post Anterior Cruciate Ligament reconstruction using a Modified Macintosh Technique

- Children with a limb deficiency may have altered anatomy of the hip and ankle/foot complex. This must be considered at all times during rehabilitation and exercises adapted to accommodate for this.
- Remember that you are aiming to get the best results for that limb try to avoid comparing to the unaffected contralateral limb.

## 2. Guideline Content

### Stage one (Protection) – Acute postoperative rehabilitation

**This phase is to protect the initial healing of the graft.**

#### Goals

1. Pain management – appropriate analgesia required including anti-spasmodic medicines as indicated
2. Oedema management with elevation
3. Full extension to be maintained
4. Mobilising Partial Weight Bearing with aid
5. Good static quads activation – can control knee extension in stance phase
6. Patient education

#### Bracing

- Brace to be kept locked out in extension.
- Brace to be worn at all times including sleep and bathing.

#### Exercises

- Patella mobilisations
- Full extension to be maintained – passive stretches applicable
- Prone lying to be encourage/prone knee hangs
- Knee flexion not to commence until 2 weeks post operation

#### Strength

- Static quads
- Static glute
- Active hip abduction
- Active ankle range of movement

#### Weight bearing and mobility

- Partial Weight Bearing requiring a walking aid. Crutches or walking frame.
- Brace must always be worn when mobilising and focus on quads activation in stance phase.
- The child should be encouraged to wear their shoe raise at all times when they are walking.

#### Therapeutic Adjuncts

- Oedema Management- Cryocuff used as inpatient and Taylor made cold pack to be provided on discharge.
- Electrical muscle stimulations (EMS) can be used for sluggish/ineffective quads.
- If patient has a splint patient must wear this under knee brace when walking and for periods of rest in the day to maintain ankle position.
- Continuous passive movement (CPM) is discussed in the literature however is unlikely to be helpful in the prepubescent child. Focus should be on maintaining extension over commencing passive flexion is early rehabilitation.

**Muscular control 2-6 weeks****Children should be reviewed weekly at this point of their rehabilitation****Goals**

1. Oedema management to continue as indicated
2. Full extension to be maintained
3. Gait re-education
4. Progress strengthening and start early proprioceptive skills
5. Promote knee flexion towards full range of motion
6. Good patella mobility

**Bracing**

- Brace to be worn at all times including sleep and bathing.
- Brace can be unlocked 0-90 when mobilising to work on normal gait pattern

**Exercises**

- Balance exercises
- Commence closed chain knee flexion exercises active and active assisted (open chain should not be commenced before week 4)
- Patella mobilisation
- Start proprioceptive work. Mirror work patient concentrating of where the leg is in space and completing exercises through a good movement pattern. This will need support from a paediatric physiotherapist.
- Monitor Home Exercise Program and quality of movement. Correct where needed.

**Strength**

- Closed chain strengthening only at the knee
- Mini wall squats
- Step ups
- Hamstring pulls
- Core strengthening
- Progress gluteal strengthening - bridging, clam shells, hip abduction in crook lying. These exercises will be dependent on knee flexion.

**Weight Bearing**

- Continue with Partial weight bearing with a walking aid until patient has full quads control in stance phase.
- A walking aid should be used for at least the first 4 weeks.
- Gait re-education with close supervision from physiotherapist to monitor movement patterns and quadriceps activity.

**Therapeutic Adjuncts**

- Cryotherapy – No specific evidence on the benefits of cryotherapy with this group after 1 week.
- Generalised uses of cryotherapy include pain relief and oedema management so should be considered on a case to case basis.
- EMS should be considered alongside conventional exercise therapy in early rehabilitation if quadriceps activation is not responding.
- CPM – CPM is not well supported in the literature. This adjunct should be used only if other methods of encouraging knee flexion are unsuccessful.

**To progress to Phase Two patient must meet the following criteria:**

1. Full knee range extension and 120 degrees of knee flexion. Please be aware of patients preoperative knee range of motion as this may vary from anatomically predicted range of motion (ROM).
2. Little or no knee effusion
3. Must be able to maintain knee in full extension during single leg stance.

**Stage two****Proprioception 6-12 weeks****Goals**

1. Develop good muscle control and early proprioceptive skills
2. Full extension to be maintained
3. Mobilising Full Weight Bearing as tolerated, wean walking aid if still in use.
4. Promote knee flexion towards full range of motion
5. Improve endurance capacity of muscles

**Bracing**

- Brace to be worn at all times including sleep and bathing.
- Brace can be unlocked fully when mobilising
- Brace can be removed during physiotherapy session as long as patient is closely supervised by an experienced therapist

**Exercises**

- Range of movement exercises
- Hydrotherapy if available
- Stretching program
- Begin jogging in straight line
- Start static bike

**Strength**

- Gluteal strengthening
- Core strengthening
- Progress quads and hamstring strengthening through range

**Weight Bearing**

- Full weight bearing
- Patient should have a good gait pattern at this point. Take into consideration that hip and ankle anatomy may alter normal position. For example the foot may be fixed in a splint or the hip externally rotated. It is important to note these things preoperatively. Exercises must be adapted to accommodate this.

**To progress to phase three the patient must meet the following criteria:**

1. Full knee range of motion
2. Adequate movement pattern through squat, jump and landing
3. Able to jog or cycle on static bike for 5 minutes with no subsequent knee effusion
4. Can balance appropriately on the affected limb in a static position to move on to more dynamic activities.

## **Stage Three**

### **Neuromuscular and sport specific 3-5 months**

#### **Goals**

1. Incorporate more dynamic activities into therapy session that look at agility and reaction time
2. Full extension to be maintained throughout
3. Progress strengthening throughout limb
4. Develop confidence

#### **Bracing**

- Brace to be worn at all times including sleep and bathing.
- Brace can be unlocked fully when mobilising
- Brace can be removed to do supervised home exercise program (only if patient has good control and movement patterns) and during supervised physiotherapy sessions.

#### **Exercises**

- Commence straight line shuttle runs, use a ball for dribbling, jogging in and out of cones as able.
- Skipping if able
- Hopping and jumping activities focussing on a good landing technique
- Incorporate lateral movement activities
- Dynamic
- Can commence swimming
- Consider using a scooter in therapy for dynamic balance
- Stretching program

#### **Strength**

- Mini squats
- Wall squats
- Set ups and down with different size steps
- Core strengthening – bridging, dead bugs, blanks.
- Gluteal strengthening – clam shells, four point kneel hip extension, sideways squat walking.

#### **To progress to phase four the patient must meet the following criteria:**

1. Confident in knee function (use patient reported outcome measure (PROM) to indicate patient readiness)
2. Mentally ready to return to activity (Advocate PROM use)

## **Stage Four**

### **Prepare for return to activity 6-12 months**

#### **Goals**

1. Can return to Physical Education with restrictions on high risk activities
2. Consider if using a bike or scooter is appropriate to improve confidence and function in limb.

#### **Bracing**

- Brace to be worn for all dynamic activity and school. This should continue for two years post-surgery.
- Brace can be unlocked fully when mobilising.
- Brace can be removed when patient is at rest at home, to complete supervised home exercise program and during physiotherapy appointments.
- It does not need to be worn over night.

#### **Exercises**

- Stretching program
- Exercises should include a warm up
- Plyometrics
- Agility

#### **Strength**

- Progressive strengthening, based on ability

#### **Return to activity criteria**

Recommendations for return to activity/sport should be dependent on the patient's perceived readiness for activity and a battery of outcome measures.

The battery of outcome measures should test strength, dynamic movement ability and quality of movement.

Rehabilitation Guidelines for children with a Congenital lower limb deficiency post Anterior Cruciate Ligament reconstruction using a Modified Macintosh Technique

### 3. Recommended battery of outcome measures

ICF Domain	Outcome measure	Data Provided	Return to activity criteria
<b>Structure and function</b>	ROM (goniometry)  Strength (Oxford Scale)  Ligament Laxity (Lachman's Test)  Gait Lab – analysis of limb position, biomechanics of limb compared to contralateral limb	<ul style="list-style-type: none"> <li>Data on limb health compared with itself throughout the process and to the contralateral limb.</li> <li>Indicate ability to progress rehab based on strength and ROM in the early stages post-surgery.</li> </ul>	Full ROM No quads lag. Patient able to hold terminal extension with resistance Minimum of 12 months post operation
<b>Activity</b>	Pedi – International knee documentation committee (IKDC) Gait analysis	<ul style="list-style-type: none"> <li>PROM based on patient's perception of their own ability to complete a given activity.</li> <li>Indication of readiness to progress even if structure and function measures meet criteria for progression.</li> <li>Gait analysis provides objective data on changes in gait pattern, efficiency.</li> </ul>	Able to complete patient specific dynamic activity Repeated hop Repeated jumps Controlled balance on one leg with dynamic movement (eg. throwing and catching) Appropriate Pedi-IKDC score indicative of confidence in ability (90% is given as a aim in literature)
<b>Participation</b>	PEDS-QL Pedi-IKDC	<ul style="list-style-type: none"> <li>Patient reported quality of life (QOL) measure and patient perception of ability to participate</li> <li>Essential information for progression and return to high level activities/sport school to avoid reinjury.</li> </ul>	Appropriate Pedi-IKDC and PEDS-QL score indicative of confidence in ability (90% is given as an aim in literature)



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## Rehabilitation Guidelines for children with a Congenital lower limb deficiency post Anterior Cruciate Ligament reconstruction using a Modified Macintosh Technique

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