King's College Hospital NHS
NHS Foundation Trust

Guidance for the Physiotherapy Management of Patients Undergoing Limb Reconstruction with a Circular Frame External Fixator.

Table of Contents

Introduction

This guidance is for use for patients undergoing complex limb reconstruction treatment involving the application of a circular frame external fixator more commonly referred to as an Ilizarov frame or Taylor Spatial Frame (TSF). It is normally indicated for patients who have the following injuries/conditions:

- Complex fractures - comminuted/open/peri-articular, often with associated loss of bone and soft tissue.
- Acute fracture stabilisation without deformity correction
- Fracture non-union
- Fracture mal-union
- Limb length discrepancy (congenital or acquired)
- Charcot foot
- Soft tissue contractures
- Osteomyelitis
- Paediatric growth deformities e.g. Blount's Disease

Target Audience

This guidance is to be used by in-patient and out-patient Physiotherapists treating patients who have a circular frame external fixator in situ.

Key changes from previous guideline

The general content remains the same, however the previous guideline has been updated to reflect changes in current practice concentrating on tibial and femoral circular frame external fixators.

Derogation from NICE Guidance or Royal Marsden Manual

No NICE guidance available.

Key Priorities for Implementation

To standardise post-operative management of patients undergoing limb reconstruction treatment with a circular frame external fixator.

Identification

Rehabilitation.

Treatment and Management

Limb Reconstruction is a lengthy and difficult process for patients to experience. It is ESSENTIAL that Physiotherapy supports and rehabilitates patients throughout their external fixator wearing period, and remains ongoing following external fixator removal. Improvements in muscle strength,

power, function and ability to complete timed functional tests such as sit-to-stand and climbing stairs have been reported up to 2 years post external fixator removal (Barker et al, 2010).

The majority of patients have external fixators applied to the lower limb(s) to stabilise fractures or treat bony deformities. In deformity correction, the external fixator is attached to the bone, with circular ring(s) above and below the deformity/fracture. Correction then occurs either at the site of the acute fracture or at an osteotomy site made at the point of bony deformity. The external fixator is then adjusted daily by the patient over a period of time to restore alignment. The patient follows a specific external fixator adjustment prescription, with movement occurring at the bony gap (fracture/osteotomy site).

If the external fixator is applied to stabilise a fracture (where bony alignment is acceptable), then there may not be an adjustment phase. The external fixator in this instance is there to stabilise the fracture to allow healing to occur.

Bone lengthening can also be performed using the external fixator. An osteotomy is performed and the external fixator is slowly lengthened under tension to form new bone or tissue. This process is known as distraction histiogenesis.

Stages of Limb Reconstruction

Throughout the limb reconstruction process patients are monitored radiologically and clinically by their Consultant, Clinical Nurse Specialist and Limb Reconstruction Physiotherapist.

The limb reconstruction process can be split into five stages:

1: Pre-operative:
Where possible every patient will undergo physical, medical and psychological assessment and screening.

2: Post-operative latency period:
The latency period refers to the length of time (usually seven to ten days) following application of the external fixator. During this time, the healing process starts (callus formation) and no adjustments are made to the external fixator. Patients should be introduced to range of movement exercises for all joints particularly the ones above and below the external fixator at this stage, and should focus on completing them as part of their daily routine.

3: The correction period
Where indicated, the external fixator is adjusted (usually by the patient or carer) a small amount daily. Constant tension is applied to the area of newly forming, soft callus. The new bone that forms is called the regenerate and is only visible on x-ray once it has sufficiently calcified; this can be several weeks/months after the correction period has ended. The tension applied will also stimulate new tissue formation; this is known as distraction histiogenesis. It is during this correction phase, as bone and soft tissue becomes stretched that the patient becomes most vulnerable to losing range of movement and becoming stiff. It is imperative that patients are closely monitored during this period and may require additional physiotherapy input to help them maintain their range of movement and reduce the risk of contractures developing. Patients are provided with a full contact resting splint to maintain ankle plantigrade when sleeping/resting and should use this splint whilst their external fixator is in situ.

4: The consolidation period
Once the correction is complete, the external fixator is locked and left in situ whilst the new regenerate bone consolidates. The length of time patients remain in the external fixator varies, depending on the type and extent of limb reconstruction being done. During the consolidation period, patients are often allowed to progress towards full weight bearing mobilisation. This will be guided by the Consultant following clinical review.

Weight-bearing for lower extremity applications is essential for the proper maturation and ossification of either a fracture callus or a lengthening distraction gap (Green, 1990).

A low impact, gym based exercise routine that avoids a patient twisting on the affected limb can be considered during this phase to increase the patient's movement, fitness and strength where appropriate.

5: External fixator removal and ongoing rehabilitation
Prior to its removal, the external fixator is unlocked (dynamised).This involves loosening the external fixator struts to allow normal weight bearing through the regenerate bone. Once adequate consolidation has taken place the external fixator is removed. Patients are advised to use crutches at this time and a cast or a walking splint may be applied to protect the regenerate and allow it to consolidate further. Patients should avoid twisting on the operated limb in a weight bearing position at this stage so as not to torsion (and potentially bend or fracture through) the regenerate bone. After further review they will then have the cast or splint removed and should be allowed to increase weight bearing and activity as per their Consultant's advice.

The Role of Physiotherapy during Limb Reconstruction

Physiotherapy is vital throughout all the stages of limb reconstruction. The post-operative physiotherapy should start from Day 1 and continue until phase 5 rehabilitation is complete and the patient has reached their optimum physical and functional potential. Every limb reconstruction case is different so each patient requires an individualised treatment approach.

The aims of physiotherapy for limb reconstruction patients are to improve movement, function and reduce pain. A prophylactic approach should also be considered to prevent musculoskeletal complications arising.

Restrictions to Rehabilitation

Each patient should be assessed and treated according to general principles of rehabilitation and incorporating any post-operative restrictions. Rehabilitation should be aimed at maximising function, considering the physiological principles of healing so as not to compromise the surgery or outcome.

There are no absolute restrictions to rehabilitation for limb reconstruction patients. Weight bearing status varies and is patient specific.

Common Complications and Therapy Considerations

An awareness of possible complications will enable the Physiotherapist to treat prophylactically and in a timely manner; liaising with the limb reconstruction team should a complication arise.

Loss of muscle length and the development of contractures
Loss of joint movement due to poor adaptation of the muscle is a major problem during limb lengthening (Barker et al, 2001). This particularly affects bi-articular muscles, those of greater size and strength, and those that have wires/pins through them (Paley, 1990).

Commonly observed contracture patterns:

Tibial External fixator	Knee flexion, ankle plantarflexion, toe clawing
Femoral External fixator	Hip flexion, hip adduction, knee flexion

Other complications include:

- Oedema
- Joint stiffness and decreased ROM
- Poor gait pattern (poor stance phase hip extension and adduction)
- Poor ankle/foot posture
- Poor weight transference
- Decreased proprioception
- Loss of muscle strength
- Neurovascular compromise
- Poor posture
- Loss of cardiovascular fitness
- General deconditioning
- Pain (Neurogenic / Myogenic / Osteogenic / Autonomic)
- Psychological problems
- Poor motivation/compliance
- Pin site/skin graft/wound infection
- Joint subluxation and dislocation
- Loss of wire tension/hardware failure
- Premature/delayed consolidation
- Fracture/deformity of regenerate bone

Additional therapy considerations:

- Hydrotherapy
- Education of colleagues, friends and family
- Referral to other services (e.g. OT, orthotics)
- Midline orientation
- Provision of equipment / splints
- Smoking cessation support

- Advice on community exercise schemes and classes (e.g. local gym, walking groups)

For external fixators on the upper limb the above complications and therapy considerations also apply; please contact the Limb Reconstruction Physiotherapist for further guidance.

Discharge from Out Patient Physiotherapy

Once the external fixator is removed, emphasis should be placed on functional rehabilitation with well-defined goals. It is also important to continue to address any specific problems/complications related to muscle length and strength, joint range of movement, posture, swelling, gait, cardiovascular fitness and endurance to optimise outcome and maximise normal function. The patient will be guided by their Consultant as to when it is appropriate to return to work/specific activities.

If you are unsure of the limb reconstruction process that your patient is undergoing and would like to discuss their Physiotherapy intervention, or have any concerns about progress please contact the Senior Physiotherapist in Limb Reconstruction who will be happy to discuss and advise as needed.

Indications & Contra-indications

These guidelines should be used by Physiotherapists for those patients undergoing limb reconstruction treatment with a circular frame external fixator.

Monitoring & Clinical Audit

These guidelines are included in the induction document for new team members.
Use of this guidance is documented in post-operative clinical notes.
Copy of this guidance is sent with all referrals for ongoing Physiotherapy (outpatients).
Guidance document reviewed and amended as indicated very 2 years.

Patient Information

This guideline has been updated in association with the patient information leaflet; 'Patient information for patients undergoing limb reconstruction treatment', which was approved for use at the Physiotherapy Clinical Governance Panel meeting (27th January 2015).

References

Barker K.L, Simpson H.R, Lamb S.E (2001) *Loss of knee range of motion in leg lengthening*. Journal of Orthopaedic Sports Physical Therapy. Vol:31(5) pp 238-244

Barker K.L, Lamb S.E, Simpson H.R, (2010). *Recovery of muscle strength and power after limb-lengthening surgery.* Archives of Physical Medicine and Rehabilitation. Vol:91(3) pp384-388

Green S.A. (1990), *Physiotherapy during Ilizarov fixation.* Techniques in Orthopaedics, Vol:5(4) pp61-65

Paley D. (1990) *Problems, obstacles, and complications of limb lengthening by the Ilizarov technique.* Clinical Orthopedics Vol. 250: pp81-104,

Contact Details

Suzanne Swaine
Senior Physiotherapist in Limb Reconstruction and Orthopaedics
Tel: 020 3299 9000 extension 35664. Pager 737* KH3527.
Email: suzanne.swaine@nhs.net

Debbie Bond
Clinical Nurse Specialist, Limb Reconstruction
Tel: 020 3299 9000 extension 33186. Pager 737* KH887418
Email: deborah.bond@nhs.net

Mr Graeme Groom MA FRCS
Consultant Orthopaedic Surgeon
Email: elaine.havens@nhs.net 020 3299 3104

Mr Om Lahoti MS (Orth) FRCS (Orth)
Consultant Orthopaedic Surgeon
Email: elaine.havens@nhs.net 020 3299 3104 (adult patients)
Email: renuka.malhotra@nhs.net 020 3299 3070 (paediatric patients)

Miss Sarah Phillips TD BSc FRCS (Orth)
Consultant Orthopaedic Surgeon
Email: renuka.malhotra@nhs.net 020 3299 3070