The Physiotherapy Management of Patients Following Trochleoplasty: Rehabilitation Protocol and Case Report

T Smith, C Wheeler, K McCabe, S Donell

Citation

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Abstract

The objective of this retrospective single case-report was to present the rehabilitation of a patient following a modified Dejour trochleoplasty for patella dysplasia. The in- and out-patient rehabilitation of a twenty four year old female with a twelve year history of right patella instability was described. This programme includes the application of a continuous passive motion machine and exercise-based treatments. Knee range of movement was measured using a long-arm goniometer, and patient-reported functional capabilities were documented. Three months following this programme, the patient subjectively reported increased strength and confidence in her knee compared to pre-operatively, with no complaints of instability. The patient had full knee extension, with 130° flexion, and had good quadriceps control. This was maintained at her fourteen month review. Further study is required to prospectively assess the outcomes of a larger number of patients, to evaluate their treatments during rehabilitation, using validated and reliable outcome measures.

INTRODUCTION

Patella instability can occur when the patella fails to track fully in the femoral sulcus (or trochlea) during knee movement.[1,2] It can cause recurrent patella subluxation or dislocation.[3] Patella instability may occur as a result of weakened or torn medial tissues such as the medial patellofemoral ligament; tight lateral soft tissues such as the lateral retinaculum, vastus lateralis or the iliotibial band; or patella alta (which is most commonly due to either the patella tendon being abnormally long, or due to patella dysplasia).[4,5] In the case of patella dysplasia, the femoral sulcus is absent, as the trochlea is shallow or dome-shaped.[1] This is a rare condition, with approximately fifteen per cent of patients referred to a specialist patella clinic for surgical intervention, presenting with patella dysplasia.[1,5]

Presently, the surgical intervention to treat patella dysplasia is a trochleoplasty.[6] The objective of this procedure is to make a groove, or 'surgically-formed' femoral sulcus, for the patella to move in, providing stability.

Following a review of the literature, there appeared no detailed description of the rehabilitation of patients following a trochleoplasty. The purpose of this paper was therefore to present a physiotherapy protocol for the rehabilitation of such patients. The treatment and outcomes of a trochleoplasty patient managed in our department was then described to illustrate this protocol. This particular patient was selected as she was one of the earliest trochleoplasty patients managed in our department, allowing us to assess treatment progression and outcomes over a fourteen month period.

The protocol for the physiotherapy management of trochleoplasty patients is presented in Table 1, whilst Table 2 illustrates the treatment goals following this procedure.

THE PATIENT

The patient was a twenty-four year old office worker who had suffered recurrent patellar dislocations from the age of twelve. This had worsened over the past few years pre-operatively. She increasingly felt that her knee would "come out of joint". The patient was functionally very limited, and everyday activities such as walking on flat ground or running, caused feelings of instability. She was unable to tolerate any higher-level sporting activity.

The patient was initially treated conservatively with physiotherapy. Although she made slow improvements, her apprehension and functional limitations remained. Accordingly, she was referred to a specialist orthopaedic knee surgeon who, after x-rays, a CT scan and physical examination, reported that the patient had a type III trochlear dysplasia, poor quadriceps contraction, patellofemoral joint

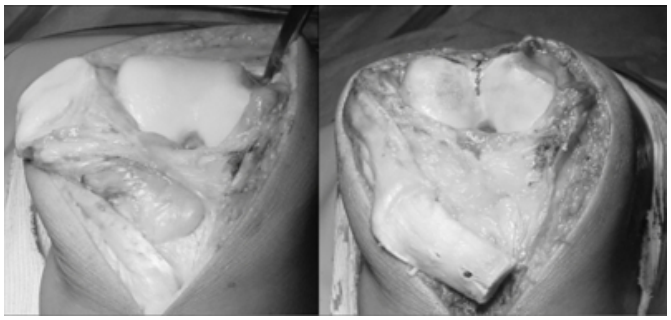
crepitus, apprehension to lateral gliding of the patella and abnormal patella tracking. The surgeon recommended a trochleoplasty, with medialisation of the tibial tuberosity and a lateral release.

SURGICAL INTERVENTION

A modified Dejour trochleoplasty, described by Donell et al,[1] was performed. Using this technique, a mid-line incision was made and a medial para-patellar approach everting the patella laterally. This exposed the distal femur. A trench of subchondral bone was removed from underneath the dysplastic trochlea creating a thick osteochondral flap with a diamond shape. A new groove was fashioned by dividing this into two triangular flaps and pushing them downwards. These were then anchored down using countersunk screws into the distal femur. Any exposed cancellous bone was then covered with bone wax. Figure 1 illustrates the trochlea before and after this procedure.

Figure 1

Figure 1: The femoral trochlea pre- and post-operatively.



To address the patient's abnormal patella tracking, the tibial tubercle was transposed medially twelve millimetres and fixed with a cortical screw (Elmslie procedure). A lateral release with double-breasted medial reefing was also performed to address the proximal realignment.

The post-operative notes permitted the immediate application of a continuous passive motion (CPM) machine, full weight-bearing, and, once quadriceps control had been regained, the Raymed splint could be replaced with a Donjoy brace (Donjoy, Vista, California, USA) fixed at zero to ninety degrees until the tibial tubercle had fused.

IN-PATIENT PHYSIOTHERAPY

After returning from theatre the patients reported that although her right knee was painful, she was not nauseous. An epidural analgesia was in situ, and the patient was wearing a cricket pad knee extension splint. This was removed and a CPM machine was applied. The objectives of CPM are to increase joint range of movement, decrease pain, reduce oedema, and to help prevent excess scar formation and capsular contractions.[7,8] In this instance CPM was employed to increase knee range of movement by as much as the patient could tolerate, as has previously been used after knee surgery.[7] The CPM was left on throughout the night. The patient was instructed on how to increase and decrease her knee range of movement using this machine. She reached twenty degrees knee flexion and could fully extend her knee when assessed that afternoon, using a standard goniometer as described by Norkin and White.[9]

The following day, pain and nausea were subjectively re-assessed. The patient was instructed on how to begin walking using a rollator walking frame. The CPM machine was reapplied and the range of movement was increased to forty degrees. The patient was encouraged to increase knee flexion to the maximum she could tolerate. Both her range of movement and the distance she was able to walk was limited by pain. When reviewed later that day, the patient had increased her knee range of movement to ninety degrees flexion.

On the second post-operative day, although her knee was still painful, the patient had maintained ninety degrees knee flexion on the CPM machine. She was taught how to mobilise independently with crutches using a reciprocal gait pattern and full weight-bearing. She could mobilise in excess of one hundred yards. The patient was also taught how to perform active knee flexion exercises, which she was instructed to continue as often as possible on discharge.

Outpatient physiotherapy was arranged for the sixth post-operative day, and the patient was discharged home.

OUT-PATIENT PHYSIOTHERAPY

On initial assessment, six days post-trochleoplasty, the patient presented with moderate knee effusion, bruising to the calf, and a moderate to severe ache. This discomfort meant that the patient had only been able to mobilise partial weight-bearing. Her passive range of knee movement was zero to ninety degrees when assessed using a long-arm goniometer. However, she had poor isometric quadriceps contraction, and was unable to straight leg raise.

The patient was initially seen on an outpatient basis on four occasions over four weeks. Initial outpatient treatment included advice regarding self-management of pain and

swelling, including the application of ice, and instructed on a home exercise programme. This included quadriceps strengthening exercises, active assisted and active knee flexion activities, toe-heel raises and lunges. These were aimed to restore active and passive range of motion, regain good quadriceps contraction and control, and encourage early weight-bearing.[10] In addition, exercises targeting the whole lower limb included strengthening exercises for hip abductors and external rotators, to improve the general stability and muscle balance of the patient's right leg.[11,12] To avoid undue loading of the patellofemoral joint and to encourage functional movement, there was a bias to closed-chain activities.[13]

At the fourth treatment session the subject reported that she was progressing well, with reduced discomfort and improved quadriceps control. She had one hundred degrees knee flexion, full passive extension, but a ten-degree extension lag when attempting to straight leg raise. At this time she was transferred to our Gym Rehabilitation class.

She attended the gym class on five occasions over five weeks. Activities in the gym included exercise bike, inner range quadriceps exercises, mini-squats, toe-heel raises, hamstring bench pulls, sit to stand activities, step-up/down and proprioceptive exercises on wobble boards and the trampette. She continued with her home exercises on non-gym days.

OUTCOME

Following this programme three months post-operatively, the patient subjectively reported that her knee felt much stronger, with no complaint of instability on walking or running, and increased confidence in the use of her knee, returning to her normal home and work activities. On examination, she presented with good inner range quadriceps contraction, no extension lag on straight leg raise, 130 degrees of knee flexion with some patellofemoral crepitus, and normal patella tracking. These outcomes were maintained when she was reviewed fourteen months post-operatively.

DISCUSSION

This paper has described the physiotherapy management of a patient with severe trochlea dysplasia who underwent a trochleoplasty and correction of abnormal patella tracking. Over a three month period, the patient made a good recovery, with the resolution of her patella instability, the principle indicator for a trochleoplasty.[14] This favourable result in stability mirrors that of Verdonk et al[6] and Donell et al's[1] series of thirteen and fifteen trochleoplasty procedures respectively.

Due to the nature of single case-reports, only one specific treatment regime was described. As with all rehabilitation programmes, the patient's treatment should be tailored to their individual needs and goals.[15] In this specific case, the patient was not particularly sports orientated. Accordingly, the higher-level sports rehabilitation detailed in the rehabilitation protocol (Table 1) was not pursued. However, trochleoplasty patients can return to sporting activities such as football.[1] For patients who had pre-operatively participated in sports, or who could realistically return to such activities, an analysis of the types of movements required to partake in such activities, would need to be assessed, to inform their rehabilitation.

Figure 2

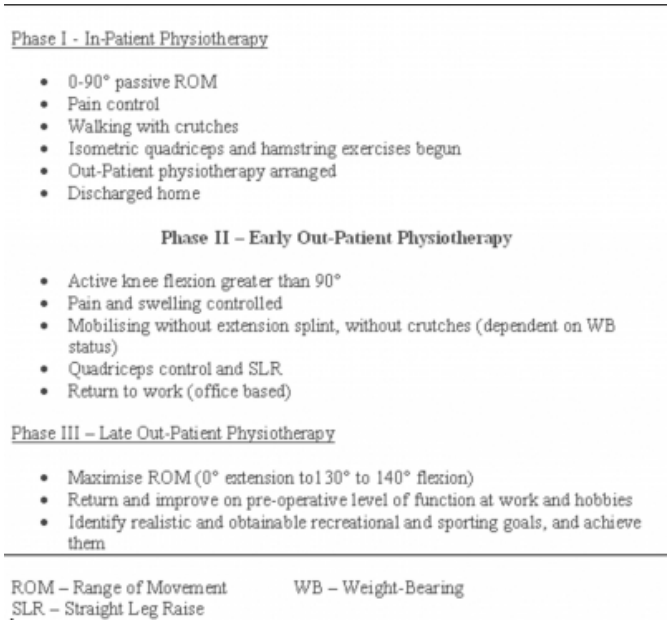
Table 1: Rehabilitation Protocol Following Trochleoplasty

Phase I - In-Patient Physiotherapy		
Day 0	ROM	CPM applied immediately after returning from theatre for 24 hours knee flexion. Set flexion to as much as the patient can tolerate. (ROM may be limited to 0-90° flexion if tibial tuberosity is distalised)
	Exercises	Active ankle dorsiflexion and plantarflexion instructed.
Day 1	ROM	CPM continued. ROM increased as pain allows.
	Strength	Isometric quadriceps and inner range quadriceps exercises taught.
	Cryotherapy	Ice applied intermittently if knee is grossly swollen.
	Gait	Taught FWB mobilisation with rollator frame. Heel-toe gait pattern encouraged. An extension splint is applied for walking until the patient can straight leg raise. Patient may be PWB if tibial tuberosity is distalised.
	Out-Patient	Arrange follow-up out-patient physiotherapy to begin Day 4-6.
Day 2-3	ROM	CPM continued until patient can achieve 90-120° flexion.
		Active, active assisted and passive knee flexion instructed using a sliding board/sheet.
	Strength	Review quadriceps exercises and encourage their continuation. Teach isometric hamstring heel-dig exercises.
	Gait	Progress from rollator frame to 2 crutches FWB or PWB as permitted. Reciprocal gait pattern encouraged. Step and stairs practice with elbow crutches for safe discharge.
	Out-Patient	Confirm out-patient physiotherapy appointment to commence Day 4-6.
Phase II - Early Out-Patient Physiotherapy		
Day 4-6 weeks	Assessment	Full objective and subjective musculoskeletal assessment, particularly assessing quadriceps function, soft tissue length and range of movement.
	ROM	Review active, active assisted and passive knee flexion exercises. Teach wall-slide and lunge exercises. Commence low resistance static bike exercises and hamstring, quadriceps, gastrocnemius and soleus stretches as indicated. If the patient does not achieve 90° flexion by 6 weeks, then may require arthrolysis.
	Strength	Review isometric hamstring and quadriceps exercises. Teach straight-leg raises; active and resisted hip extension and abduction; mini-dips; step-up/down exercises.
	Gait	Standing weight-transference activities. Heel-toe gait pattern encouraged. Increase gait distance and endurance. Progress from 2 crutches to one crutch to no crutches as weight-bearing allows. Improve confidence and fear avoidance of further patella dislocations.
	Cryotherapy	Ice for swelling as indicated.
	Manual therapy	Patellofemoral accessory mobilisations (medial and lateral glides, anteroposterior and posteroanterior as indicated) Grade as indicated.
	Proprioception	Wobble board and mini-tramp activities – two legged, eyes open/closed; and ball catching activities.
	Scar massage	Patient self-management of operative scar massage to decrease hypertrophic scarring and sensitivity if present.
Phase III – Late Out-Patient Physiotherapy		
Weeks 6 - Discharge	ROM	Continue active knee flexion; double-leg wall squats; full lunges; static bike activities; knee dip exercises and stretches as indicated.
	Strength	Increase static bike resistance. Stair walker and stepping activities, increasing speed and repetitions, with and without rucksack. Leg press. Resisted SLR and hamstring exercise-band exercises. Plyometric activities – two leg, one leg, jumping, hopping, triple jump. Mini-tramp – walking, running, jumping whilst throwing and catching; Prone knee hangs with and without weight and hamstring curls. Standing heel raises - double to single leg support. Hydrotherapy for resisted lower limb activities and assisted knee flexion if indicated.
	Gait	Acceleration/deceleration shuttle test. Quick walk to jogging to running. Interval training. Walking and running on varied surfaces, uphill, downhill and slopes. Change of direction activities.
	Sport Related Rehab	Individualised to patients but may include more: - plyometrics with and without ball/racket/bat as indicated. Drills such as jogging, running, spiriting, cone and slalom activities. Cutting, twisting and turning activities recreating sporting scenarios. Specific sporting activities such as rugby scrumaging, football tackling, tennis serving, cricket bowling, working on endurance, technique, and speed as required. Fear avoidance with respect to apprehension of patella dislocation during recreational and sporting activities.
	Proprioception	Progression on wobble board with eyes open/closed; double or single leg balance; throwing and catching balls. Mini-tramp single leg stabilisations with same exercises as on the wobble board, but whilst jumping and dipping.

CPM – Continuous Passive Motion ROM – Range of Movement FWB Full Weight-Bearing
PWB – Partial Weight-Bearing SLR – Straight Leg Raise

Figure 3

Table 2: Table to illustrate the rehabilitation goals following a trochleoplasty



Phase I - In-Patient Physiotherapy

- 0-90° passive ROM
- Pain control
- Walking with crutches
- Isometric quadriceps and hamstring exercises begun
- Out-Patient physiotherapy arranged
- Discharged home

Phase II – Early Out-Patient Physiotherapy

- Active knee flexion greater than 90°
- Pain and swelling controlled
- Mobilising without extension splint, without crutches (dependent on WB status)
- Quadriceps control and SLR
- Return to work (office based)

Phase III – Late Out-Patient Physiotherapy

- Maximise ROM (0° extension to 130° to 140° flexion)
- Return and improve on pre-operative level of function at work and hobbies
- Identify realistic and obtainable recreational and sporting goals, and achieve them

ROM – Range of Movement WB – Weight-Bearing
SLR – Straight Leg Raise

The major complication acknowledged with this procedure has been arthrofibrosis.[1,6] By combining epidural analgesia and CPM over the first three days, this complication may be reduced.[1] It must be stressed that this procedure is very painful, and adequate management of the patient's pain is imperative to allow them to regain the range of movement required to prevent arthrofibrosis. For these reasons, the CPM machine was applied rather than simple active and passive exercise, to provide continuous movement.

An important part of the rehabilitation of this patient group is to address the psychological impact that recurrent dislocation may have. Patients may not have ‘trusted' their knee for many years, avoiding certain tasks such as squatting or twisting. Therefore, it has been important to practice these previously more challenging activities, to re-educate the patient, and to allow them to feel capable of undertaking normal home, work and recreational activities.

This paper presented a number of limitations. The report retrospectively detailed a rehabilitation programme. Accordingly, it was not possible to determine important factors such as pre-operative level of function, or to detect changes in quality of life, pain or other symptoms over time; a considerable limitation to this paper. To address this weakness, future prospective study designs are required to fully assess the outcomes of this proposed physiotherapy programme. Although the case-report provided a framework to present a rehabilitation protocol after trochleoplasty, it only assessed outcomes using range of movement and patient's reported functional capabilities. For future evaluation, the use of a functional knee outcome measure such as the Cincinnati Knee Rating System[16] or the Larsen-Lauridsen score as used in Verdonk et al's[6] study may provide additional information on which aspects of knee function improve as trochleoplasty patient's progress through their rehabilitation. Finally, pre-operative outcomes were assessed by the patient's orthopaedic surgeon, whilst these were recorded post-operatively by her physiotherapist. This introduced issues of inter-tester reliability to the paper, which could be prevented when designing a future prospective study.

This case report presented a patient who, in addition to a trochleoplasy, underwent a lateral release, medial reefing, and a tibial tubercle transfer. This latter procedure limited the extent to which flexion, and quadriceps exercises were permitted during the first six weeks. In the absence of this procedure, flexion would have been unlimited and encouraged to maximise as pain allowed, following the programme in Table 1.

Quadriceps weakness may also be a major problem for these patients. In most patients with severe trochlear dysplasia there is also a quadriceps dysplasia. In particular, the vastus medialis obliquus is absent. The patient in this case study had very poor quadriceps pre-operatively, which may have impacted upon her post-operative rehabilitation. Poor post-operative quadriceps function has featured in a number of these cases treated in our department. Further study investigating whether intensive pre-operative physiotherapy can improve the post-operative rehabilitation of these patients may be indicated.

CONCLUSIONS

This paper has detailed the rehabilitation of a patient who underwent a modified Dejour trochleoplasty, in our department. The primary goal during the early stages of rehabilitation was to maximise range of movement with adequate analgesia. This is stressed to prevent arthrofibrosis, a major complication following this procedure. After this period, functional, exercise-based rehabilitation was undertaken to rehabilitate both the patient's lower limb, and re-educate the patient on their ‘newly-found' patella stability, to allow a return to full activity, without patella apprehension. Further research detailing the outcomes of larger scale, longer follow-up period studies, using

functional knee scoring systems, is suggested to assess the results during rehabilitation of trochleoplasty patients.

Ethical Approval: Signed consent was obtained from the patient presented in this case study.

CORRESPONDENCE TO

Mr T O Smith Physiotherapy Department - Out-Patients East Norfolk and Norwich University Hospital Colney Lane Norwich Norfolk, NR4 7UY Tele: 01603 286990 Fax Number: 01603 287369 Email Address: toby.smith@nnuh.nhs.uk

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Author Information

Toby O. Smith, BSc. (Hons) MCSP
Senior Musculoskeletal Physiotherapist, Physiotherapy Department, Norfolk and Norwich University Hospital NHS Trust Orthopaedic Physiotherapy Research Unit, Norfolk and Norwich University Hospital

Chris Wheeler, Grad. Dip. Phys. MCSP MMACP
Senior Musculoskeletal Physiotherapist, Norfolk and Norwich University Hospital NHS Trust Physiotherapy Department, Norfolk and Norwich University Hospital

Kate McCabe, BSc. (Hons) MCSP
Senior Orthopaedic Physiotherapist, Physiotherapy Department, Norfolk and Norwich University Hospital NHS Trust Orthopaedic Physiotherapy Research Unit, Norfolk and Norwich University Hospital

Simon T. Donell, BSc MBBS FRCS (ORTH) MD
Consultant Orthopaedic Surgeon, Norfolk and Norwich University Hospital NHS Trust Institute of Orthopaedics, Norfolk and Norwich University Hospital