

Supplementary File 1: Targeted Physiotherapist-led treatment therapist handbook

The physiotherapy for Femoroacetabular Impingement Rehabilitation Study (physioFIRST): A participant and assessor-blinded randomised controlled trial of physiotherapy for hip impingement.

The Lion group refers to the progressive, semi-standardised rehabilitation program for patients with femoroacetabular impingement (FAI).

The treatment program lasts for 6 months and has two phases. Phase 1 refers to months 0-3; Phase 2 refers to month 4-6 of treatment. Both phases target six key components of treatment. The six components of the rehabilitation program were selected based on current knowledge of the highest level of evidence for physical impairments in FAI, and from the results of our recent pilot study.

The six key components targeted in this program include:

- 1. ROM (flexion)**
- 2. Hip muscle strength (Extension, Abduction, Adduction)**
- 3. Trunk strength/endurance**
- 4. Functional task performance (strength and plyometric)**
- 5. Cardiovascular training/load management**
- 6. Education**

The two phases of treatment are outlines below.

Phase 1 month 0-3

This phase consists of

- i. Fortnightly one-on-one consultations with the treating physiotherapist;
- ii. Weekly physiotherapist-supervised gym sessions (these can be one-on-one or small groups, as long as there is no cross-contamination between the lion and tiger groups, where patients from each group attend the gym at the same time. This is critical for patient-blinding and the integrity of the study design).
- iii. Twice-weekly unsupervised exercise at home or in gym, patients' preference.

Phase 2 month 4-6

This phase consists of

- i. Monthly one-on-one consultations with the treating physiotherapist
- ii. Three times weekly unsupervised gym visits.

Details of one-on-one physiotherapy consultations (6 in phase 1, 3 in phase 2), physiotherapy supervised gym visits (12 in phase 1) and unsupervised gym visits (3 times week in phase 2) are detailed below.

One-on-one physiotherapy visits

These visits should last 30 minutes each. During these visits, the following should be completed

1. Flexion range of motion measured and recorded using inclinometer
2. Abduction and Adduction strength measured and recorded using hand-held dynamometer
3. Manual therapy as appropriate targeted to impairments in range of motion, and pain management. Details of therapy selection and progression outlined in Table 1 below.
4. Review of exercise program and progression of program as appropriate, for each of the targeted elements (hip adductor, abductor, extensor strength, trunk strength, functional strength and plyometric). **Note: each patient should always be doing one exercise from each targeted element.** See Tables 2-7 for details below. Progression to the next level will be determined by successful completion of the previous level, while maintaining VAS <20mm and Borg perceived exertion ≤ 5 (moderate).
5. Review of cardiovascular fitness program as appropriate. See Table 8 for details below. Progression to the next level will be determined by successful completion of the previous level, while maintaining VAS <20mm and Borg perceived exertion ≤ 5 (moderate).
6. Tailored education based on patient preference, three patient-focussed goals, and other topics raised by patient during treatment. Answers to common questions outlined below in Table 9.

Note: prior to the initial physiotherapy visit, the project investigator (Joanne Kemp) will contact the treating physiotherapist and provide them with details to access the exercise app, the 3 patient-focussed goals, and ensure patient appointments are booked into the system.

Physiotherapy-supervised gym visits

These visits should last 30-60 minutes, depending on clinic and patient preference. These can be one-on-one or small group, as long as no cross-contamination occurs where patients from each of the two treatment groups attend at the same time. During these visits, the following should be completed

1. Completion of all current exercises in hip strength (adduction, abduction, extension), trunk strength and functional strength exercises, including full sets and reps.
2. Checking patient recording of exercises from that session (and unsupervised sessions) in exercise diary or exercise app
3. Progression of exercises for each of the targeted elements where appropriate
4. Continuation of tailored education program

Unsupervised gym program


Each patient will be given a gym membership for phase 2 of the program, and will be asked to

1. Attend the gym 3 times per week
2. Record each session in exercise diary or exercise app
3. Report any issues with program to the treating physiotherapist during one of the monthly one-on-one visits. Patients will also be able to contact the project investigator (Joanne Kemp) during this time with any questions about the program.

Table 1: Manual therapy overview

Target for treatment	Assessment method	Technique	Aim	Description	Dosage
Overactive secondary stabilisers	Palpation, pain, reduced ROM	Soft tissue massage and trigger point release of iliopsoas, adductor group, gluteus minimus, gluteus medius, piriformis, tensor fascia latae, erector spinae	Address soft tissue restrictions with the aim of reducing pain and increasing hip joint range of movement	Sustained digital pressure to each trigger point with the muscle positioned on stretch Massage longitudinally along the muscle belly	30-60 seconds digital pressure per trigger point 2-5 minutes of massage per muscle
Lumbar dysfunction	Pain, palpation, ROM	Mobilisation of lumbar spine	To improve lumbar spine mobility and restore normal lumbo-pelvic movement	Unilateral postero-anterior accessory glides, Grade III or IV	3-5 sets of 30-60 seconds
Capsular tightness	Palpation of femoral head glide in squat	Manual traction if ligamentum teres is intact or ligated and patient is >3 months post labral repair	Increase hip flexion and/or IR/ER range of motion	Seatbelt around patient's proximal femur and therapist's hips. Gentle inferior and/or lateral traction force applied. May include patient actively moving hip into flexion as traction is applied	3 sets of 10 seconds. If tolerated increase by 1 set per treatment session to a maximum of 6 sets in total
Bony limitations	Hard end feel in ROM tests	None	Treat with respect	None	N/A
Hip muscle weakness	Hand held dynamometry	See section 2	See section 2	See section 2	See section 2

Table 2: Hip extension strength program

Extension			
Phase	Exercise	Description	Dosage
1		Bridging Gluteal squeeze and lift up into bridge hold and lower	3x10 reps 5 sec hold Weight = 10RM (10kg max)










2		Single leg Bridging Gluteal squeeze and lift up into bridge position, extend one leg, hold, extend other leg, hold, lower	3x10 reps 5 sec holds Weight = 10RM (10kg max)
3		Prone Hold Hip Extension - knees From knees move affected leg into hip extension, hold and lower leg, Cuff weight on ankle	3x10 reps 5 sec hold Weight = 10RM (5kg max)
4		Prone Hold Hip Extension - toes From toes move affected leg into hip extension, hold and lower leg, cuff weight on ankle	3x10 reps 5 sec hold Weight = 10RM (5kg max)
5		Standing single leg arabesque, weight in opposite hand	3x10 reps 5 sec ecc, 5 sec conc Weight = 10RM (10kg max)
6		Standing single leg arabesque, weight in opposite hand	3x20 reps 5 sec ecc, 5 sec conc Weight = 20RM (10kg max)

Table 3: Hip abduction strength program

Abduction			
Phase	Exercise	Description	Dosage
1		Bridging with band Bridge with band around knees, gently abduct against light band.	1x20 reps 5kg on pelvis 5 sec hold Band = 20RM
2		Bridging with band Bridge with band around knees, gently abduct against light band.	3x10 reps 5 kg on pelvis 5 sec hold Band = 10RM
3		Bridging with band Bridge with band around knees, gently abduct against heavy band.	3x10 reps 10 kg on pelvis 5 sec hold Band = 10 RM
4		Bridge with band, leg extension Start: lift up with two feet on ground, extend one leg then the other then lower with both feet on ground.	3x10 reps 5kg on pelvis 5 sec hold Band = 10RM




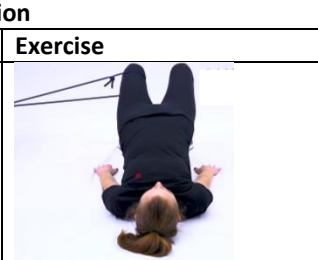





5		Bridge with band, leg extension Start: lift up with two feet on ground, extend one leg then the other then lower with both legs on ground.	3x10 reps 10kg on pelvis 5 sec hold Band = 10RM
6		Standing abduction with band or pulley, abduction to 30-45°	3x10 reps 3 sec conc 3 sec ecc Band/pulley = 10RM
7		Side lie abduction with band	3x10 reps 3 sec conc 3 sec ecc Band = 10RM

Table 4: Hip adduction strength program

Adduction			
Phase	Exercise	Description	Dosage
1		Bridge position, heavy band around thigh turning knee out. Pull knee to midline against band and maintain position throughout. Lift bottom, hold 3 secs and lower	1x30 reps 5 sec hold 5 kg on hips
2		Bridge position, heavy band around thigh turning knee out. Pull knee to midline against band and maintain position throughout. Lift bottom, hold 3 secs and lower	2x30 reps 5 sec hold 5 kg on hips
3		Side lie, affected leg down. Keep leg in neutral alignment, small lift, hold 3 secs and lower	2x8 reps 5 sec hold
4		Side lie, affected leg down. Keep leg in neutral alignment, small lift, hold 3 secs and lower	3x8 reps 5 sec hold
5		Side lie, affected leg down. Keep leg in neutral alignment, small lift, hold 3 secs and lower	3x10 reps 5 sec hold
6		Side lie, affected leg down. Keep leg in neutral alignment, small lift, hold 3 secs and lower	3x10 reps 5 sec hold Cuff weight = 10RM, 5kg max









7		Standing adduction with band or pulley	3x10 reps 3 sec conc 3 sec ecc Band/pulley = 10RM
8		Copenhagen adduction: unaffected leg on step, affected leg down, small lift hold 3 secs and lower	3x10 reps 5 sec hold
9		Copenhagen adduction: unaffected leg on step, affected leg down, small lift hold 3 secs and lower. Cuff weight on ankle	3x10reps 5 sec hold Cuff weight = 10RM

Table 5: Trunk strength and endurance program

Trunk muscle strength (both sides in all patients)			
Phase	Exercise	Description	Dosage
1		Side bridge knees	30 secs hold 5 reps each side
2		Side bridge knees with arm lifts, can add dumbbell in top hand	3x10 reps each side 5 secs conc, 5 secs ecc Weight = 10RM
3		Side bridge toes	30 secs hold 5 reps each side
4		Side bridge toes with arm lifts, can add dumbbell in top hand	3x10 reps each side 5 secs conc, 5 secs ecc Weight = 10RM
5		Side bridge toes with arm rotations, can add dumbbell in top hand	3x10 reps each side 5 secs conc, 5 secs ecc Weight = 10RM









6		Side plank with stability ball	30 secs hold 5 reps each side
7		Side plank with stability ball, with arm lifts. Can add dumbbell in top hand	3x10 reps each side 5 secs conc, 5 secs ecc Weight = 10RM

Table 6: Functional strengthening program

Functional task			
Phase	Exercise	Description	Dosage
1	Box/chair squats.	Flex at hips and squat to comfortable depth, tighten gluteal muscles to return to standing	3x10 reps 5 secs conc, 5 secs ecc
2	Box/chair squats with weight.	Flex at hips and squat to comfortable depth, tighten gluteal muscles to return to standing. Hold weight plate to chest	3x10 reps 5 secs conc, 5 secs ecc Weight = 10RM (10kg max)
3	Backwards lunges.	Step back and drop back knee towards ground, then stand up. Ensure good alignment	3x10 reps each side 5 secs conc, 5 secs ecc
4	Backwards lunges with weight.	Step back and drop back knee towards ground, then stand up. Ensure good alignment. Hold weight plate to chest	3x10 reps each side 5 secs conc, 5 secs ecc Weight = 10RM (10kg max)
5	Repeater Step Ups	Stand on step on one foot, good alignment. Bring other knee up to hip level in front, then back down to touch floor.	3x10 reps 5 secs conc, 5 secs ecc
6	Repeater Step Ups with weight	Stand on step on one foot, good alignment. Bring other knee up to hip level in front, then back down to touch floor. Hold weight plate to chest	3x10 reps 5 secs conc, 5 secs ecc Weight = 10RM (10kg max)
7	Single Leg Squats	Stand on affected side, squat down to touch box/chair ensuring good alignment. Tighten gluteals to return to standing	3x10 reps 5 secs conc, 5 secs ecc
8	Single Leg Squats with weight	Stand on affected side, squat down to touch box/chair ensuring good alignment. Tighten gluteals to return to standing. Hold weight plate to chest	3x10 reps 5 secs conc, 5 secs ecc Weight = 10RM (10kg max)

Table 7: Functional plyometric program

Functional task			
Phase	Exercise	Description	Dosage
1		Jump forwards as far as possible – double leg take-off and landing	20 reps
2		Jump forwards as far as possible – double leg take off, single leg landing	20 reps each leg
3		Jump up onto box/step double leg take-off and landing	20 reps
4		Jump down off box/step/bosu double leg take-off and landing	20 reps
5		Jump down off box/step/bosu double leg take off, single leg landing	20 reps each side
6		Single leg hop forwards	20 reps each leg

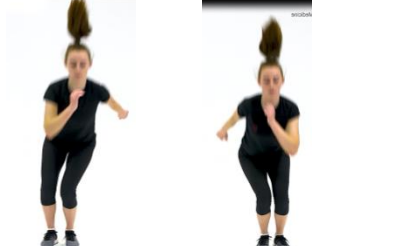

7		Multidirectional jump double leg	20 reps
8		Multidirectional hop single leg	20 reps each leg

Table 8: Cardiovascular fitness progressive program

Cardiovascular training			
Phase	Exercise	Description	Dosage
1	Level 1 patient choice	Cycling (stationary or road bike, no MTB); swimming (no breaststroke); other aquatic activity (water aerobics, water jogging no egg beater kick); walking (on flat terrain, no beach or bush walking); kayaking; rowing (if flexion ROM >100); elliptical cross trainer.	10 minutes every second day
2	Level 1 patient choice	Cycling (stationary or road bike, no MTB); swimming (no breaststroke); other aquatic activity (water aerobics, water jogging no egg beater kick); walking (on flat terrain, no beach or bush walking); kayaking; rowing (if flexion ROM >100); elliptical cross trainer.	20 minutes every second day
3	Level 1 patient choice	Cycling (stationary or road bike, no MTB); swimming (no breaststroke); other aquatic activity (water aerobics, water jogging no egg beater kick); walking (on flat terrain, no beach or bush walking); kayaking; rowing (if flexion ROM >100); elliptical cross trainer.	30 minutes every second day
4	Level 1 patient choice	Cycling (stationary or road bike, no MTB); swimming (no breaststroke); other aquatic activity (water aerobics, water jogging no egg beater kick); walking (on flat terrain, no beach or bush walking); kayaking; rowing (if flexion ROM >100); elliptical cross trainer.	30 minutes total, including 5x60 seconds high intensity every second day
5	Level 1 patient choice	Cycling (stationary or road bike, no MTB); swimming (no breaststroke); other aquatic	30 minutes including up to 10x60secs or 5x2 minutes

		activity (water aerobics, water jogging no egg beater kick); walking (on flat terrain, no beach or bush walking); kayaking; rowing (if flexion ROM >100); elliptical cross trainer.	high intensity every second day
6	Level 1 patient choice	Cycling (stationary or road bike, no MTB); swimming (no breaststroke); other aquatic activity (water aerobics, water jogging no egg beater kick); walking (on flat terrain, no beach or bush walking); kayaking; rowing (if flexion ROM >100); elliptical cross trainer.	45 minutes including up to 15 minutes total high intensity every second day
7	Level 2 patient choice	Dance, running, MTB, athletics, bush walking, netball, football (all codes), hockey, racquet sports	15 mins every second day (can be combined with 30 mins level 1 activity)
8	Level 2 patient choice	Dance, running, MTB, athletics, bush walking, netball, football (all codes), hockey, racquet sports	20 mins every second day (can be combined with 25 mins level 1 activity)
9	Level 2 patient choice	Dance, running, MTB, athletics, bush walking, netball, football (all codes), hockey, racquet sports	30 mins every second day (can be combined with 20 mins level 1 activity)
10	Level 2 patient choice	Dance, running, MTB, athletics, bush walking, netball, football (all codes), hockey, racquet sports	45 mins every second day, including 10 mins higher intensity (can be combined with 15 mins level 1 activity)
11	Level 2 patient choice	Dance, running, MTB, athletics, bush walking, netball, football (all codes), hockey, racquet sports	50 mins every second day, including 20 minutes high intensity (can be combined with 10 mins level 1 activity).
12	Level 2 patient choice	Dance, running, MTB, athletics, bush walking, netball, football (all codes), hockey, racquet sports	Up to 1 hour, 3 time/week, full load

Table 9. Key education components

1. Weight maintenance with recommended weight loss if BMI \geq 25. This may require referral to dietician or GP. Generally, evidence suggests that a 3kg weight loss can result in 25% reduction in symptoms in people with OA.
2. Patients' expectations of treatments. Hip pain due to FAI is not "curable" but can be well managed with appropriate treatment. Flares of pain are common and usually settle well with appropriate physiotherapy treatment. Small increases in pain (up to 3/10) can occur when starting or increasing exercises. This is nothing to be afraid of, and will settle as the body adapts to the new activity. It is of paramount importance to not completely rest, as this reduces this body's capacity to cope with normal day-to-day loads.
3. Patients' specific goals of treatment, based on baseline assessment. Important to discuss with patient whether these are appropriate, and then plan to most appropriately achieve these.

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4. Patients' expectations of returning to sport, and whether this is possible. This may require a modification of expectations. To date there is no evidence to indicate that running sports, and kicking sports are likely to lead to short-term and long-term problems in people with FAI, and in most patients, it is possible to return to these types of activity in a sensible and gradually progressive way.
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