Rehabilitation After Hip Femoroacetabular Impingement Arthroscopy

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More than 30,000 hip arthroscopies were performed in 2008. This number is expected to grow at a rate of 15% over the next 5 years, resulting in more than 70,000 hip arthroscopies performed each year by 2013. Hip arthroscopic techniques to repair labral tears and address femoroacetabular impingement (FAI) continue to evolve. Multiple published studies have reported positive surgical outcomes. Although there is evidence to support arthroscopic procedures to address labral tears and FAI, there are few published evidence-based rehabilitation studies dedicated to postoperative rehabilitative care.

Pain, loss of motion, changes in muscle strength and motor control, loss of stability, and loss of function can be caused by FAI and labral tear. Hip arthroscopic procedures are used to correct the bony geometry and provide an intact labral complex and ligamentous structure for improved hip congruency. A thorough postoperative rehabilitation program must protect the integrity of these healing tissues, control pain and inflammation, allow for early range of motion (ROM), reduce muscle inhibition, restore neuromuscular control and proprioception, normalize gait, and improve strength. For the athlete, power, speed, and agility are recommended for optimal return to competition. A positive outcome is not necessarily how quickly patients return to their preinjury level of function or sport but the overall longevity and patient satisfaction.

PRINCIPLES OF HIP ARTHROSCOPY REHABILITATION

The following are the key principles of rehabilitation after hip arthroscopy: (1) rehabilitation is an individualized and evaluation-based (not time-based) program designed...
to be able to address specific findings of the surgeon, the procedures performed, and the patient’s individual characteristics; (2) circumduction is critical for early mobility to provide an environment in and around the joint to reduce the risk of scar tissue; and (3) sport-specific functional rehabilitation should be provided.

Rehabilitation is considered individualized, with specific time lines for weight bearing and ROM restrictions determined by the specific procedures performed on the patient. Compliance with these restrictions by patients and therapists is critical to allow for soft tissue healing. Rehabilitation is done in phases and should be comprehensive, be easy to understand, and err on the side of safety. Exercise progressions used are similar in all patients during the early and mid phases. Specific objective criteria to advance are used to progress to the next phases. Such advancement allows for differences in a patient’s age, genetics, nutrition, concomitant injuries, symptom onset, goals, and sport-specific demands. The 4 phases of rehabilitation include maximum protection and mobility (phase 1), controlled stability (phase 2), strengthening (phase 3), and return to sport (phase 4) (Fig. 1).

**REHABILITATION PROTOCOLS**

Phase 1 of the rehabilitation program is shown in Table 1. Hip arthroscopy is a package of several to all procedures listed in Table 2. Patients who undergo a microfracture for the treatment of full-thickness chondral injuries are restricted to foot-flat weight bearing (FFWB, 9 kg) for 6 to 8 weeks. Patients who do not undergo a microfracture are restricted to FFWB for 3 weeks to decrease postoperative inflammation and reduce the risk of a stress fracture due to the osteoplasty. Patients are restricted to 50% weight bearing for another week to allow time for restoration of motor control. Hip extension past neutral is restricted for 21 days because it has been shown to increase anterior hip forces and place stress on the anterior labrum and capsule. ROM restrictions also include no external rotation (ER) for 17 to 21 days, depending on the viability of the tissue, capsular closure technique, and overall joint laxity; flexion up to 120°; and abduction up to 45°. A hip hinge brace assists in limiting extension and ER and is worn when ambulating for 17 to 21 days. Patients wear calf pumps while at rest as a preventative measure for blood clots.

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**Fig. 1.** The 4 phases of rehabilitation as shown in a motor control diagram.
Table 1
Phase 1 of rehabilitation program

<table>
<thead>
<tr>
<th>Phase 1: Maximum Protection and Mobility</th>
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<tbody>
<tr>
<td><strong>Goals</strong></td>
</tr>
<tr>
<td>1. Protect the integrity of the repaired tissues</td>
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<tr>
<td>2. Diminish pain and inflammation</td>
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<tr>
<td>3. Restore ROM within the restrictions</td>
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<tr>
<td>4. Prevent muscular inhibition</td>
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<table>
<thead>
<tr>
<th>Restrictions</th>
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<tbody>
<tr>
<td>See Table 2</td>
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<table>
<thead>
<tr>
<th>Treatment Strategies</th>
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<tbody>
<tr>
<td>1. CPM: 30°–70° placed in 10° abduction</td>
</tr>
<tr>
<td>4–6 h/d × 3 d, then 1–2 h/d × 2 wk (non-Mfx patients)</td>
</tr>
<tr>
<td>4–6 h/d × 6–8 wk (Mfx patients)</td>
</tr>
<tr>
<td>2. Ice and compression: as needed in phase 1</td>
</tr>
<tr>
<td>3. Nonresistant stationary bicycle: 20 min 1–2 times/d × 6 wk</td>
</tr>
<tr>
<td>4. Circumduction (passive ROM): 2 times/d × 2 wk, then daily through 10 wk</td>
</tr>
<tr>
<td>5. Laying prone for a minimum of 2 h/d: phases 1 and 2</td>
</tr>
<tr>
<td>6. Lymphatic massage/soft tissue: as needed in phases 1 and 2</td>
</tr>
<tr>
<td>7. Pain-free gentle muscle stretching</td>
</tr>
<tr>
<td>8. Isometrics</td>
</tr>
<tr>
<td>9. Active ROM: emphasis on gluteus medius and deep rotators</td>
</tr>
<tr>
<td>10. Aquatic pool program</td>
</tr>
<tr>
<td>11. Cardiovascular and upper body exercises (see Table 5)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Minimum Criteria To Advance</th>
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</thead>
<tbody>
<tr>
<td>1. Minimal complaints of pain with all phase 1 exercises</td>
</tr>
<tr>
<td>2. Proper muscle firing pattern with all phase 1 exercises</td>
</tr>
<tr>
<td>3. Minimal complaints of “pinching” sensation in the hip before 100° of flexion</td>
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<tr>
<td>4. Full weight bearing is allowed and tolerated</td>
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</table>

Abbreviations: CPM, continuous passive motion; Mfx, microfracture.

Table 2
Restrictions and precautions per surgical procedures performed

<table>
<thead>
<tr>
<th>Procedure</th>
<th>PROM</th>
<th>WB</th>
<th>CPM</th>
<th>Brace</th>
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</thead>
<tbody>
<tr>
<td>Osteoplasty Rim Trimming</td>
<td>No limits</td>
<td>FFWB × 21 d then 50% × 1 wk</td>
<td>4–6 h/d × 3 d then 1–2 h/d × 2 wk</td>
<td>21 d</td>
</tr>
<tr>
<td>Chondroplasty</td>
<td>No limits</td>
<td>WBAT</td>
<td>4–6 h/d × 3 d then 1–2 h/d × 2 wk</td>
<td>No</td>
</tr>
<tr>
<td>Microfracture</td>
<td>No limits</td>
<td>FFWB × 6–8 wk</td>
<td>4–6 h/d × 6–8 wk</td>
<td>No</td>
</tr>
<tr>
<td>Labral Repair</td>
<td>Flexion up to 120°, abduction up to 45°, No external rotation × 17–21 d, Ext to 0 × 1 wk but no ext &gt; 0 x 17–21 d</td>
<td>—</td>
<td>4–6 h/d × 3 d then 1–2 h/d × 2 wk</td>
<td>17–21 d</td>
</tr>
<tr>
<td>Capsule Plication and Capsule Closure</td>
<td>Flexion up to 120°, abduction up to 45°, No external rotation for 17–21 d, Ext to 0 × 1 wk but no ext &gt; 0 x 17–21 d</td>
<td>—</td>
<td>4–6 h/d × 3 d then 1–2 h/d × 2 wk</td>
<td>17–21 d</td>
</tr>
</tbody>
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Abbreviations: CPM, continuous passive motion; FFWB, foot-flat weight bearing; PROM, passive range of motion; WB, weight bearing; WBAT, weight bearing as tolerated.
POSTOPERATIVE THERAPY MODALITIES

Pain and inflammation is decreased with ice, compression, and lymphatic massage. As the initial swelling decreases, other soft tissue techniques are used, including effleurage, petrissage, myofascial release, and active release techniques. Emphasis is placed on the tensor fasciae latae (TFL), gluteus medius, iliotibial band, adductors, iliopsoas, and lumbar spine.

Mobility within the ROM restrictions is achieved with the continuous passive motion machine, stationary bike, aquatic therapy, and passive ROM, with emphasis on circumduction (Fig. 2). Patients are instructed to lay prone for a minimum of 2 h/d to keep the hip flexors from shortening.

MUSCULATURE RESTORATION

Restoration of normal muscle performance is critical to reestablish dynamic hip joint congruency after surgery. Correct motor function is achieved through careful selection of exercises for muscular strength (capacity to actively develop tension), work (force × distance), power (rate of work output), or endurance (ability to delay onset of fatigue).\(^{18}\) Isometric (static), isotonic (eccentric or concentric), slow- and fast-speed dynamic, and functional exercises are used depending on the phase of rehabilitation and the goal of the exercise. Goals of these exercises can include preventing muscle inhibition, regaining neuromuscular control and proprioception, or increasing strength, power, and/or endurance. It is critical that the exercises selected are based not only on the muscles recruited and the amount of force they will produce but also on the fact that they can be performed while maintaining the surgical precautions and with consideration to the joint reaction forces that they may place on the joint.

Quadriceps, gluteus maximus, and transverse abdominis (TA) pain-free isometrics are initiated on day 1. Active prone hamstring curls are used to facilitate early motor control, active prone terminal knee extensions (Fig. 3) are used to facilitate glutes and quads to neutral hip extension, and active prone and hook-lying internal rotations (Fig. 4) are used to facilitate active rotation within safe ROM. Quad rocking facilitates patient-controlled hip flexion and can be used to facilitate spine mobility or stability. Stool rotations (Fig. 5) are used after week 3.

It has been shown that the gluteus medius muscle is a key stabilizer of the hip during gait.\(^ {19}\) Gluteus medius strength when compared with the maximum voluntary contraction from the smallest amount of force produced to the highest is achieved with supine abduction, non-weight-bearing standing abduction, side-lying abduction,

![Fig. 2. Circumduction. (A) Passive clockwise and counter-clockwise ROM at the hip at ~70 degrees flexion. (B) Passive clockwise and counter-clockwise ROM at the hip with the leg straight.](image-url)
weight-bearing opposite hip abduction, flexed hip weight bearing opposite hip abduction, and pelvic drop exercises, respectively.\textsuperscript{20} This progression to strengthen the gluteus medius is used with the exception of side-lying abduction, which should be avoided because of the increased acetabular joint forces.\textsuperscript{21} Standing abduction in internal rotation (Fig. 6) is emphasized throughout rehabilitation because it can be performed early to activate the gluteus medius within the ER restrictions and because of the low flexor activation with this exercise.

Gentle stretching of the iliopsoas is performed early by bringing the patient’s opposite knee to the chest in supine position. Gentle Thomas stretch can be used when tolerated after week 4 and kneeling stretch when the patient can tolerate weight bearing. Patient can gently stretch the quads and hamstrings when pain free. The piriformis can be stretched in side-lying position with support. Stretching of the adductors is not recommended to protect the surgical area; however, soft tissue work seems to reduce the patient’s complaint of tightness usually brought on by hypertonicity in this muscle group. Aquatic therapy is highly recommended throughout rehabilitation. Protection of the incisions is achieved with op-site waterproof dressings (Smith and Nephew, London, UK).

Daily circumduction is continued, whereas ER and extension are initiated by the physician’s orders. Active assisted FABER slides (Fig. 7) and active butterfly exercise (Fig. 8) allow the patient to control the amount of ER.

**REHABILITATION PROGRESSION**

Weaning off crutches depends on the patient’s tolerance to the gradual increase in weight bearing and demonstration of proper firing of the gluteal muscles without

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**Fig. 3.** Prone terminal knee extensions. (A) Start position. (B) Extend knee and hip to neutral with quad and glutes.

**Fig. 4.** Active reverse butterflies. (A) Start in hook-lying position with feet slightly wider than shoulder width apart and toes pointed inward. (B) Rotate thighs inward to touch knees and hold 5 seconds then bring knees outward.
Fig. 5. Stool rotations. (A) Knee flexed to 90 degrees placed on spinning stool and lightly weighted with hip in neutral. (B) Actively rotate hip inward controlling pelvis with core muscles then return to neutral. (C) When external rotation allowed, actively rotate hip outward.

Fig. 6. Standing abduction in internal rotations. (A) Start position with knee straight and toes pointed slightly inward. (B) Slowly bring your leg straight out to the side keeping toes slightly pointed inward and your pelvis level.

Fig. 7. FABER slides. (A) Start position with heel resting on hand which is resting on table and opposite hand behind knee. (B) Active assisted flexion, abduction, and external rotation supporting and assisting as needed.
a Trendelenburg gait (phase 2 as listed in Table 3). Progressive increases in weight bearing of 10% to 25% every 1 to 3 days or slower is recommended. Aquatic therapy may assist in the patient’s ability to wean off crutches. Restoring normal gait without using a standard or underwater treadmill is recommended because the authors think that a sheer stress is placed on the anterior aspect of the hip when ambulating on the moving tread of the treadmill.

![Fig. 8. Active butterflies. (A) Start position hook-lying with feet shoulder width apart. (B) Slowly allow knees to fall out and hold 5 seconds then return.](image)

<table>
<thead>
<tr>
<th>Table 3</th>
<th>Phase 2 of the rehabilitation program</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase 2: Controlled Stability</td>
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</table>
| Goals | 1. Normalize gait  
2. Restore full ROM  
3. Improve neuromuscular control, balance, proprioception  
4. Initiate functional exercises maintaining core and pelvic stability |
| Precautions | 1. Recommend no treadmill use  
2. Avoid hip flexor and adductor irritation  
3. Avoid joint irritation: too much volume, force, or not enough rest  
4. Avoid ballistic or aggressive stretching |
| Treatment Strategies | 1. Wean off crutches as per weight-bearing guidelines  
2. Gait training with emphasis on gluteal firing and core control  
3. Nonresistant stationary bicycle until a minimum of 6 wk  
4. Circumduction, prone lying, and soft tissue and muscle stretching as before  
5. Full passive ROM including ER and extension  
6. Active ROM, core stability, weight bearing, and movement preparation exercises  
7. Progress aquatic pool program  
8. Progress cardiovascular and upper body exercises (see Table 4)  
9. Initiate functional exercises in late phase 2 |
| Minimum Criteria to Advance | 1. Gait is pain free and normalized  
2. Full ROM with mild stiffness into ER  
3. No joint inflammation, muscular irritation, or pain  
4. Successfully initiated functional exercises without pain and good neuromuscular control |
MUSCULATURE BALANCE

Assessment of the entire lumbar-pelvic-hip complex and lower extremity kinetic chain helps to address muscle imbalances, sacroiliac joint, lumbar spine articular dysfunctions, and restrictions in the fascial planes. Treatments to facilitate normal mechanics of these functional units include manual mobilization and/or manipulations of the thoracic or lumbar spine, sacroiliac joint, and soft tissue work as previously described.22–25 Manual mobilization of the hip capsule is performed only as needed after week 6.

During this phase, improvement of neuromuscular control is critical using sensorimotor exercises for balance and proprioception. Endurance is emphasized while using weight-shifting exercises including reverse lunge static holds (Fig. 9) and double knee bends with weight shift. Standing abduction in internal rotation (SAIR) is performed bilaterally, and exercises emphasizing the gluteus maximus and medius, including prone hip extensions off the edge of tables, bridges, and clams, and manually resisted exercises are performed. Core exercises such as supine heel slides, supine marching, or standing knee to chest are used to facilitate the iliopsoas muscle. These exercises should be performed with proper firing of the TA in core neutral position while avoiding overfiring of the TFL. Emphasis is placed on correct muscle firing patterns while not allowing patients to work beyond their ability. A dynamic movement preparation group of exercises including toe touches, standing knee to chest (Fig. 10), standing knee to chest with rotation (Fig. 11), walk outs (Fig. 12), lateral lunges, and scorpions (Fig. 13) can be initiated. Pilates as an adjunct to rehabilitation is recommended versus yoga.
REHABILITATION: MIND AND BODY

Rehabilitation after hip arthroscopy can be a challenge for many patients who are otherwise very active individuals. The long period of inactivity after surgical procedures can be difficult on the athlete/patient both mentally and physically. There are many options available for athletes that concurrently address the rehabilitation of the hip while maintaining or minimizing the loss of fitness. These activities can be performed in compliance with all weight-bearing and ROM restrictions. Incorporating a philosophy of focusing not only on the surgically repaired hip and each phase individually (as seen in Fig. 14) but also on the athlete or patient as a whole (as seen in Fig. 15) keeps the athletes engaged mentally and physically and should allow for an easier transition to their respective sport when the injured hip is healed. Athletes can take pride in maintaining fitness or even improving on weaknesses that otherwise go unaddressed in their sport training (Table 4).

ADVANCING REHABILITATION BEYOND THE HIP

Cardiovascular fitness activities are generally started during phase 1 after postoperative day 7. Intensity and duration can be progressed throughout phase 1 and can continue into phase 2 of the hip rehabilitation program.

Upper extremity strengthening is efficiently, effectively, and safely performed during phase 1 using suspension-type training. This setup allows the patient to perform a multitude of exercises using body weight resistance rather than attempt to carry...
Fig. 11. Standing knee to chest with rotation.

Fig. 12. Walk out. (A) Start in standing then bend forward and touch the floor keeping the knees straight and walk the hands out. (B) Keeping the knees straight and hands in one spot while walking the feet up. (C) Walk hands out again.
dumbbells or other weights while on crutches. Minimal movement is required, and resistance can easily be altered with small changes in foot position. Bodyweight can be distributed as dictated by weight-bearing restrictions. Cord resistance exercises can be used in late phase 1, whereas sitting on a Swiss ball and/or kneeling for proprioceptive training as the patient is weaning off crutches (Fig. 16).

During the later stages of phase 2, nonmicrofracture patients may be cleared to begin running in the pool in chest-deep water progressing to waist-deep water. This exercise is done in preparation for the land running progression at the beginning of phase 3. Running is delayed as long as possible for patients who have undergone a microfracture, but pool running should be initiated several weeks in advance of land running if necessary for the running athlete. Skating athletes are allowed to return to the ice at this time. Cycling resistance can be added at week 6.

Phase 2 sees more mobility of the patient and allows a return to the athlete’s presurgery upper extremity strength regimen. Returning to the gymnasium to use dumbbells, barbells, and/or machines, athletes can achieve previous levels of upper body strength. Core conditioning can be advanced as well, with consideration to type and intensity of forces placed on the hip with particular attention to iliopsoas overuse.

The athletes are allowed to initiate their sport progressions during phase 3, provided they have restored a normal gait and established the necessary strength and stability around the hip joint. This initiation will allow athletes to load the entire system (heart, lungs, muscles, joints) similar to the loading requirements of their sport to maximize...
motor control and metabolic demands as the overall strength of the hip increases. Following the 3 P’s principle, the program is pain-free, progressive, and predictable.

**RETURN TO PLAY**

Sport progressions during this stage are performed within a pain-free ROM, with a duration and intensity that does not result in an increase in soreness of the joint or musculature. A progressive plan involves beginning with simple, slow, and short-duration activities. As the athlete gains strength, endurance, and confidence in the hip, more complex and faster movements of increasing volume can be performed. A predictable plan means beginning only with movements that are known to the athlete. It is not a time to explore a new running, cycling, or skating form or a route that may have unknown distances or uneven surfaces or require reactive movements such as defending someone.

Running progression on land and skating progressions with specific drills and speeds are initiated. The athlete can now swim without the pull buoy, and cycling resistance can be further added. Athletes are allowed to shoot a basketball, throw

<table>
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<th>Table 4</th>
<th>Cardiovascular fitness and conditioning</th>
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<tbody>
<tr>
<td><strong>Cardiovascular Fitness</strong></td>
<td><strong>Upper Body/Sport Specific Conditioning</strong></td>
</tr>
<tr>
<td><strong>Phase 1</strong></td>
<td>55%–70% of maximum heart rate up to 30 min</td>
</tr>
<tr>
<td>1. Upper body ergometry</td>
<td>1. Suspension-type training (see Fig. 16)</td>
</tr>
<tr>
<td>3. Swimming with pull buoy</td>
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</tr>
<tr>
<td><strong>Phase 2</strong></td>
<td>85% for phase 1 cardiovascular exercises; 55%–70% for phase 2 exercises</td>
</tr>
<tr>
<td>1. Swimming with pull buoy</td>
<td>1. Presurgery upper body regimen: dumbbells, barbells, machines at lower resistance</td>
</tr>
<tr>
<td>2. Easy return to ice for skating sports</td>
<td>2. Core conditioning: planks, crunches, avoiding hip flexor dominant exercises</td>
</tr>
<tr>
<td>3. Resistance on bicycle</td>
<td></td>
</tr>
<tr>
<td><strong>Phase 3</strong></td>
<td>1. Swimming without pull buoy</td>
</tr>
<tr>
<td>2. Running progression in pool (non-Mfx patients)</td>
<td>1. Shooting, swinging, hitting, dribbling, kicking, throwing sport-specific progressions</td>
</tr>
<tr>
<td>3. Running, skating, cycling progressions</td>
<td></td>
</tr>
<tr>
<td>4. Strength days emphasizing PAQ with minimum rest between sets in late phase 3</td>
<td></td>
</tr>
<tr>
<td><strong>Phase 4</strong></td>
<td>1. Maximize presurgery fitness regimen: running, cycling, skating, swimming, strengthening</td>
</tr>
<tr>
<td>1. Advanced sport specific drills</td>
<td></td>
</tr>
</tbody>
</table>

*Abbreviations: Mfx, microfracture; PAQ, power, agility, quickness.*
a baseball, swing a racquet or a bat, or dribble or pass a soccer ball depending on their individual sport. The volumes and intensities at which these sport-specific exercises are performed need to be to be controlled, and rest days are mandatory. A careful plan is best developed to find a balance in strengthening; cardiovascular, aquatic, core, and sport-specific exercises; and rest.

Fig. 16. TRX Suspension Training (Fitness Anywhere, Inc, San Francisco, California). (A & B) Push start-end. (C & D) Pull start-end.
Sport progressions, as previously described, are critical aspects of phases 3 and 4, whereas double leg strengthening is initiated and progressed to single leg strengthening. Phase 3 is shown in Table 5. Neuromuscular control emphasized in phase 2 is maintained. Endurance strength is emphasized (15–20 repetitions minimum) throughout phase 3, eventually incorporating power, agility, and quickness training into the program. Depending on the demands of the sport involved and the overall condition of the surgical hip, the athlete’s strengthening program is adjusted with focus primarily on progressive endurance strengthening, power and agility movements, or both. Cardiovascular fitness is achieved with the traditional programs (running, bike, elliptical trainer), sport progressions (skating, dance), or metabolic conditioning that is gained from using power and agility exercises with shorter rest periods. Recovery during this training can include balance, coordination, or mobility exercises.

Passive circumduction is continued for 10 weeks and should continue actively for an additional 4 weeks; soft tissue work and gentle stretching should also be done. Glute activation exercises continue using SAIRs, single leg bridges, and manually resisted exercises. Core neutral position with transverse abdominal control should be emphasized with all exercises.

Double leg strengthening includes leg press, double knee bends with resistance, and tuck squats (Fig. 17). Olympic lifts are not recommended early because of the quick explosive movements required to perform them correctly. Single leg strengthening progressively added includes balance squats (Fig. 18), split squats (Fig. 19), reverse lunges, lateral lunges (Fig. 20), and single knee bends (Fig. 21). Resistance is added with sport cords, dumbbells, or kettlebells. As the patient demonstrates the ability to perform single knee strengthening with adequate endurance and good form, power and agility movements are added, including lateral and diagonal agilities with sport cords. Single knee bend, lateral agility (Fig. 22), diagonal agility (Fig. 23),

| Table 5                                                                 |
|---|---|
| **Phase 3 of the rehabilitation program** | **Phase 3: Strengthening** |
| Goals | 1. Restore muscular strength and endurance  
2. Optimized neuromuscular control, balance, proprioception  
3. Restore cardiovascular endurance  
4. Progress sport progressions |
| Precautions | 1. Recommend no treadmill use  
2. Avoid hip flexor and adductor irritation  
3. Avoid joint irritation: too much volume, force, or not enough rest  
4. Avoid ballistic or aggressive stretching  
5. Avoid contact and high velocity activities |
| Treatment Strategies | 1. Continue circumduction, prone lying, soft tissue, muscle stretching, gluteal activation, core stabilization, movement prep exercises and aquatic pool program as needed  
2. Sport progressions or functional activities  
3. Cardiovascular fitness (see Table 4)  
4. Double leg strengthening  
5. Single leg strengthening |
| Minimum Criteria to Advance | 1. Perform all phase 3 exercises pain free and with correct form  
2. Pass sport test |
and forward lunge onto a box (Fig. 24) are the 4 exercises that comprise the sport test.\textsuperscript{10}

Phase 3 should culminate in the passing of a sports test (as shown in Table 6) that once completed allows the athlete to return to practice without limitations to train and prepare for competition. The athlete transitions into full training with a dedicated return to sport plan with any specific precautions as recommended by the physician. Specific demands of the sport are addressed with advanced power, plyometrics, performance, and conditioning training. These transitions should occur smoothly not only if hip-specific treatments were applied throughout the phases of rehabilitation.

Fig. 17. Tuck squats.

Fig. 18. Balance squat. (A) Start position with one leg behind supported on a bench and other leg forward enough to prevent knee from coming out past the toes when squatting. (B) Perform squat on forward leg keeping pelvis level.
Fig. 19. Split squat. (A) Start position with one leg behind on the floor while other leg is forward enough to prevent knee from coming out past the toes when squatting. (B) Perform squat on forward leg keeping pelvis level.

Fig. 20. Lateral lunge. (A) Start position. (B) Step lateral while squatting keeping the knee straight ahead and the pelvis level.
Fig. 21. Single knee bend. (A) Start position. (B) Keep knee from collapsing into adduction, internal rotation and valgus and hip neutral while performing single leg squat 30–70 degrees knee flexion.

Fig. 22. Lateral agility. (A) Start position: Sport cord attached from the wall to the waist. First line placed on floor the distance away from wall where the cord remains taut. Second line is the placed away from the first the distance from the patient’s greater trochanter to the floor. (B) Patient performs a lateral push-off from the leg nearest the wall with enough force to land with the opposite leg past the second line. (C) The increase in cord tension will result in a force that pulls the patient back. The patient should land in front of the first line and absorb the landing with a controlled squat.
Fig. 23. Diagonal agility. (A) Start position: Same as lateral agility except 2 lines are placed at a 45 degree angles forward and backward from the first. (B) The patient performs the lateral push-off from the leg nearest the wall as before but lands first rep on forward line. (C) The patient returns to the first line landing in a controlled squat. (D) The patient performs the next rep landing on the back line and continues alternating forward and backward lines.

Fig. 24. Forward lunge onto box. (A) Start position. Cord attached from wall to back of waist and taut. (B) Perform a deep forward lunge onto a box the height of the patient’s knees then return and perform with opposite leg.

Table 6  
Functional hip sport test

<table>
<thead>
<tr>
<th>Exercise</th>
<th>Goal</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single knee bends</td>
<td>3 min</td>
<td>1 point earned for each 30 s completed</td>
</tr>
<tr>
<td>Lateral agility</td>
<td>100 s</td>
<td>1 point earned for each 20 s completed</td>
</tr>
<tr>
<td>Diagonal agility</td>
<td>100 s</td>
<td>1 point earned for each 20 s completed</td>
</tr>
<tr>
<td>Forward lunge on box</td>
<td>2 min</td>
<td>1 point earned for each 30 s completed</td>
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</tbody>
</table>

Passing score: 17 of 20.
but also if cardiovascular fitness, conditioning, and sport progressions were used. Phase 4 is shown in Table 7.

**SUMMARY**

Rehabilitation after FAI arthroscopy is different for different patients. By following the restrictions set by the physician while performing early circumduction, using the minimal criteria to advance through each subsequent phase, and allowing patients to perform functional sport progressions throughout the rehabilitation athletes will be able to return to sport smoothly and effectively with positive outcomes.

**REFERENCES**


<table>
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<th>Table 7</th>
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<tbody>
<tr>
<td><strong>Phase 4 of the rehabilitation program</strong></td>
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<td><strong>Phase 4: Return to Sport</strong></td>
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<td><strong>Goals</strong></td>
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<td><strong>Precautions</strong></td>
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<td><strong>Treatment Strategies</strong></td>
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<td><strong>Minimum Criteria to Advance</strong></td>
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