

Rehabilitation Guidelines For Periacetabular Osteotomy (PAO) Of The Hip

The hip joint is composed of the femur (the thigh bone) and the acetabulum (the socket formed by the three pelvic bones). The hip joint is a ball and socket joint that not only allows flexion and extension, but also rotation of the thigh and leg (Fig 1). The head of the femur is encased by the bony socket in addition to a strong, non-compliant joint capsule, making the hip an extremely stable joint. Because the hip is responsible for transmitting the weight of the upper body to the lower extremities and the forces of weight bearing from the foot back up through the pelvis, the joint is subjected to substantial forces (Fig 2). Walking transmits 1.3 to 5.8 times body weight through the joint and running and jumping can generate forces across the joint equal to 6 to 8 times body weight.

The labrum is a circular, fibrocartilaginous structure that surrounds the socket. It functions to seal the joint, enhance stability and provide proprioceptive feedback (a sense of joint position) to the brain and central nervous system. The labrum acts as a suction seal or gasket for the hip joint. This helps to maintain the hydrostatic pressure that protects the articular cartilage on the head of the femur and the acetabulum.

If the acetabulum (socket) does not

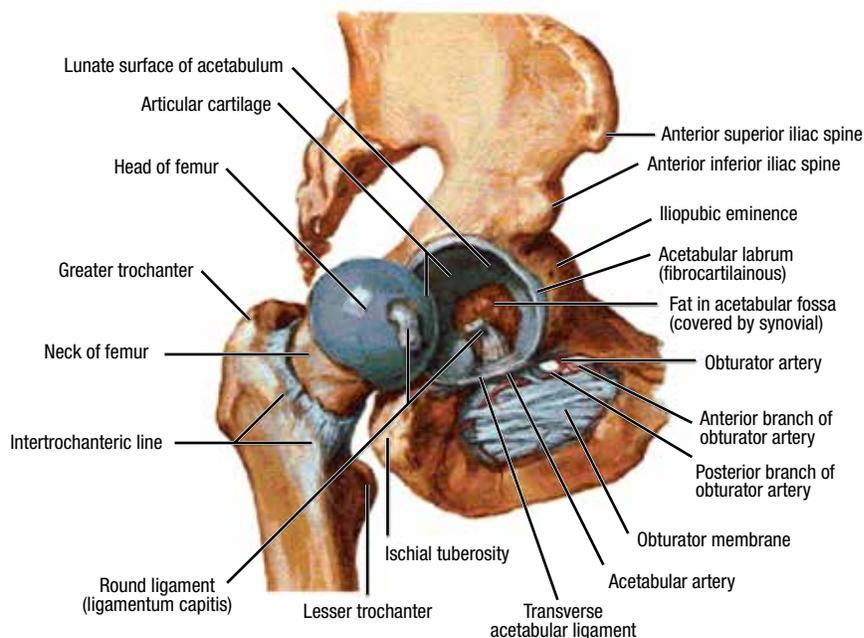


Figure 1 Hip joint (opened) lateral view

fully form, the result can be hip dysplasia. This causes the hip joint to experience load that is poorly tolerated over time, resulting in joint pain and restricted movement. Note the difference of how far the socket covers the head of the femur in Figure 3 compared to Figure 4 below.

While this type of joint abnormality is usually present from birth, patients often do not become symptomatic until adolescence or early adulthood. An adequate amount of acetabular (socket) depth creates load distribution

that is shared by the whole hip, including joint surfaces and the previously-mentioned acetabular labrum.

When dysplasia is present, loads transferred through the hip joint can be more focal and result in overload of cartilage and bone causing injury that can progress to osteoarthritis. This condition can occur with femoroacetabular impingement and labral tearing.

If the symptomatic dysplasia of the hip is not caught soon enough and progresses to arthritis, the patient would be more of a candidate for

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a total hip replacement. If arthritic changes are minimal, or absent, the patient might be a candidate for a periacetabular osteotomy (PAO).

A PAO is an open procedure where the socket is separated from the rest of the pelvis by making three cuts in the pelvis. It is then repositioned to better cover the femoral head and secured with long screws and potentially bone grafting material (Fig 5 and 6). This surgery will require a short stay in the hospital.

If a torn labrum is present, this can be addressed with a hip arthroscopy prior to the PAO portion of the surgery (see https://www.uwhealth.org/files/uwhealth/docs/pdf2/Rehab_Hip_Arthroscopy.pdf for more details). If cam type femoroacetabular impingement is present (FAD), it can be addressed after the PAO is completed.

Part of the information gathering in determining if a patient might benefit from a PAO, with or without hip arthroscopy, includes imaging. Radiographs, or x-rays, give a good initial view of bony alignment and help diagnose the hip dysplasia. Magnetic resonance imaging, or MRI, shows the soft tissue such as the labrum or cartilage that covers the bony surfaces of the hip joint. A hip CT scan provides excellent three-dimensional anatomy of the pelvis and femur for surgical planning and a better understanding of hip joint mechanics.

Your surgeon may recommend anesthetic or corticosteroid injections to treat pain and help identify the origin of your pain which helps to determine if surgery could be helpful. Physical therapy with a provider who is experienced

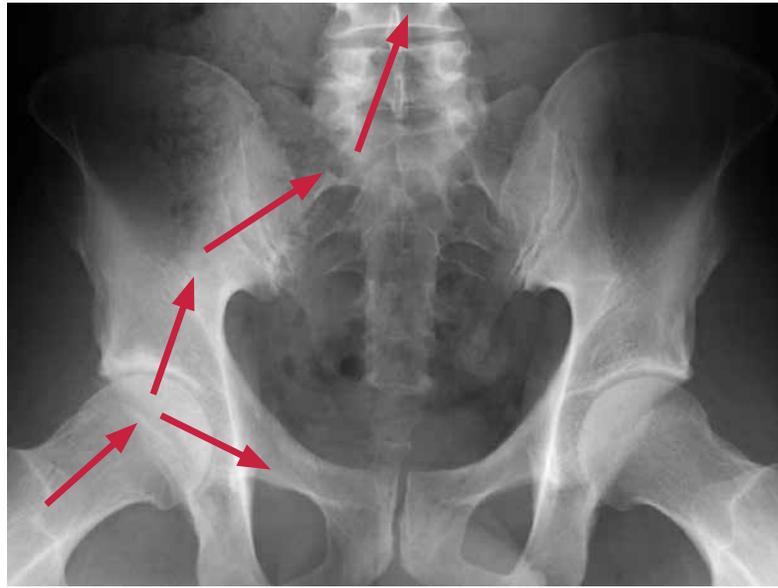


Figure 2: Image depicting force transmittal through the hip joint



Figure 3: Pelvic radiograph with measurements of the lateral center edge angle (LCEA) on the patient's left hip. Normal LCEA is $>25^\circ$. This patient would be diagnosed with hip dysplasia.

in treating hip conditions both pre-and post-operatively is usually recommended as this can help patients avoid surgery or strengthen their hip and core muscles to make the post-surgical recovery a little bit easier.

Following surgery, a patient spends 2-5 days in the hospital. They will learn to walk with crutches or a walker, usually about day 2 after surgery, minimizing weight bearing on the leg until the newly positioned socket heals. They will



Figure 4: Pelvic radiograph with measurements of the lateral center edge angle (LCEA) on the patient's left hip. Normal LCEA is $>25^\circ$.

have to maintain this partial weight bearing status for about 6 weeks.

Post-operatively the patient will begin outpatient physical therapy at about 3 weeks eventually being able to return to full weight bearing, walking without crutches and even athletics. Physical therapy will help strengthen the muscles around the hip and pelvis, restore range of motion of the hip joint and integrate the newly aligned hip into a patient's overall daily function.

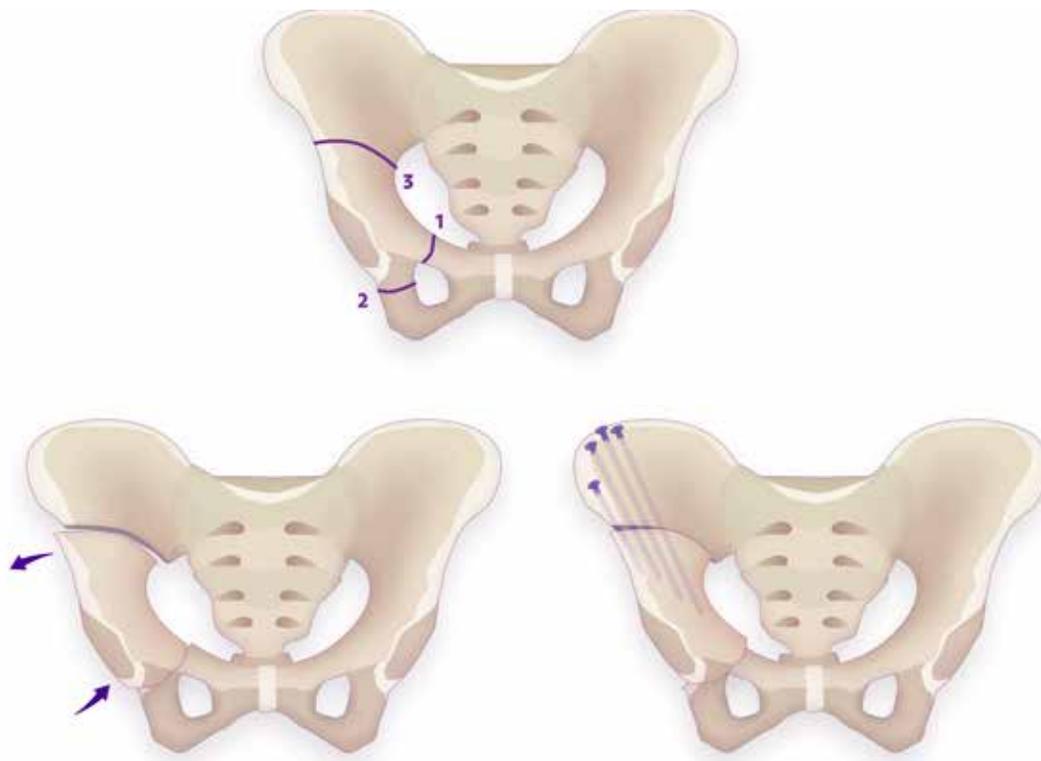


Figure 5 (multiple figures above): These images demonstrate the cuts made around the acetabulum and how they are repositioned. Image copyright © 2018: UW Health Sports Medicine.



Figure 6: The before (left) and after (right) pelvis radiographs of a patient who underwent PAO. Notice the increased coverage indicated by the yellow arrow after PAO.

The rehabilitation guidelines are presented in a criterion-based progression. The patient may also have postoperative hip and thigh pain and numbness of the groin, thigh, and/or pelvis near and around incision but these symptoms usually resolve over time.

Basic Rehabilitation Principals:

1. Post-operative recovery begins with preoperative rehabilitation, preoperative hip and core strengthening, review of gait training with assistive device and discussion of post-operative equipment needs; elevated toilet seat, wheelchair and long handled reachers are discussed.
2. A continuous passive motion (CPM) machine will be issued at the preoperative workup appointment and will be used with a setting of 0 degrees extension and 30 degrees of flexion for eight hours per day until the first post-operative appointment at 2-3 weeks. After the first week, the flexion range of motion can be gradually increased up to 90 degrees if the patient remains pain-free.
3. Patients will be limited in weightbearing for the first 6 weeks. No more than 20 pounds of body weight and crutches or a walker will need to be used for all walking. Patients should avoid prolonged sitting or lying on the surgical side for the first 4-6 weeks.

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4. Other precautions for the first 6 weeks: avoid painful range of motion, sit with knee below the hip and refrain from lifting your leg towards the ceiling when lying down or a marching motion in a standing position.
5. Many patients will be able to return to an active lifestyle after PAO but the presence of mild arthritic changes would indicate that safer activities to return to after the procedure include biking and swimming. For those patients without arthritic changes return to impact activities such as running is guided in a criterion-based fashion by the rehabilitation provider and physician.

PHASE I (Surgery to 6 weeks)

Appointments	<ul style="list-style-type: none"> • Surgery will require an inpatient hospital stay of 2-5 days • Inpatient rehabilitation begins post-op day 1, with emphasis on gait training and protection of the surgical limb • Physician appointment scheduled 3 weeks after hospital discharge • First outpatient rehabilitation appointment should be 3 weeks after discharge • Second appointment 6 weeks after discharge
Rehabilitation Goals	<ul style="list-style-type: none"> • Protection of the post-surgical hip through limited weight bearing and education on avoiding pain • Reduce pain to 0/10 at rest and with walking • Normalize gait with assistive device • Restore leg control
Precautions	<ul style="list-style-type: none"> • Avoid prolonged sitting for more than 1 hour with hips flexed to 90° or greater • Avoid walking distances to point of fatigue • Anterior hip precautions: no hip extension past neutral, avoid external rotation (ER), no crossing the legs • No active hip flexion with long lever arm, such as active SLR • No open chain isolated muscle activation, such as side lying hip abduction or prone hip extension • Protective foot flat weight bearing, no more than 20# of body weight, with axillary crutches • CPM for 8 hours per day, range of motion (ROM) set from 0° of extension to 30° of flexion, at speed of 1. This can be increased after 1 week gradually up to 90° as the patient tolerates. This will typically be discharged at the first post-operative appointment.
Suggested Therapeutic Exercises	<ul style="list-style-type: none"> • Passive range of motion (PROM) • Supine abdominal setting, prone abdominal setting with pillow under hips, quad sets, ankle pumps • Isometric hip exercises: abduction, adduction, internal rotation, ER, bridge without lifting hips. Prone heel squeeze with pillow under hips • Short arc quads, long arc quads, standing hamstring curls • Can begin pool walking, chest deep, at 6 weeks
Cardiovascular	<ul style="list-style-type: none"> • Upper body circuit training or upper body ergometry (UBE)
Progression Criteria	<ul style="list-style-type: none"> • Normal gait with assistive device and minimal to no pain • May be advanced to Phase II prior to 6 weeks per physician

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PHASE II (begin after meeting phase I criteria. Usually 6-12 weeks after surgery)

Appointments	<ul style="list-style-type: none"> • Rehabilitation based on patient progress, 1 times every 1-2 weeks
Rehabilitation Goals	<ul style="list-style-type: none"> • Normalize gait without device, progressing to WBAT first then from 2 crutches to 1 crutch to no device • Demonstrate good core control, adequate pelvic stability, and no pain with ADLs • Ascend/descend an 8" step with good control and no pain
Precautions	<ul style="list-style-type: none"> • Use assistive device until gait is non-antalgic • Symptom provocation during ADLs and therapeutic exercise • Avoid post-activity swelling or muscle weakness • Active hip flexion if symptomatic, especially SLR. Impingement of iliopsoas on pubic osteotomy site after PAO is common and can cause tendinopathy. • Faulty movement patterns and postures
Suggested Therapeutic Exercises	<ul style="list-style-type: none"> • Open chain AROM: standing hip abduction and hip extension to neutral • Hip AROM with stable pelvis: bent knee fall out, heel slide, prone windshield wiper • Prone lying progressing to prone knee bending, then to prone posterior pelvic tilts to facilitate recovery of functional hip extension • Closed chain work: squats, step ups, step downs, static lunge stance, leg press • Balance and proprioceptive work: narrow stance double leg work, single leg, single leg with contralateral lower extremity resistance, Romanian deadlift, upper extremity reaches • Upper extremity resistance training in lunge stance: single arm rows, single arm punches with and without pelvic rotation
Cardiovascular Exercise	<ul style="list-style-type: none"> • UBE, swimming laps with pull buoy, walking in the pool (chest height water is 75% unweighted, waist height is 50% unweighted)
Progression Criteria	<ul style="list-style-type: none"> • Normal gait on all surfaces without device • ROM that allows for carrying out functional movements without unloading affected leg or pain, while demonstrating good control • Able to ascend/descend 8" step with good pelvic control • Good pelvic control while maintaining single leg balance for 15 seconds

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PHASE III ((begin after meeting phase II criteria. Usually 12-16 weeks after surgery)

Appointments	<ul style="list-style-type: none"> • Rehabilitation based on patient progress, 1 times every 2-3 weeks
Rehabilitation Goals	<ul style="list-style-type: none"> • Optimize ROM • Improve core strength, adequate performance of level III on Sahrman core test • Improve lower extremity strength, particularly proximally, to 5/5 • Pain-free ADLs • Demonstrate symmetry to uninvolved side with higher level single leg balance tests, such as y-balance test
Precautions	<ul style="list-style-type: none"> • No ballistic or forced stretching • Avoid painful end range hip flexion. Due to change in orientation of acetabulum a little restriction is end range hip flexion is expected • Be cautious with repetitive hip flexion activities, such as treadmill and StairMaster. Sahrman testing should not be used as an exercise progression. • Avoid lumbar and pelvic compensations with functional movement • No impact activities until patient is at least 3 months out from surgery and demonstrates adequate hip and lower extremity control
Suggested Therapeutic Exercise	<ul style="list-style-type: none"> • Gait and functional movement drills • Non-impact LE and core strength work, with progression from quadruped to standing, double leg to single leg, and single plane to multiplane • Focus on hip abduction strengthening: side lying and functional closed chain • Continue aggressive hip rotator strengthening: lunge stance single arm rows and punches with and without pelvic rotation • Balance and proprioceptive training • Progress hip ROM without pain. While manual therapy/joint mobilization may be appropriate, some patients dealt with hip instability prior to surgery so these techniques should be used with caution • When strength is adequate, Impact control exercises beginning 2 feet to 2 feet, progressing from 1 foot to other and then 1 foot to same foot then progress from single plane drills to multi-plane drills • Sport/work specific balance and proprioceptive drills • Stretching for patient specific muscle imbalances
Cardiovascular Exercise	<ul style="list-style-type: none"> • Cycling, elliptical, deep water running • Avoid pelvic compensations
Progression Criteria	<ul style="list-style-type: none"> • Level III on Sahrman core test • 5/5 lower extremity strength • Good pelvic control with single limb activities • Hip ROM adequately meets demands of all ADLs

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PHASE IV (Begin after meeting Phase III criteria. Usually 16-20 weeks after surgery)

Appointments	<ul style="list-style-type: none">• Rehabilitation based on patient progress, 1 time every 3-4 weeks
Rehabilitation Goals	<ul style="list-style-type: none">• Independence with exercise program• Abolish post exercise soreness• Able to walk long distances, > 1 mile, without limp• Pass appropriate functional tests prior to return to sport
Precautions	<ul style="list-style-type: none">• Maintain adequate strength base
Suggested Therapeutic Exercises	<ul style="list-style-type: none">• Continue aggressive hip and core strength work• High level balance and proprioceptive training• Maximize ROM• Introduce plyometrics, running, and cutting• Sport/work specific balance and proprioceptive drills• Stretching for patient specific muscle imbalances
Cardiovascular Exercise	<ul style="list-style-type: none">• Specific to sport
Progression Criteria	<ul style="list-style-type: none">• Pain-free with rehab• Pass appropriate functional testing to ensure safety with return to sport

These rehabilitation guidelines were developed collaboratively between UW Health Sports Rehabilitation and the UW Health Sports Medicine physician group.

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REFERENCES

1. Ganz R et al. A New Periacetabular Osteotomy for the Treatment of Hip Dysplasias: Technique and Preliminary Results. Clinical Orthopaedics and Related Research. 232, 1988.

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