Rehabilitation of the Hip

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Introduction

Over the past decade, hip arthroscopy has gained an increase in popularity. With the advent of hip arthroscopy, there has come an increased recognition of intra-articular hip pathologies and improved techniques for the management of these various pathologies [1–7]. In 2008, more than 30,000 hip arthroscopies were performed, and 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 [8]. While mechanical problems can often be corrected through surgery, the functional deficits must be corrected through the rehabilitation process. Therefore, the evolution of hip arthroscopy has necessitated a progression in hip rehabilitation to insure optimal postsurgical results. Understanding the process of rehabilitation from preoperative education to the patient's achievement of full function is an integral part of the patient reaching their full potential postsurgery. While it is generally accepted that rehabilitation after hip arthroscopy is vitally important, there is limited evidence-based research to support the rehabilitative guidelines [9–12]. Rehabilitative methodology and techniques commonly employed after minimally invasive surgical techniques for other joints, such as the knee, shoulder, elbow, and ankle, have found application in the management of hip disorders. Understanding and respecting basic principles is always key to obtaining successful outcomes with any technique. As the surgical treatment for hip pain has evolved, the hip rehabilitation process has followed a similar path.

While the rehabilitation protocols following hip arthroscopy continue to evolve, the overall fundamental objective has remained the same: return the patient back to their preinjury level of activity as quickly and as safely as possible with the best possible long-term results. The goal of the rehabilitation plan is to reduce symptoms (modulate pain and inflammation) and improve function (restore mobility, strength, proprioception, and endurance). This is approached through a systematic progression dependent on the patient's status (pathology present) and functional needs. During the assessment process, it is important to determine the patient's level of understanding regarding the pathology, expectations of goals, and the time frame for achieving them. Patient education is the foundation of the rehabilitation plan. The patient must comprehend the related precautions and the recommended progression per their individual situation. Through collaborative consultation with the physician, physical therapist, and patient, reasonable goals and expectations can be formulated for favorable outcomes.

Assessment and Overview

The physician's history, examination, and diagnostic studies determine the patient's diagnosis and prognosis of surgical or nonsurgical treatment. The patient's history and the clinical evaluation assist in determining how the symptoms will respond to treatment. A course of presurgical treatment (prehab) may be indicated in some hip cases to regain neuromotor control and decrease stresses to the joint. An appropriate exercise program can, at times, help restore normal mechanics and minimize joint stresses to facilitate healing. In other circumstances, it can "buy time" when a patient desires and the physician thinks it is beneficial to delay operative intervention. Rehabilitation of a patient preoperatively, when the need for surgery has been confirmed, better prepares patients psychologically and physically for postsurgical recovery.

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As direct access and autonomous practice for physical therapists become more prevalent, the rehab provider may have the opportunity to be the initial caregiver for a patient with hip pain. Understanding the hip mechanics and how to properly assess the hip is imperative in deciding whether the severity of the hip dysfunction requires referral back to their orthopedic physician or if the problem can be managed conservatively. Treating a hip patient conservatively can be just as important as treating a patient postoperatively.

The foundation of assessment of a hip dysfunction begins with an understanding of the pathomechanics of the hip and pelvis. Joint dysfunction can manifest as a primary mechanical complaint or secondarily as a compensatory mechanical dysfunction. For example, for a patient with degenerative changes within the joint, the primary disorder is the antalgic gait due to joint pain. The secondary dysfunction may be due to weakness of the gluteus medius presenting as an abductor lurch (Trendelenburg gait) (Fig. 33.1). Disorders of the sacroiliac joint (SI joint) and lumbar spine also become considerations with chronic hip dysfunction because of altered gait and weight-bearing mechanics. Primary problems of symptomatic hip pathology may involve the soft tissue encasing the joint, the surrounding capsule, or the joint structure. The irritation and inflammation of the musculotendinous structures, bursae, or joint capsule can result in concomitant tendinitis, bursitis, or capsulitis. The ligaments of the hip joint are susceptible to acute tearing and chronic degeneration. Within the joint, labral or chondral injury can be responsible for protracted hip symptoms. Femoroacetabular impingement (FAI) has been suggested as playing a role in the development of acetabular labral tears and chondral lesions. FAI is a newly well-recognized indication for arthroscopic hip surgery [13]. Loose bodies and labral lesions are also well-recognized indications for arthroscopic surgery, which tends to produce gratifying results for properly selected patients [3].

Pain-free functional movement necessary to allow participation in sports is composed of many components: posture, ROM, muscle performance, and motor control. Impairments in any of these components can potentially alter required functional movement. The therapeutic plan of care needs to be focused on the patient's functional impairments that are a result and/or cause of pathology. The clinician can then use the traditional parts of the clinical examination to refine and deduce the specific pathoanatomic structures responsible for the functional limitation.

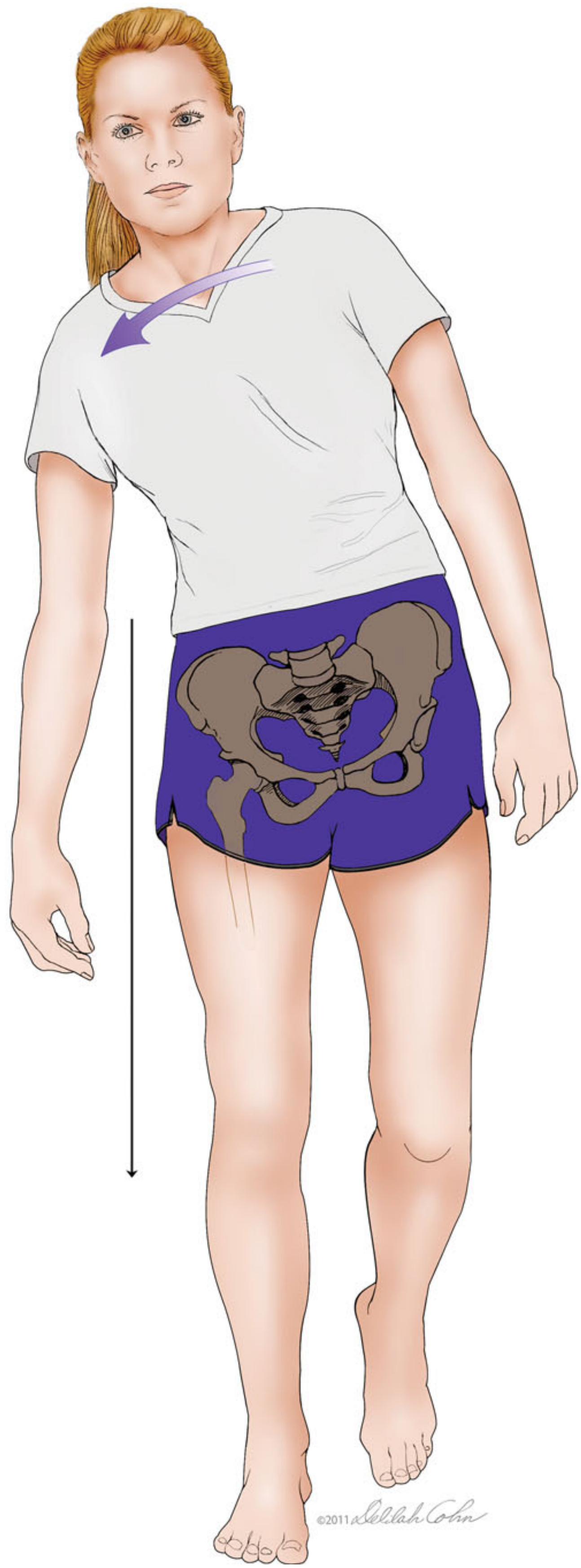

Fig. 33.1 Trendelenburg gait. Abductor lurch may occur as a compensatory mechanism to reduce the forces across the joint. Shifting the torso over the involved hip moves the center of gravity closer to the axis of the hip, shortens the lever arm moment, and reduces compressive joint force. (All rights are retained by Dr. Byrd)

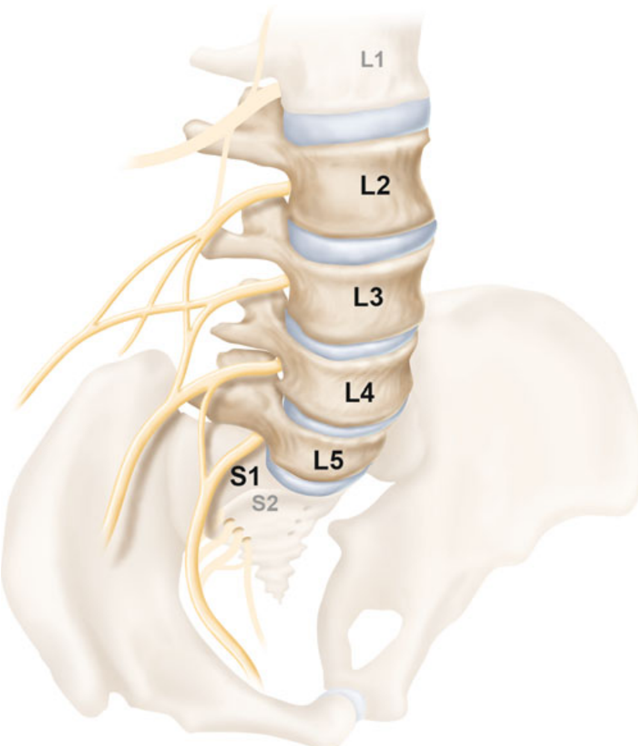

Fig. 33.2 The hip receives innervation predominantly from the L2–S2 nerve roots of the lumbosacral plexus. (All rights are retained by Dr. Byrd)

The clinical presentation of a patient with an acetabular labral tear has shown to be anterior hip or groin pain in greater than 90% of patients. Less often, patients can complain of lateral hip pain or pain deep in the posterior buttock. Data suggests that anterior hip or groin pain is more consistent with an anterior labral tear, whereas buttock pain is more consistent with a posterior labral tear. Mechanical symptoms can include clicking, locking or catching, or giving way, with clicking being the most consistently reported mechanical symptom [14]. The patient can complain of a sharp "catching" pain that is often associated with a popping, and a sensation of locking or giving away of the joint [15, 16]. Patients can have pain in the anterior groin, anterior thigh, buttock, greater trochanter, and medial knee. The reason for the variety in locations of complaints of pain is that the sensory supply to the hip joint is 65% from the obturator nerve; so pain in this area will be referred to the groin and the medial aspect of the knee. Approximately 30% of the sensory distribution is from the femoral nerve, which will refer to the anterior portion of the thigh. The remaining sensory distribution is from a branch of the sciatic nerve; therefore, the pain will be referred to the buttock [19] (Fig. 33.2). In a retrospective study by McCarthy and associates, they reviewed 94 consecutive patients with intractable hip pain who underwent hip arthroscopy [17]. They found statistically significant associations between the preoperative clinical presentation and arthroscopic operative findings. Acetabular labral tears detected arthroscopically correlated significantly with symptoms of anterior inguinal pain ($r = 1$), painful clicking episodes ($r = 0.809$), transient locking ($r = 0.307$), and giving way ($r = 0.320$). Patients also commonly complain of pain deep in the hip in which they may grasp/cup their lateral hip just above the greater trochanter. This is termed the "C" sign which describes the shape that the hand makes to surround the hip (Fig. 33.3a, b) [4].

History

Taking a thorough history in any patient case can help determine an appropriate tailored rehabilitative program. Understanding the patient's goals preoperatively and/or postoperatively can also help guide the rehab. As there are various disorders that can result in a painful hip, the history may be equally varied as far as onset, duration, and severity of symptoms. For example, acute labral tears associated with an injury have gone undiagnosed for decades, presenting as a chronic disorder. Conversely, patients with a degenerative labral tear may describe the acute onset of symptoms associated with a relatively innocuous episode and gradual progression of symptoms [4]. Many patients with FAI who develop symptoms as adults will often reflect back on the fact that they were never very flexible when they were younger. They commonly complain that they were never able to sit cross-legged on the floor (Fig. 33.4a, b). Common complaints of pain, functional limitations, and impairments are seen among patients that present with hip pain and/or a hip pathology. For example, common functional deficits include pain with prolonged sitting; difficulty donning socks or shoes; inability to squat or sit on low surfaces; and altered gait with a shortened stance phase, protraction of the hip, and decreased hip extension on the involved side. In addition, other common complaints can be loss of ROM, pain with increased stride length during the gait cycle, dyspareunia, and pain with negotiating stairs. Understanding your patient's mechanism of injury, current activity level, and goals for rehab/surgery will help guide your assessment and treatment for the patient.

Physical Examination

The clinical assessment includes observation of gait (Fig. 33.5), assessment of hip ROM and strength, performance of special tests (as referenced in previous chapters), and observation of basic functional transitional movements

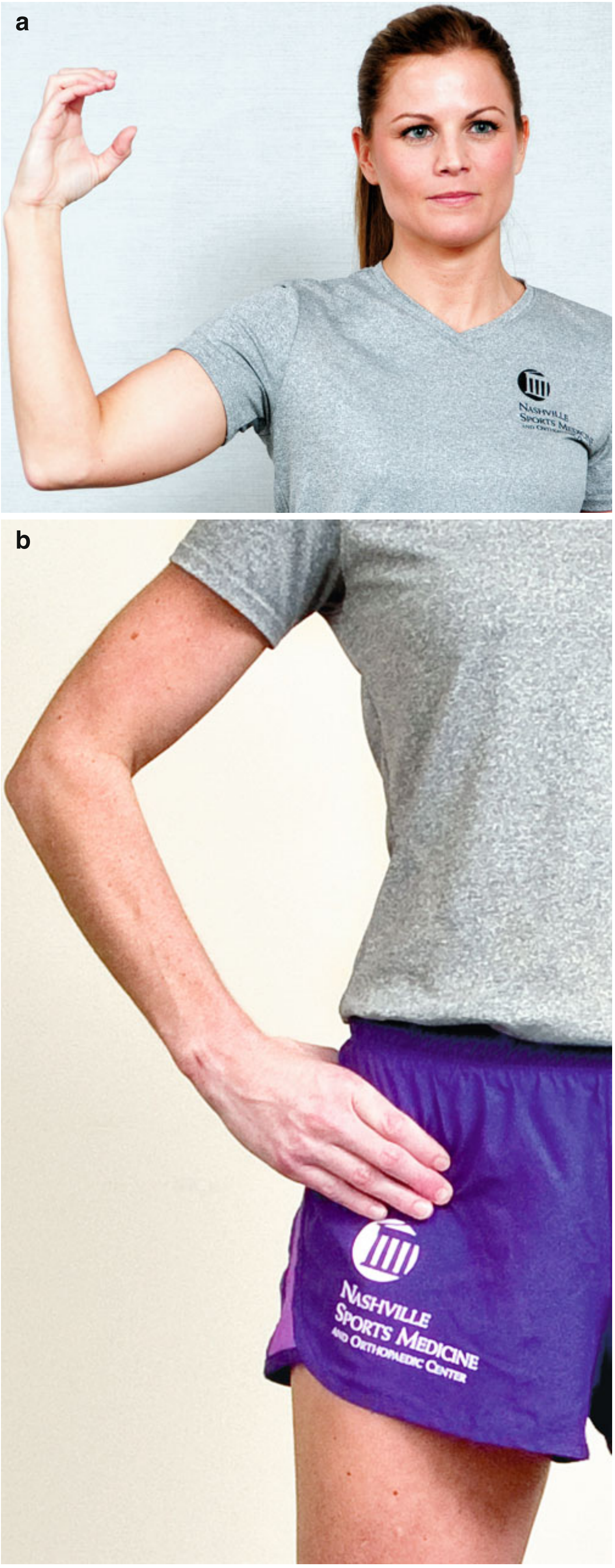

Fig. 33.3 C sign. Patients commonly complain of pain deep in the hip and may grasp/cup their lateral hip just above the greater trochanter. This is termed the "C" sign which describes the shape that the hand (**a**) makes to surround the hip (**b**). (All rights are retained by Dr. Byrd)

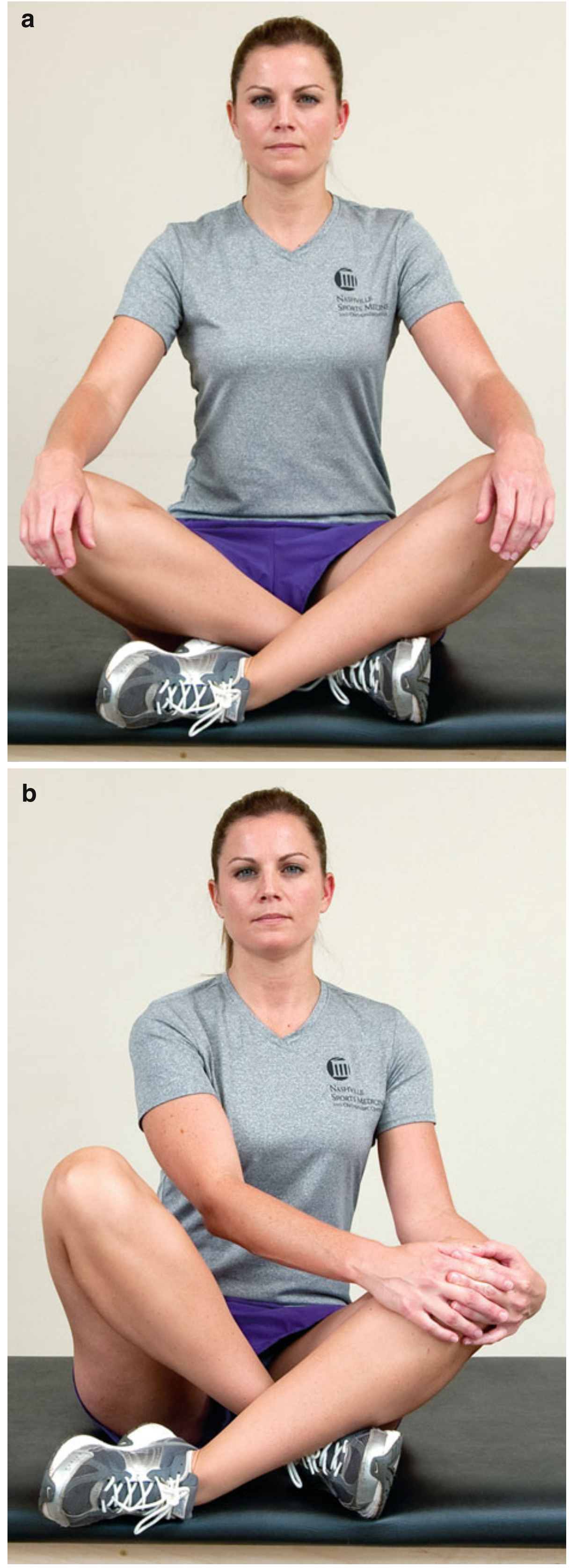

Fig. 33.4 (**a**) Normal cross-legged sitting position. (**b**) Patients will commonly demonstrate that they are not able to sit in a cross-legged position due to pain or reduced flexibility. (All rights are retained by Dr. Byrd)

Fig. 33.5 Gait is continuously assessed throughout the rehab process. Schematic illustrates the normal phases of the gait cycle. (All rights are retained by Dr. Byrd)

such as sit to stand to sit, ascending/descending stairs, and balance activities. This also includes understanding the patient's specific movement patterns and what elicits their painful symptoms. At this time, determining if the patient has involvement of the lumbar spine, pelvis, or sacroiliac joint is important in guiding your physical examination and differential diagnosis. Screening the entire lower extremity chain, including the knees and feet, can be imperative to your evaluation and should be performed during your assessment.

Movement Dysfunction and Assessment

A sport or movement-specific examination is imperative to understanding the contributions of athletic activity to functional limitations or pain. Motion, related to and produced by all the neuromusculoskeletal contributions of the human body, although variable by age remains the prerequisite for function. Traditional rehabilitation approaches used with athletes are often based on identification of inflamed tissues (and subsequent symptomatic treatment of those tissues) rather than on the correction of the mechanical cause of the tissue irritation. The symptom-based approach makes the assumption that the painful tissue is the source of the pain and subsequent dysfunction [18]. Although clinicians are trained to examine both the local area of complaint and the whole patient, typically the sequence of assessment is specific to general, with the examination focused on reproducing the athlete's pain. By looking at specific tissue first, an opportunity is missed to watch the body move as a whole and lost is the overall perspective of what the athlete can functionally achieve. All too often clinicians become too focused on the special tests that serve to confirm a pathologic diagnosis that they fail to refine, qualify, and quantify the functional parameters of the problem at hand. Reversing the sequence of assessment by examining gross movements before looking at component impairments, the therapist may determine where to focus specific assessment. By taking this approach, gross movements may provoke or reveal symptoms in the problem area as well as in other areas. Observing functional movements that the patient is able or unable to perform and those that produce pain may provide a clearer picture of the cause of the problem. One exception to initiating the examination using functional movements is the presence of chemical pain, that is, acute postsurgical or postinjury inflammation. Pain or inflammation of chemical origin is capable of influencing and producing movement dysfunction. Initial treatment emphasis would be directed locally in order to mediate the problem prior to a complete functional examination.

The Selective Functional Movement Assessment

Mobility and stability coexist to create efficient movement in the human body. Mobility and stability are the fundamental building blocks of strength, endurance, speed, power, and agility and therefore of all athletic activities. When these building blocks are decreased, the patient may compensate quality and therefore develop altered biomechanical habits to allow continued performance of an activity. When required movements are changed to accommodate less than optimal musculoskeletal integrity, negative changes and compensations such as altered joint arthrokinematics can occur. Accommodations to altered mobility and stability can produce inefficiency and thus require more energy, resulting in an increased chance of poor performance, pain and likelihood of injury, especially with the years of accumulation of these accommodations combined with the aging changes of the musculoskeletal system.

The Selective Functional Movement Assessment (SFMA) is one way of quantifying the qualitative assessment of functional movement and is not a substitute for the traditional examination process [19]. Rather, the SFMA is the first step in the functional orthopedic examination process, which serves to focus and direct choices made during the remaining portions of the exam, which are pertinent to the functional needs of the older athlete. The SFMA uses functional movement patterns to identify impairments that potentially alter specific functional movements. The approach taken with the SFMA places less emphasis on identifying the source of the symptoms and more on identifying the cause. An example of this assessment scheme is illustrated with a runner that presents with low back pain. Frequently, the symptoms associated with the low back pain are not examined in light of other secondary causes such as hip mobility. Lack of mobility at the hip is compensated for by increased mobility or instability of the spine. The global approach taken by the SFMA would identify the cause of the low back dysfunction.

The functional assessment process emphasizes the analysis of function to restore proper movement of specific physical tasks. Use of movement patterns with the application of specific stresses and overpressure serves to determine if dysfunction and/or pain are elicited. The movement patterns will also reaffirm or redirect the focus of the musculoskeletal problem. Maintaining or restoring proper movement of specific segments is a key to preventing or correcting musculoskeletal pain. The SFMA also identifies where functional exercise may be beneficial and also provides feedback regarding the effectiveness of such exercise. A functional approach to exercise utilizes key specific movements that are common to the patient regardless of the specific sport or activities of daily living they participate in. Exercise that uses repeated movement patterns required for desired function is not only realistic but also practical and time efficient.

The Scoring System for the SFMA

The SFMA uses seven basic movement patterns to rate and rank the two variables of pain and function (Fig. 33.6). The hip is affected by five of these (Video 33.1: http://goo.gl/ZHYvk) (Fig. 33.7). Function comprises mobility and stability. The term *functional* describes any unlimited or unrestricted movement. The term *dysfunctional* describes movements that are limited or restricted in some way, demonstrating a lack of mobility, stability, or symmetry within a given movement pattern. *Painful* denotes a situation where the selective functional movement reproduces symptoms,

Fig. 33.6 SFMA scoring chart

				
Multi-Segmental Flexion	Multi-Segmental Extension	Multi-Segmental Rotation	Single Leg Stance	Overhead Deep Squat
Touches toes and returns to standing position with knees straight	ASIS clears the toes	Pelvis rotation > 50˚	Eyes open > 10 seconds	No loss of shoulder flexion
Uniform spinal curve	Maintains normal (> or = to 170˚) shoulder flexion	Trunk/shoulder rotation > 50˚	Eyes closed > 10 seconds	Maintain thoracis extension
Posterior weight shift	Spine of the scapula clears the heels	No spine or pelvis deviation	No loss of height	Hips break parallel
>70˚ sacral angle	Uniform spinal curve	No excessive knee flexion	Normal dynamic leg swings	No sagittal plane deviations of lower extremities, right or left
		Symmetrical right and left	Symmetrical right and left	

Fig. 33.7 SFMA movements that affect the hip are shown

increases symptoms, or brings about secondary symptoms that need to be noted. Therefore, each pattern of the SFMA must be scored with one of four possible outcomes.

The seven basic movements or motions that comprise the basic SFMA screen look simple but require good flexibility and control. A patient who is (1) unable to perform a movement correctly, (2) shows a major limitation with one or more of the movement patterns, or (3) demonstrates an obvious difference between the left and right side of the body has exposed a significant finding that may be the key to correcting the problem.

Box 33.1 Functional Assessment (Should Be Done Throughout the Rehab Process, but Official Assessments by the Orthopedic Physician and the Therapist Are Done at 4, 8, 12, and 16 Weeks (Which Coincide with the Phases of Rehab) Unless Otherwise Indicated by the MD)

- Tailor to each pt
- Functional squat (see SMFA assessment)
- Gait

– Job/sport requirements
– Endurance
– Mobility (ROM)
– Strength
– Flexibility

The first five movements examine a combination of upper quarter, lower quarter, and trunk movements. The shoulder and cervical assessments examine upper quarter movement quality. Each movement is graded with a notation of FN, FP, DP, or DN. All responses other than FN are then assessed in greater detail to help refine the movement information and direct the clinical testing. Detailed algorithmic SFMA breakouts are available for each of the movement patterns, but it is beyond the scope of this chapter to describe. Once dysfunction and/or symptoms have been provoked in a functional manner, it is necessary to work backward to more specific assessments of the component parts of the functional movement by using special tests or range of motion comparisons. As the gross functional movement is broken down into component parts, the therapist should examine for consistencies and inconsistencies as well as level of dysfunction for each test as compared to the optimal movement pattern. Provocation of symptoms as well as limitations in movement or the inability to maintain stability during movements should be noted.

Loaded and Unloaded Implications

By performing parts of the test movements in both loaded and unloaded conditions, the clinician can draw conclusions about the interplay between the patient's available mobility and stability. If any of the first five movements are restricted when performed in the loaded position (e.g., limited, and/or in some way painful prior to the end of the ROM), a clue is provided regarding functional movement. For example, if a movement is performed easily (does not provoke symptoms or have any limitation) in an unloaded situation, it would seem logical that the appropriate joint ROM and muscle flexibility exist and therefore a stability problem may be the cause of why the patient cannot perform the movement in a loaded position. In this case, a patient has the requisite available biomechanical ability to go through the necessary ROM to perform the task, but the neurophysiological response needed for stabilization that creates dynamic alignment and postural support is not available when the functional movement is performed.

If the patient is observed to have a limitation, restriction, and pain when unloaded, the patient displays consistent abnormal biomechanical behavior of one or more joints and therefore would require specific clinical assessment of each relevant joint and muscle complex to identify the barriers that restrict movement and that may be responsible for the provocation of pain. Consistent limitation and provocation of symptoms in both the loaded and unloaded conditions may be indicative of a mobility problem [20, 21]. True mobility restrictions often require appropriate manual therapy in conjunction with corrective exercise.

How to Interpret the SFMA

Once the SFMA has been completed, the therapist should be able to do the following: (1) Identify the major sources of dysfunction and movements that are affected. (2) Identify patterns of movement that cause pain where reproduction of pain indicates either mechanical deformation or an inflammatory process affecting the nociceptor in the symptomatic structures. The key follow-up question must be "Which of the functional movements caused the tissue to become painful?" (3) Once the pattern of dysfunction has been identified, the problem is classified as either a mobility or stability dysfunction, determine where intervention should commence. With the SFMA, the choice of treatment is not about alleviating mechanical pain; rather, the SFMA guides the therapist to begin by choosing interventions designed to improve the dysfunctional nonpainful patterns first. This philosophy of intervention does not ignore the source of pain; rather, it takes the approach of removing the mechanical dysfunction that causes the tissues to become symptomatic in the first place.

Conservative Treatment

In some cases, decided by the patient and the surgeon, conservative treatment will be the most desired choice for the patient. The patient may have FAI and/or a labral tear, but some patients are either not ready for surgery or their symptoms may not be affecting their daily functional activities yet. Some may have only had symptoms for a short period of time or only with higher level activities. They may decide to treat their hip conservatively with physical therapy and modification of their current lifestyle before looking to surgery.

The goals of conservative treatment, when the diagnosis is known, focus more on education and comprehensive home exercise programs as compared to the rehabilitative treatment of postoperative patients. Education is imperative in this type of treatment focusing on what activities to avoid (see Box 33.2) that may accelerate their degenerative hip pathology and/or worsen their labral tear. In addition, emphasis is put on teaching the patient what they can do to

Box 33.2 Activities to Avoid Long Term

– Deep squats/lunges
– High-impact activities – running, jumping, etc. (articular damage)

Fig. 33.8 (**a**) Normal squatting position. The depth of the squat may need to be altered postsurgery or if the patient is being treated conservatively for hip pain. (**b**) The patient is instructed to perform the squat no deeper than 45° to decrease the compression on the labrum. (All rights are retained by Dr. Byrd)

decrease the forces on their hip while maintaining or improving their hip strength and function.

Managing or modifying an athlete's training program may be crucial in preventing further irritable forces or damage to the hip. Deep loaded squatting (loaded flexion) >45°, deep lunges, and deep leg press are activities that are avoided if the athlete is trying to avoid surgery or trying to rehab the injured hip (Fig. 33.8a, b). The athlete may benefit from less compressive cardiovascular activities such as swimming and biking to use in between games, practices, etc. In addition, core (lumbopelvic) stabilization may be recommended for the athlete based upon the results of the functional movement assessment (Video 33.2: http://goo.gl/sI4Wm) (Fig. 33.9a–d). Specific findings of your assessment will serve to guide your exercise progression. This in turn will help accentuate a more neutral pelvis which in turn will open up the acetabulum anteriorly and provide some relief of compression in those with pincer FAI.

The focus of the exercise program will be on hip/core strengthening, maintaining full pain-free hip ROM (reduce risk of developing adhesive capsulitis), maintaining/improving flexibility, and helping the patient develop a cardiovascular routine that will not be detrimental to the hip. Recommendations for cardiovascular exercise are as follows: (in order of least-most compressive for the hip) swimming, biking (no deep hip flexion, may have to adjust seat height), elliptical, walking, and jogging (limit if the patient does not have to perform this activity). If the patient already has a comprehensive workout routine, then the goal will be to help assess their current routine and make changes as needed. The comprehensive programs may be taught in 1–2 visits or over a period of a few weeks to let the patient acclimate to the new program.

Some patients will still respond to manual therapy for temporary symptom relief. Hip mobilizations (described in post-arthroscopic treatment) as well as long axis traction may be tolerated very well. If the patients do respond well, these techniques can easily be taught to a spouse, friend, or family member so they can be performed more often.

During the education process, it is very important to emphasize the importance of compliance with the strengthening program as well as avoiding the activities that worsen their symptoms. If after completing the preliminary phases of a thorough program that is 4–6 weeks in length or if the

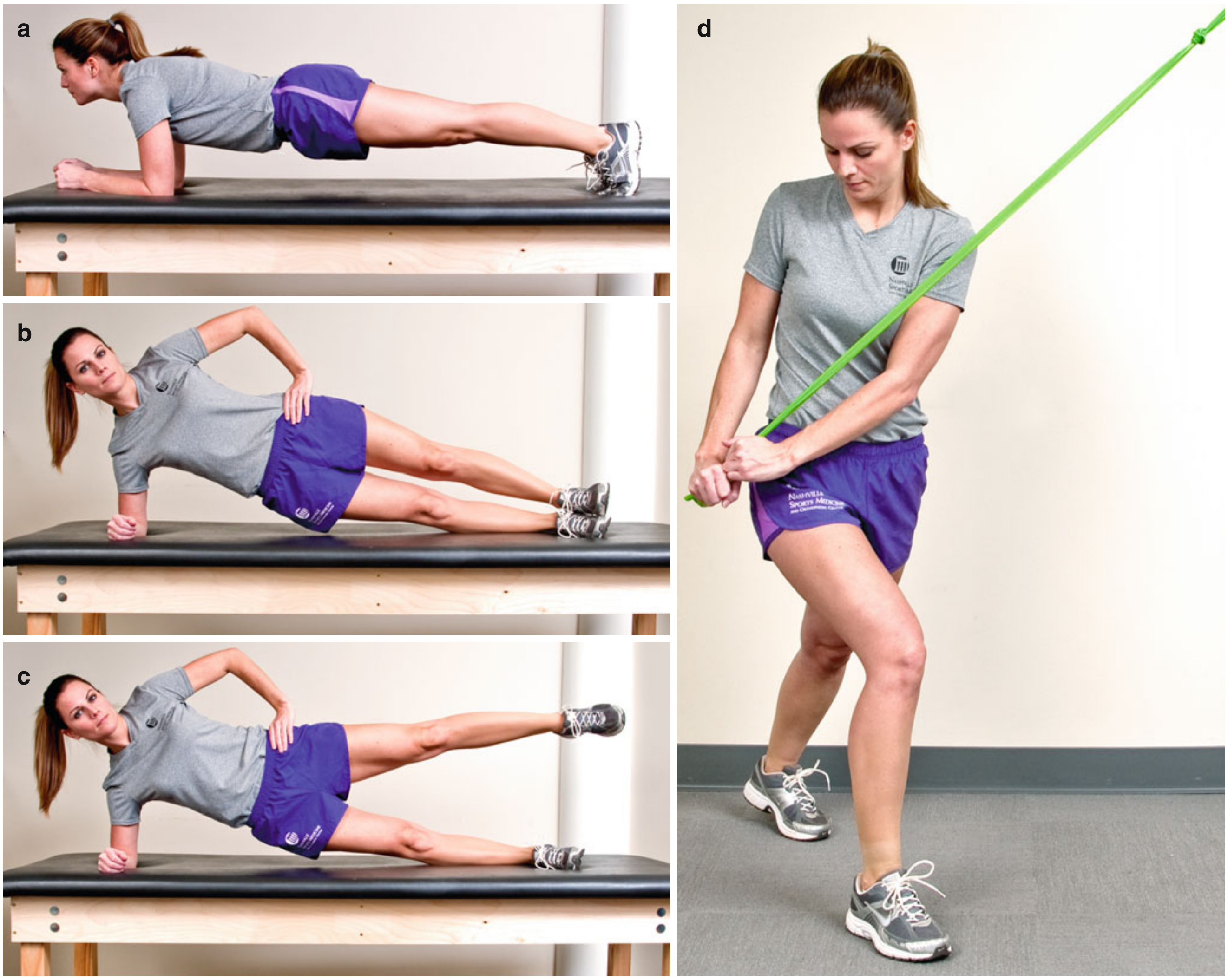

Fig. 33.9 Lumbopelvic (core) stabilization may be recommended to the patient to decrease compression in the hip in someone with a pincer type lesion or in patients who want to get back to higher level functional activities such as running, jumping, or specific sporting activities. (**a**) Forward core planks. (**b**) Side core planks. (**c**) Side plank with leg lift. (**d**) Lunge with shoulder PNF pattern. (All rights are retained by Dr. Byrd)

patient continues to have increasing amounts of pain or does not respond well to conservative treatment, then it will be beneficial to refer the patient back to the orthopedic physician. Failure to respond to a poor conservative treatment program or lack of compliance to an adequate program does not constitute failure of the rehabilitation program.

Treatment/Rehabilitation Progression

From the clinician's subjective and objective assessment and the information provided by the surgeon, specific areas of concern and needs will be identified [4]. To achieve the overall goals for an individual patient, the clinician must assess what instruction, monitoring, and equipment are necessary and must gauge the intensity or aggressiveness of the patient's functional progression. The rehabilitation program must be individualized based upon the evaluation findings of the surgeon and the physical therapist and not a strict timeline. The rehabilitation program must be individualized with specific time frames for weight bearing and ROM as determined by the pathology and the specific procedures used for correction (Table 33.1). For example, a patient with significant degenerative changes that undergoes a microfracture will have a slower recovery, dictated primarily by their symptoms and healing precautions. Compliance with the rehabilitation program is vital to allow for optimal soft tissue and bone healing. The rehabilitation program will progress through phases that utilize specific criteria to advance or progress to the next phase. Early in the rehab process (first 1–2 weeks), the exercise prescription is similar for all pathologies while still being mindful of the labral repair ROM restrictions and the microfracture weight-bearing precautions. During phase 1 of the rehab program, the intensity of rehabilitation is very conservative and is accomplished not only by supervision through the first phase but also with the patient performing

Table 33.1 Weight-bearing guidelines

Procedure	WB	Crutches	ROM
Routine arthroscopic procedure (loose body removal, labral debridement, chondroplasty, etc.)	WBAT	5–7 days or when gait is normalized	No limits
Femoroplasty	WBAT	1 month	No limits
Acetabuloplasty	WBAT	2 weeks or until gait is normalized	No limits
Labral repair/refixation	50% BW	1 month	90° of hip flexion; no ER for 4 weeks; week 4–5: increase to 105° hip flexion, ER to 20°; week 5–6: 115–120° of hip flexion, ER: 40° (pain-free); week 6+: Full AROM/PROM (pain-free)
Microfracture	30# PWB	2 months	No limits (emphasize ROM)
Iliopsoas release	WBAT	2 weeks or until gait is normalized	No limits on PROM, limit AROM flexion to allow healing to occur, emphasize passive hip extension to aid in healing process

WB Weight bearing, *ROM* Range of motion, *WBAT* Weight bearing as tolerated, *BW* Body weight, *ER* External rotation, *AROM* Active range of motion, *PROM* Passive range of motion

their home exercise program independently. Progress through this phase is dependent upon the specific pathology that the patient had. A patient with debridement of a labral tear, loose body removal, synovectomy, or otherwise healthy joint may be expected to progress much more aggressively through the protocol phases with the anticipation of regaining full function and return to sports. Because the patient is moving through the protocol at a faster pace, the use of a well-equipped facility is preferred so that the patient has access to rehabilitative tools/equipment that will complement the high level demands of the rehabilitative program. In addition, this higher level patient may require more clinical attention in order to gauge their response to exercise and assure a safe progression. The four phases of rehabilitation include the following: phase 1, mobility and early exercise; phase 2, intermediate exercise and stabilization; phase 3, advanced exercise and neuromuscular control; and phase 4, return to activity.

While pathology-specific protocols have been developed for routine arthroscopic procedures, there are general guidelines that can be applied across four phases of rehabilitation. A sample rehabilitation protocol for routine arthroscopic procedures that require little to no biological healing (loose body removal, labral debridement, synovectomy, ligamentum teres debridement, etc.) has been included as supplemental material with the included DVD. Sample protocols for those arthroscopic procedures that require more extensive biological healing (iliopsoas release, labral repair, femoroplasty, acetabuloplasty, microfracture) have been included in the supplemental material as well.

Postoperative recovery actually begins with the preoperative educational process. This may be a structured prehabilitation program that addresses impairments such as pain, swelling, postural deviations, compensated mobility, muscle length and muscle strength, decreased proprioception, and muscular and cardiovascular endurance. Hip pain may alter lumbopelvic-hip movement, creating patterns which lead to impairments of muscular imbalances and faulty mechanics [20, 21]. In other cases, a single comprehensive preoperative visit for instruction, explanation, and demonstration of the expected postoperative rehabilitation protocol will suffice. The patient should be aware that their rehabilitative responsibilities such as an understanding of weight-bearing precautions, wound care, and use of assistive devices begin even before leaving the outpatient area. Many of the initial exercises can be performed independently, but the patient should understand the importance of beginning isometric contractions (Video 33.3: http://goo.gl/dY4V5) at the hip and ankle plantarflexion and dorsiflexion pumps (Video 33.4: http://goo.gl/OJX4M) to facilitate lower extremity circulation. Reasonable goals are discussed with the patient depending on the extent of the injury, prior level of function, extent of the surgery, and extent of the damage in the hip.

Initial Visit

The first postoperative visit evaluation (usually day 1 or 2 after surgery) starts when the patient walks through the door. Initiation of treatment begins with normalization of the patient's gait, which involves education about the importance and actual demonstration of proper ambulation (Fig. 33.10). The patient will then start with week 1 exercises that are listed with the supplemental material. These exercises are meant to improve the initial activation of the muscles surrounding the hip/knee as well as decreasing pain, stiffness, and inflammation. The patient should be aware not to "push through" pain as they perform the exercises and as they progress through the rehab program. During this visit, the patient should be educated on their postsurgical restrictions, driving restrictions, sleeping recommendations, and the importance of compliance with their supervised rehab program. For simpler arthroscopic procedures that do not require much biological healing, patients may experience prompt decreased pain and symptoms when existing at a low activity level. This has been

Fig. 33.10 Crutch/gait training is imperative in normalizing the patient's gait and provides better stability as they are ambulating. (All rights are retained by Dr. Byrd)

termed the "honeymoon period" where most patients feel better regardless of their eventual outcome. Early enthusiasm at about 1 month following surgery makes it easy for patients to overdo their activity and results in a flare-up and setback in their recovery. Following more extensive procedures such as correction of FAI, stricter precautions are necessary during the early recovery, and flare-ups are more frequent at around 6–8 weeks as function starts to intensify. A thoughtful rehabilitation strategy can minimize these setbacks, but they are still frequent enough that, by having warned patients of this occurrence, they will have more confidence that it can be corrected and is not a sign of an unsuccessful eventual outcome. See Box 33.3 for how to treat a flare-up if it may occur.

Phase 1: Mobility and Initial Exercise

During the initial phase of rehabilitation, the goals of the program are to protect the repaired tissue, diminish the pain and inflammation, restore pain-free ROM, prevent muscle inhibition, and normalize gait. The primary constraint during this phase is soft tissue healing and avoiding the negative effects of immobilization [22].

Box 33.3 How to Treat a Flare-up

- Ice/use of vasopneumatic compressive device
- Anti-inflammatory
- Assess activity outside of therapy
- Hold on activity or PT for 2–3 days as needed
- Maintain ROM
- Continue isometrics
- Pool therapy
- Contact our clinic if you have any questions

The patient's weight-bearing status can vary depending on the surgeon's findings and procedure performed. If the pathology addressed with the surgical procedure does not require extensive biological healing, then foot-flat weight bearing is allowed as tolerated, and crutches are discontinued within the first week (chondroplasty, debridement, loose body removal, or synovectomy). In those cases where biological healing is required (i.e., microfracture, femoroplasty, acetabuloplasty, and labral repair), the patient may remain on a limited weight-bearing status for up to 8 weeks (see Table 33.1 for details). Although the discomfort associated with arthroscopy might be surprisingly little, due to the combination of capsular penetration with the arthroscopic portals and the traction applied to the capsule during the procedure, there can still be a significant amount of reflex inhibition. This reflex inhibition can lead to limited or poor muscle firing, thereby altering normal patterns of movement [11]. Cold compression devices are often used in the initial stages of rehabilitation to minimize inflammation and reflex inhibition. The gluteus medius muscle is an example of a muscle that commonly exhibits reflex muscle inhibition following hip injury or surgery. In a typical arthroscopic procedure, the anterolateral and posterolateral portals pass through this muscle. Clinically, it is common to see that the patient will have a difficult time regaining muscle tone and appropriate firing of this muscle postsurgery. This is analogous to the effects of an arthroscopic knee surgery on the vastus medialis muscle. Functionally, the gluteus medius muscle is needed to maintain a level pelvis during ambulation. With gluteus medius weakness, a Trendelenburg gait will occur as the contralateral pelvis drops when the limb becomes unsupported in the swing phase of gait. Additionally, due to the short moment arm of the gluteus medius, this muscle causes a large joint compression force when it contracts during the single limb stance phase of gait [23–25]. In a patient with hip articular pathology, it is common to find inhibition of the gluteus medius muscle due to pain [11]. Consequently, assistive devices are helpful to minimize the Trendelenburg pelvis drop and reestablish a normal gait pattern with synchronous muscle activity. The most effective method of neutralizing compressive forces across the hip is to allow the patient to apply the equivalent weight of the leg on the ground [26, 27]. This is especially important with microfracture, protecting the gradually maturing fibrocartilaginous healing response of the articular surface. Maintaining a true non-weight-bearing status requires significant muscle force to suspend the extremity off the ground, thus generating considerable dynamic compression across the joint as a result of muscle contraction [26, 27]. Resting the weight of the lower extremity on the ground neutralizes this dynamic compressive effect of the muscles [26, 27]. The decision on when to discontinue assistive devices is based upon the patient's tolerance to weight bearing and the demonstration of proper firing of the gluteal muscles without a Trendelenburg gait pattern.

Early range of motion (ROM) (Video 33.5: http://goo.gl/yEuQm) is initiated to restore joint motion and decrease the likelihood of adhesions forming about the joint [22]. Joint range of motion is normalized by restoring capsular extensibility. Emphasis with passive range of motion is placed upon internal rotation and flexion to help prevent scarring between the hip joint capsule and the acetabular labrum. Limitation of hip flexion and internal rotation also commonly occurs because of the FAI [12]. Hip extension past neutral is initially restricted due to increased anterior hip forces and excessive stress on the anterior labrum and capsule. Active assisted range of motion exercises are initiated and progressed to active range of motion, gravity-assisted and then to gravity-resisted exercises during the postoperative recovery. Exercises are directed in all planes of hip motion, and the end ranges for motion are determined by the patient's level of discomfort. Stretching is typically pushed only to tolerance, and the patient is educated as to these parameters. Manual mobilization techniques can assist in the reduction of compressive forces across the articular surfaces. This may lessen discomfort and over time enhance cartilage healing [28]. Regaining full functional pain-free ROM is critical in preventing concurrent compensatory patterns with the lower back, SI joint, etc. Small accessory oscillation movements stimulate joint mechanoreceptors assisting in pain modulation while at the same time help to maintain capsular mobility. Graded mobilization with flexion and adduction movement or internal rotation is gently implemented with the moderately painful joint [12]. Stationary bicycling with minimal to no resistance is an excellent adjunct to the range of motion program and should be done daily.

Hip Mobilizations

Distraction techniques (longitudinal movement) (Video 33.6: http://goo.gl/uu0Bf) are most useful when hip movements are painful and also following compressive exercises

Fig. 33.11 Longitudinal hip distraction. Distraction techniques (longitudinal movement) are most useful when hip movements are painful and also following compressive exercises. (All rights are retained by Dr. Byrd)

Fig. 33.12 Inferior/caudal glide mobilization. This technique can be performed in varying degrees of flexion. During this mobilization, some longitudinal distraction is performed to decrease compression as the hip is brought into more flexion and the inferior glide is performed. (All rights are retained by Dr. Byrd)

(Fig. 33.11). Oscillatory longitudinal movements are produced by pulling gently on the lower extremity down the long axis of the femur which can be performed in varying degrees of flexion. In addition, capsular stretching can be made more specific with three-dimensional mobilization by rotating the femur into the restrictive barrier and performing an inferior or caudal glide (Fig. 33.12). During the inferior glide mobilization (Video 33.7: http://goo.gl/3vgY7), it is key that some longitudinal distraction is provided to prevent increased force on the labrum rather than actually mobilizing the joint within the capsule. This mobilization can be done in all quadrants of hip flexion and is imperative to regaining full functional pain-free mobility. Changing the hand position to be more medial or lateral is all that has to be done to achieve this goal. To improve internal and external rotation movement, rotational mobilizations can be performed with support under the knees of the patient. A bolster may be used to

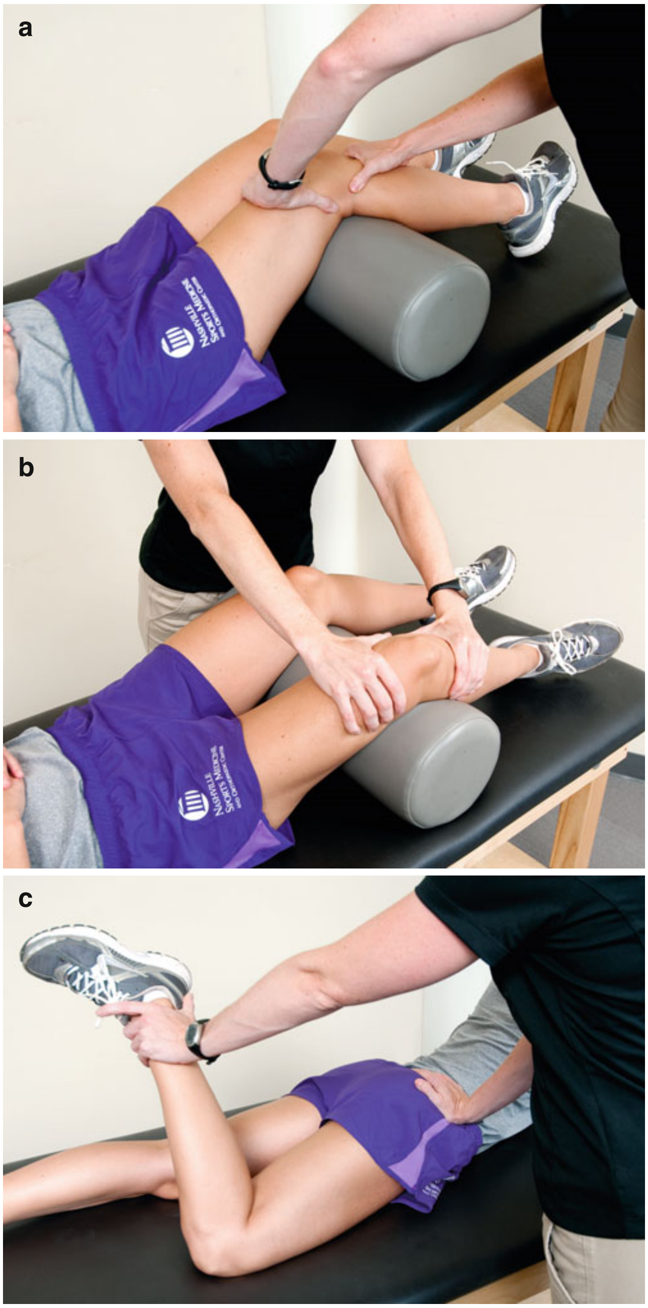

Fig. 33.13 (**a**) Internal rotation mobilizations. (**a**) bolster is used to prop the hip up into approximately 30° to allow the capsule to be on slack. This will help relax the patient as the mobilization is performed. (**b**) External rotation mobilizations. (**c**) Prone internal/external stretch. The patient's pelvis should be stabilized while the hip is stretched into internal or external rotation. A contract-relax method can also be utilized in this position. (All rights are retained by Dr. Byrd)

Fig. 33.14 Side-lying hip extension posterior-anterior (PA) mobilization. (**a**) Viewing from the front, during this mobilization, the patient is instructed to relax the hip but slightly activate the transverse abdominis to keep the back in neutral while the leg is brought into extension. (**b**) Viewing from the back, the therapist's hand should be placed on the posterior aspect of the hip. When the patient starts to feel a stretch in the front of the hip, some motion is backed off and the therapist will provide a posterior to anterior mobilization. This should all be pain-free. (All rights are retained by Dr. Byrd)

put the hip into about 30° of hip flexion which allows the capsule to be on slack (Fig. 33.13a, b). Rotational mobilizations (Video 33.8: http://goo.gl/KZNNK) into each end range direction can be started during week 3–4 of the initial phase of rehab unless the patient has ROM restrictions. Working into small amplitude end range rotational mobilizations are well tolerated by postoperative patients and may be started during week 4 and on. If patients continue to have ROM limitations long term, then it is important that mobilizations be taught to someone who is available to perform them on the patient on a more consistent basis. Another option for those who have limitations in IR/ER is to have the patient in prone and perform IR/ER stretching at 90° of knee flexion. The patient is to initiate the motion after an outside force (therapist) stabilizes the pelvis with one hand, then the other hand either pushes or pulls the hip into more internal or external rotation as tolerated by the patient (perform 3–5 reps of 10 s). The prone position can be useful to perform a contract-relax method for increased IR/ER (Fig. 33.13c). Limitations in anterior hip mobility can be seen in the terminal stance phase of gait and can be addressed with the side-lying hip extension posterior-anterior mobilization (Fig. 33.14a). The patient begins side-lying on the nonoperative side, and the leg is passively brought into extension,

Table 33.2 Single leg squat criterion

Criterion	To be rated "good"
Overall impression across five trials	
Ability to maintain balance	Patient does not lose balance
Perturbations of the person	Movement is performed smoothly
Depth of the squat	The squat is performed to at least 60° knee flexion
Speed of the squat	Squat is performed at a rate of 1 per s
Trunk posture	
Trunk/thoracic lateral deviation	No trunk/thoracic lateral deviation
Trunk/thoracic rotation	No trunk/thoracic rotation
Trunk/thoracic lateral flexion	No trunk/thoracic lateral flexion
Trunk/thoracic forward flexion	No trunk/thoracic forward flexion
The pelvis "in space"	
Pelvic lateral deviation	No pelvic lateral deviation
Pelvic rotation	No pelvic rotation
Pelvic tilt	No pelvic tilt
Hip joint	
Hip adduction	No hip adduction
Hip "femoral" internal rotation	No hip "femoral" internal rotation
Knee joint	
Apparent knee valgus	No apparent knee valgus
Knee position relative to foot position	Center of knee remains over the center of the foot

keeping the lumbar spine in neutral. The hip is brought back far enough to feel a stretch in the anterior hip, but no pain should be felt. Some extension motion is then released, and a posterior-anterior mobilization is performed with the heel of the hand placed in the posterior hip area (Fig. 33.14b). Small oscillatory motions (10–15) are made by the therapist utilizing their own core, and then the leg is brought back to neutral. This can be repeated as tolerated. Oscillatory movements in a compression mode, stopping short of the pain position, can be helpful especially for patients with pain in weight bearing. The posterior-anterior mobilization can also be used as an accessory movement at the limit of physiological range when a goal of treatment is to increase the range of motion of the joint. The presence of a capsular pattern of the hip as described by Cyriax is often found secondary to the postoperative effusion [28]. Characteristic of that pattern is a gross limitation of flexion, abduction, and internal rotation with minimal loss of extension and external rotation [17, 28]. Regardless of the pattern of restriction, every attempt must be made to restore full capsular mobility and all physiological range of motions. In cases with painful restricted motion, the clinician must carefully assess the end feel to motion and physical status of the joint in order to determine whether mobilization techniques are a viable treatment option.

A key postoperative goal is the restoration of dynamic hip stability. The prevention of muscle inhibition can be achieved through early muscle-toning exercises (Video 33.9: http://goo.gl/jRBPZ) which are performed within the first week after surgery. Progression is dependent on the patient's tolerance but should not be overly aggressive. Exercise selection should be based upon evidence related to the specific muscles recruited while at the same time maintain all surgical precautions with regard to forces on the healing tissues. Isometric exercises are the simplest and least likely to aggravate underlying joint symptoms [29]. These include isometric sets for the gluteals, quadriceps, hamstrings, adductor and abductor muscle groups, and lower abdominals [29]. Additionally, isometric contraction of the antagonistic muscle group may inhibit spasms and promote pain relief.

Specific emphasis in the strengthening program is placed upon isolating and strengthening the gluteal muscles (Video 33.10: http://goo.gl/nwldn). The gluteus medius muscle is one of the key stabilizers of the hip during gait [25]. Initial assessment of isolated gluteal muscle weakness can best be accomplished with standardized manual muscle testing procedures in the side-lying and prone positions. The dynamic quality of single leg support as a part of the kinetic chain can be assessed functionally with a single leg squat. The single limb squat test requires frontal plane stability of the pelvis and control of the lower limb in both the frontal and transverse plane, both of which require high gluteus medius muscle activation (Table 33.2 with scoring criterion). The single leg squat test also significantly activates the gluteus maximus muscle. The relationship between hip muscle strength and control of the hip and knee motions during a single leg task has been established [30]. The motion of the single limb squat requires stability of the lumbopelvic region while at the same time providing eccentric control of hip flexion and concentric hip extension.

Weak or fatigued gluteal muscles can result in excessive pelvic rotation and femoral internal rotation. Gluteal isometrics in a neutral pelvic position may decrease

Fig. 33.15 Gluteal isometrics done in a neutral pelvis position may decrease overactivity of the iliopsoas and provide a decrease in anterior hip pain. (All rights are retained by Dr. Byrd)

Fig. 33.16 Side-lying hip abduction may be done to aid in strengthening the gluteus medius, but if the patient has concurrent hip flexor irritation, this may need to be done in slight internal rotation. (All rights are retained by Dr. Byrd)

overactivity of the iliopsoas and provide a decrease in anterior hip pain [31–33] (Fig. 33.15). Proper strength and conditioning of these muscles is important due to the influence on the hip, pelvis, and back [34]. A commonly seen substitution pattern for gluteus medius weakness is overactivation of the tensor fascia lata and the iliopsoas with abduction strength testing. Typically, the patient will flex and externally rotate their hip in order to achieve abduction. In order to alleviate this problem, the patient is asked to keep their hip in neutral or in slight extension while lifting their hip into abduction.

It has been established that iliopsoas pain and tenderness can be common during postoperative rehabilitation [12, 35]. The same exercises that are used to strengthen the gluteal muscles may also aggravate an inflamed iliopsoas muscle. Therefore, exercise selection for strengthening the gluteal muscles must also reduce the activation of the iliopsoas muscle 34. Supine hip flexion, side-lying hip abduction with external hip rotation, and the hip clamshell progression have been identified to also activate the iliopsoas muscle considerably and should be avoided with concurrent hip flexor irritation [35] (Figs. 33.16 and 33.17a–f). The clamshell progression (Video 33.11: http://goo.gl/UJIl0) is used to emphasize both internal and external rotations while strengthening the gluteus medius in the neutral position significantly activate the iliopsoas and is safe to use [35]. Other strengthening exercises with low concurrent iliopsoas activation include double to single leg bridging (Video 33.12: http://goo.gl/yIj8q), stool hip rotations, resisted hip extension, side-lying hip abduction with the heel against the wall, prone heel squeezes, and side-lying hip abduction (Video 33.13: http://goo.gl/33OAW) with internal hip rotation [35] (Fig. 33.18a–i). In addition, patients can also start performing a limited arc leg press (Video 33.14: http://goo.gl/ew19Q) and mini-squats (Video 33.15: http://goo.gl/HVnCf) to also work on gluteus maximus. Table 33.3 provides a list of gluteal exercises listed in hierarchy of activation based upon EMG data that was normalized to a maximum volitional isometric contraction (MVIC). Previous research has indicated that muscle activation greater than 50–60% MVIC is considered adequate for muscle strengthening [36].

An aquatic program is often beneficial for allowing early return to exercise and can begin as soon as the portal sites have healed and the sutures have been removed [11]. A pool program will allow for muscle relaxation which allows for earlier joint mobilization and gentle strengthening in a reduced-weight environment. The water buoyancy can provide assistance to movement in all planes and safer resistance with active exercises. Gait activities can be progressed in waist deep water with minimized compression of the surgical site. Once the goals of phase 1 have been met and there is minimal to no pain with the phase 1 exercise program, patients are progressed to the intermediate phase of the rehabilitation program. The patients should have achieved close to full range of motion and accomplished a normalized gait pattern without crutches in order to progress.

Box 33.4 Common Complaints Postsurgery

- Nonpainful popping
- Feeling of stiffness
- Mild swelling (should return to normal within 2 weeks)
- Sharp pains with quick or rotating movement of the hip up to 12 weeks post-op

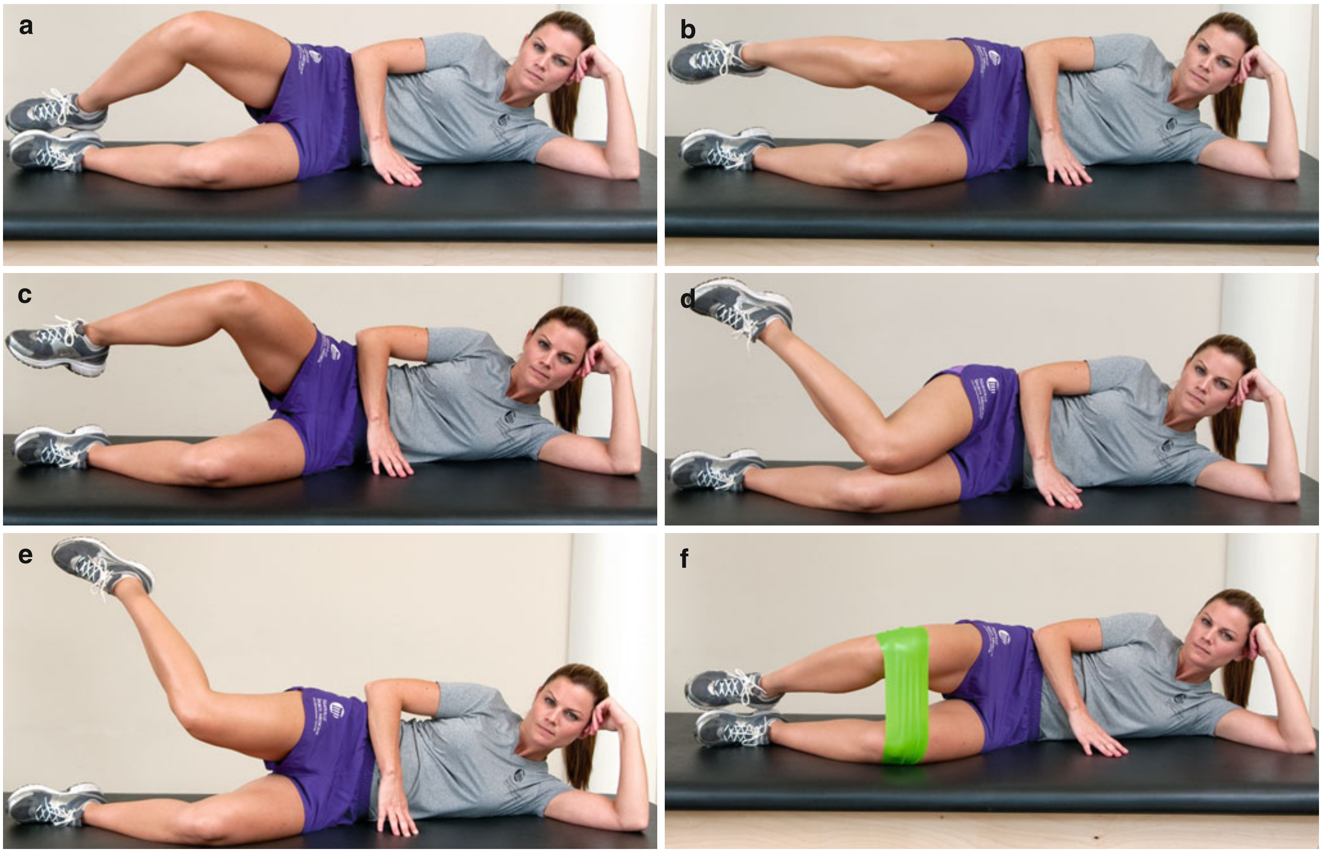

Fig. 33.17 Clamshell progression. (**a**) Classic clamshell. (**b**, **c**) Level 2 clamshell with hip in an isometric abduction position. (**d**) Reverse clamshell. (**e**) Level 2 reverse clamshell. (**f**) Resisted clamshell. (All rights are retained by Dr. Byrd)

Phase 2: Intermediate Exercise and Stabilization

The intermediate phase of rehabilitation typically begins around week 4 and is a progression of the range of motion/stretching (Video 33.16: http://goo.gl/LF0Vi and Video 33.17: http://goo.gl/AJx93) and strengthening exercises (Video 33.18: http://goo.gl/zzSTs) started in phase 1. The range of motion exercises should be continued until full pain-free range of motion is present. Strengthening and stabilization exercises should advance throughout this phase to challenge the patient and correct any muscle weakness or imbalance that was present. Weight-bearing (progressive resistive exercises) resistance exercise (Video 33.19: http://goo.gl/hz5Jh) and resistance to the bicycling program can be added during this phase. Emphasis must be placed upon the elimination of muscle imbalances and motor substitution patterns that occur with tasks of ADL. The most common cause for muscle imbalance is chronic overuse or injury which leads to neuromuscular compromise and an eventual change in the elasticity of the muscle. The neuromuscular compromise can manifest by three different mechanisms: (1) *Arthrokinetic Inhibition:* The neuromuscular phenomenon that occurs when a muscle is inhibited by joint dysfunction or the capsule that crosses the joint. Overuse leads to shortening/tightening (not spasm) of postural muscles; disuse leads to a weakening/inhibition of phasic muscles. (2) *Synergistic Dominance:* The neuromuscular phenomenon that occurs when synergists, stabilizers, and neutralizers take over for a weak or inhibited prime mover. (3) *Reciprocal Inhibition:* The neuromuscular phenomenon that occurs when a tight muscle decreases the neural drive to its functional antagonist. This leads to compensation patterns and predictable injury patterns. The most common muscle imbalance seen is tightness of the hip flexors and erector spinae muscles with weakness of the gluteals and abdominal musculature resulting in an anterior pelvic tilt with an increased lumbar lordotic curve. Therefore, core stabilization exercises (Video 33.20: http://goo.gl/FSwdO) are progressed in conjunction with the hip progressive resistive exercise program (Video 33.21: http://goo.gl/SrYh0).

Core stability is an exceedingly important, yet often overlooked, aspect of hip rehabilitation after both injury and surgery, and may be especially critical in optimizing performance and minimizing the risk of reinjury. Core stabilization/strengthening emphasizes training of the trunk musculature to develop better pelvic stability and abdominal control. A simple analogy could be made comparing the core stabilization component after surgery to that of a scapular stabilization program with injury in the upper quarter. Often patients develop the strength, power, and endurance of specific extremity musculature to perform required activities but are deficient in muscular strength of the lumbopelvic-hip complex. The core stabilization system must be checked as part of the assessment and specifically challenged as part of the rehabilitation program [4]. The basic screen involves several basic screening tests. The *Pelvic Tilt Test*

Fig. 33.18 (**a**) Double leg bridge. (**b**) Single leg bridge. (**c**, **d**) Stool hip internal/external rotation. (**e**) Resisted hip extension. (**f**) Side-lying hip abduction with heel against the wall. (**g**) Prone heel squeezes. (**h**) Hip abduction with hip in internally rotated position. (**i**) Mini-squat. (All rights are retained by Dr. Byrd)

Fig. 33.18 (continued)

Table 33.3 Results: gluteus medius

Exercise	%MVIC gluteus medius
Side plank abduction, DL down	103.11
Side plank abduction, DL up	88.82
Single limb squat	82.26
Clamshell (hip clam) 4	76.88
Front plank	75.13
Clamshell (hip clam) 3	67.63
Side-lying abduction	62.91
Clamshell (hip clam) 2	62.45
Lateral step-up	59.87
Skater squat	59.84
Pelvic drop	58.43
Hip circumduction, stable	57.39
Dynamic leg swing	57.30
Single limb dead lift	56.08
Single limb bridge, stable	54.99
Forward step-up	54.62
Single limb bridge, unstable	47.29
Clamshell (hip clam) 1	47.23
Quadruped hip ext, DOM	46.67
Gluteal squeeze	43.72
Hip circumduction, unstable	37.88
Quadruped hip ext, non-DOM	22.03

(Video 33.22: http://goo.gl/JKuUU) is a great test for overall mobility of the hips and the lumbar spine and the patient's ability to control the position of their pelvic posture. This test examines the ability to mobilize and control the movement of the pelvis linking the lower body with the upper body. The test begins with having the patient tilt their pelvis forward and backwards. Begin by having the patient create an arch in their back (rolling pelvis forward) and then flattening their lower back (rolling their pelvis backward). Observe for both the motion available and the smoothness or nature of the movement. The quality of the movement indicates the frequency of use on a day-to-day basis. The *Pelvic Rotation Test* (Video 33.23: http://goo.gl/x7TDY) checks the patient's ability to rotate their lower body independently from their upper body. This movement requires good mobility of the spine, hips and pelvis, and simultaneous stability of the trunk. Look for smooth turns to the right and left with no choppiness or lateral movement (no lateral movement of the pelvis). This test requires the use of hip rotators and oblique abdominals to rotate the pelvis. The *Torso Rotation Test* (Video 33.24: http://goo.gl/z8gvu) checks the patient's ability to rotate their upper body independently from their lower body. This movement requires good mobility of the trunk and simultaneous stability of the hips and pelvis. Look for any movement of the hips or extension/side bending of the thoracic spine vs. rotation. (There should be no motion below the waistline.) The *Bridge with Leg Extension Test* (Video 33.25: http://goo.gl/tIwqq) is a great test for stability in the pelvis, lumbar spine, and core – especially the gluteal muscles. This test will highlight any inhibition or weakness in the gluteus maximus due to over-recruitment of the synergistic muscles, like the hamstrings and lower back. If the pelvis on the unsupported side drops or the support leg shakes, this indicates instability in the gluteal muscles on the support side. If the support leg hamstrings or lower back start to cramp, this also indicates inhibition of the gluteals and recruitment of synergistic muscles – LOOK FOR CRAMPING. The most common reason for a failed test is a deactivation of the gluteals. The patient is used to recruiting the hamstrings and lower back for hip extension, so when asked to go into a bridge position those muscles go into hyperactivity. Next, when the leg is extended, this position should normally be easy for the gluteals to support, but if the gluteals are inhibited, cramping of the synergistic muscles will usually occur. Weakness in the abdominals, legs, and gluteals can also show a positive test. The patient will not show signs of cramping, but instead they will say the test is not easy or that one leg is easier than the other. An integrated functional unit of an effective core stabilization system plus a strong lumbopelvic-hip musculature complex is important for efficient weight distribution, absorption, and transfer of compressive forces [36].

Phase 3: Advanced Exercise and Neuromotor Control

Proprioceptive deficits routinely occur in conjunction with articular injuries [18]. The acetabular labrum contains free nerve endings and sensory organs [11, 25]. It is believed that these free nerve endings contribute in nociceptive and proprioceptive mechanisms [18]. The acetabular labrum also improves the stability of the hip joint by maintaining a negative intra-articular pressure [37]. With injury to the labrum, this negative pressure is lost and stability of the hip is adversely affected. This inhibits normal motor response and decreases neuromuscular stabilization of the joint. The aim of proprioceptive retraining is to restore these deficits and assist in reestablishing neuromotor control. The elements necessary for reestablishing neuromuscular control are proprioception, dynamic joint stability, reactive neuromuscular control, and functional motor pathways [18]. Joint positioning tasks performed early in the rehabilitative process can enhance proprioceptive and kinesthetic awareness. More advanced proprioceptive neuromuscular techniques incorporated in functional patterns of movement or modified ranges may be acceptable transition exercises, depending on the symptoms and status of the hip (Fig. 33.19a–c).

Dynamic stabilization exercises encourage muscular co-contractions to balance joint forces. Closed chain methods allow progressive weight-bearing transference to the lower

Fig. 33.19 Advanced proprioceptive neuromuscular hip exercises. (**a**) Single leg balance on balance pad. (**b**) Single leg balance on BOSU ball. (**c**) Mini-squats on BOSU ball. (All rights are retained by Dr. Byrd)

extremity in a manner that lessens the shear and translational forces across the joint surface [18]. This begins with simple static balance maneuvers, starting with full stance, and evolving to single limb stance, with and without visual input. Progression is then made to a combination of balance and strength activities. Bilateral heel raises (Video 33.26: http://goo.gl/svEd1) and mini-squats (Video 33.27: http://goo.gl/KEFsI) are progressed to unilateral heel raises and mini-squats (Video 33.28: http://goo.gl/9zpNw). More advanced closed kinetic exercises such as partial squats, lunges (Video 33.29: http://goo.gl/WHcdw), and dynamic weight shifts are encouraged initially in the pool. Low force, slow speed, and controlled activities may be transitioned to high progressive force, fast speed, and uncontrolled activities if the joint allows without becoming overstressed. For example, balance devices (Video 33.30: http://goo.gl/Y4DPu), mini-trampolines, and unlimited creative upper extremity activities while balancing can further challenge the neuromuscular system (Fig. 33.20a–m). Emphasis in the balance and functional training program (Video 33.31: http://goo.gl/X77M2) should be focused upon core stabilization and proper recruitment of the gluteus medius muscle group.

Static stabilization, transitional stabilization, and dynamic stabilization are phases of progression from closed chain loading and unloading, to conscious controlled motion with high joint tolerance, and ultimately to unconscious control and loading of the joint. Thus, depending on the patient's tolerance, the exercise program may progress from slow to fast, simple to complex, stable to unstable, low force to high force, and general to specific [18].

Phase 4: Return to Activity

The ultimate time frame for return to function depends upon the type of hip pathology present and the specific demands of the patient's anticipated activities.

Functional exercises simulating the patient's daily activities or sport-specific programs must be individualized to meet the patient's goals. Each patient or athlete's reassessment and phase 4 rehab program will need to be tailored to their specific demands of their sport or activity. It is beyond the scope of this chapter to include individualized programs for each sport for phase 4 rehab and specific functional tests. Functional tests are used at this time to assess the readiness of the patient to return to unrestricted activity (Fig. 33.21). These may include a functional squat test, a functional single leg step-down test, running/sprinting assessments, cutting/lateral movements, and sport-specific tests. These must be kept within the constraints dictated by the type of hip pathology that has been addressed. Improving quality of life is certainly a goal of arthroscopic procedures but must be kept within the framework of a realistic outlook.

For some cases, depending on the extent of pathology and the extent of surgical debridement, the explosive character of compressive forces generated by certain specific physical and sports activities may need to be curtailed or modified with substitutions that the joint can tolerate during healing. In fact, some patients or athletes may need to change the sport position or the sport altogether. Lastly, the clinician must ensure that the patient's expectations and the goals of rehabilitation coincide by emphasizing education for current and future hip management. The patient's compliance with a continued management program should include maintaining muscle balance (strength, flexibility, and proprioception) and improving overall function.

Box 33.5 Timeline of Cardio

- Bike (day 3–1 week post-op depending on procedure)
- Elliptical (4–5 weeks post-op or 8–9 weeks for microfracture)
- Walking program (week 8)
- Jogging (start assessment at week 10–12 depending on type of surgery and extent of bone work)
- Sprinting (week 14+)

Box 33.6 Checklist for Return to Play a Specific Sport

- Can perform all required activities to participate in a game without compensation or pain
- Full functional ROM/strength
- May need to communicate with athlete's trainer/coach to discuss return to play
- Educate athlete on the importance of maintaining full strength/ROM, flexibility, and activities to avoid long term

Fig. 33.20 Dynamic stabilization exercises. (**a**) Single leg ball toss on BOSU ball. (**b**) Single leg balance with PNF pattern. (**c**–**e**) Airplane balance activity. (**f**) Plyobox jumps. (**g**) Jumping mechanics are assessed and corrected during these exercises. (**h**) Forward quick steps on plyobox. (**i**) Lateral quick steps on plyobox. (**j**) Double leg hops on plyobox. (**k**) Double leg hop hurdle drill. (**l**) Single leg hop hurdle drill. (**m**) Double leg lateral hop hurdle drill. (All rights are retained by Dr. Byrd)

Fig. 33.20 (continued)

Fig. 33.20 (continued)

Fig. 33.20 (continued)

Fig. 33.21 Single limb squat test. The stance leg is assessed for correct knee and hip position during this motion. This test may be helpful when assessing if athletes are ready to go back to their desired sport. (All rights are retained by Dr. Byrd)

Conclusions

The principles of rehabilitation following hip arthroscopy continue to evolve based on expanding knowledge gained both from improved diagnostics and surgical management. The development of effective evidence-based rehabilitation protocols is advancing in conjunction with concepts that protect the integrity of the healing tissues. A common goal of hip rehabilitation should remain focused on the return to pain-free function and long-term restoration of the hip joint. A cornerstone to a successful treatment plan is constant reassessment. Outcome data indicates that this goal is being met, but further data will be required to completely validate the long-term success [38].

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