1 Introduction

Total joint replacements surgeries are one of the most common treatment to osteoarthritis, the hip being one of the joints that is affected by osteoarthritis is discussed in this case study which is divided into two main sections.

In the first section of my work I investigate osteoarthritis in general and later in particular with the hip joint being affected. Non-surgical and surgical treatments are both evaluated and reviewed with the surgical procedure being the most common treatment for advanced hip osteoarthritis. From physiotherapy point of view, hip osteoarthritis is reviewed in general and the postoperative rehabilitation is laid out.

With the second part of my work being patient specified I investigate and review the postoperative osteoarthritis patient after non-cemented hip replacement surgery. This part mainly evaluates physiotherapy treatment followed by two main kinesiologic examinations at the beginning and at the end of my clinical work period with the patient. At the end, a conclusion is laid out that includes patient's progress and physiotherapy evaluation.

The practical part of this case study was conducted under the expert supervision of the experienced physiotherapist Mgr. Renata Karásková at UVN Praha – Oddělení rehabilitační a fyzikální medicíny in pavilonu C3 from January 8th 2010 to January 18th 2010.

2 General investigation

2.1 Osteoarthritis

Osteoarthritis is the most common condition to affect synovial joints and the most important cause of locomotor disability. The term osteoarthritis should be reserved mainly for conditions caused by primary degeneration of articular cartilage.[1]

Because osteoarthritis increases significantly with age, it was long considered to be a degenerative disease that was an inevitable consequence of ageing and trauma. However, it is viewed now as a metabolically dynamic process characterized by an imbalance of joint breakdown in association with a maladaptive and insufficient repair process, and therefore considered to be a major challenge for health-care providers.[2]

When all ages are considered, men and women are equally affected. Younger than 45 years, the disease is more prevalent in men; older than 55 years, women are more commonly afflicted. The pattern of joint involvement commonly includes the joints of the hands and knees in women and the hip joints in men. The incidence of hip osteoarthritis is higher in European and American white males than in Chinese, black South Africans, and East Indians.[3]

Risk factors for osteoarthritis include advanced age, obesity, and participation in activities that predispose repetitive micro fractures. Epidemiologic data also suggest increased risk of osteoarthritis in persons with low levels of vitamins D and C and estrogen deficiency. Other causative factors include inflammatory arthritis such as rheumatoid arthritis and spondyloarthropathies, metabolic joint disease such as hemochromatosis, acromegaly, gout and pseudogout, trauma, and congenital structural abnormalities.[4]

[1] Greene, 112
[2] Adebajo, 51
[3] Frontera, Essentials, 2nd ed., 271
[4] Frontera, Essentials, 1st ed., 638

Osteoarthritis is traditionally separated into two main categories, primary and secondary. Primary osteoarthritis is increasingly prevalent with advancing age. Some arthritic changes are part of the normal aging process, as evidenced by the decreased range of motion of virtually all joints, even in people who are asymptomatic. However, after the age of 75 years, more than 80% of persons are symptomatic and are limited to some degree by osteoarthritis in one or more joints. It typically involves joints in characteristic locations (see Figure 2.1.1) and is likely to result mainly from genetic predisposition.[5]

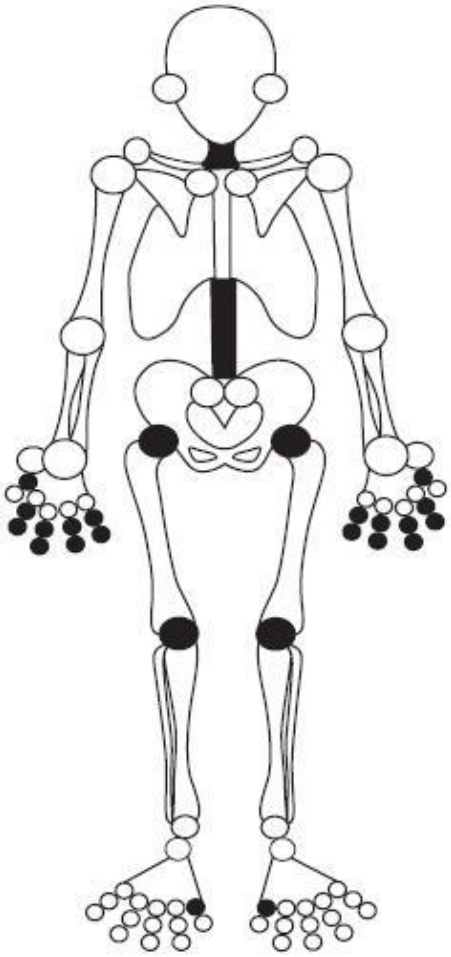


Figure 2.1.1 Typically involved joints in osteoarthritis. Adebajo, 54

Multiple Heberden's nodes, which are bony enlargement of distal interphalangeal joints of the hand (see Figure 2.1.2), appear in middle age and are a strong marker for subsequent predisposition to knee osteoarthritis and osteoarthritis at other common target sites, however, osteoarthritis can occur in any joint. When osteoarthritis occurs in atypical joints, such as the ankle, the presentation alone should trigger consideration of secondary osteoarthritis.[6]

Figure 2.1.2 Heberden's nodes. Adebajo, 54

[5] Greene, 113-114
[6] Adebajo, 51

Secondary osteoarthritis is applied when underlying recognizable local or systemic factors exist. These include conditions leading to joint deformity or destruction of cartilage, followed by signs and symptoms typically seen with primary osteoarthritis.[7] [8] Typical etiologies of secondary osteoarthritis include joint trauma, previous fracture and preceding inflammatory arthropathy such as gout.[9]

[7] Frontera, Essentials, 2nd ed., 273

[8] Cuccurullo, 94

[9] Adebajo, 51

2.2 Hip anatomy and kinesiology

The hip joint is the most proximal of the lower extremity joints. It is very important in weight-bearing and walking activities. The rounded or convex-shaped femoral head fits into and articulates with the concave-shaped acetabulum.[10]

Despite being called a ball and socket joint, the articulating surface of the acetabulum covers only the anterior, superior, and posterior sides. The area medial to the horseshoe-shaped articular cartilage is called the acetabular fossa (Figure 2.2.1) and contains the ligamentum teres, a mobile fat pad and synovial membrane. Its primary function is to carry the vascular supply to the head of the femur.[11]

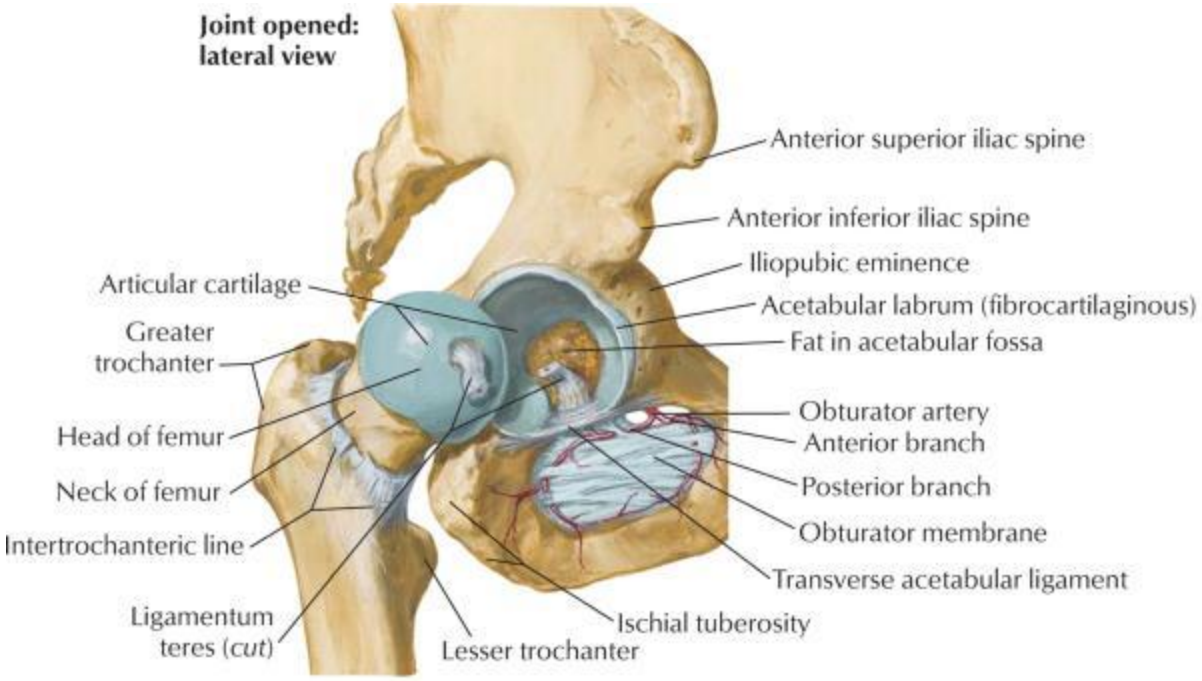


Figure 2.2.1 The hip joint opened: lateral view. Greene, 107

The acetabular fossa permits the necessary movement of the ligamentum teres and importantly serves as a reservoir for synovial fluid when the hip is heavily loaded. When the forces on the joint decrease, synovial fluid again returns to the joint space to provide lubrication

[10] Hamill, 192-193
[11] Smith, 267

and nutrition to the articular cartilages. The femoral head is two thirds of a sphere, and the acetabulum is a hemisphere with three notches bridged by ligaments. A triangular fibrocartilagious labrum encircles the rim of the acetabulum and substantially encloses the head of the femur. The joint capsule is a strong structure attaching to the outer rim of the acetabulum, enclosing the neck of the femur like a tube, and with distal attachements along the trochenteric line anterioly and just above the trochanteric crest posteriorly.[12]

The femur is held away from the hip joint and the pelvis by the femoral neck. The medial femoral neck is the portion responsible for withstanding ground reaction forces. The lateral portion of the neck resists compression forces created by the muscles. The femoral neck joins up with the shaft of the femur. The shaft is very narrow in the middle, also, the shaft bows anteriorly to offer the optimal structure for sustaining and supporting strong forces.[13]

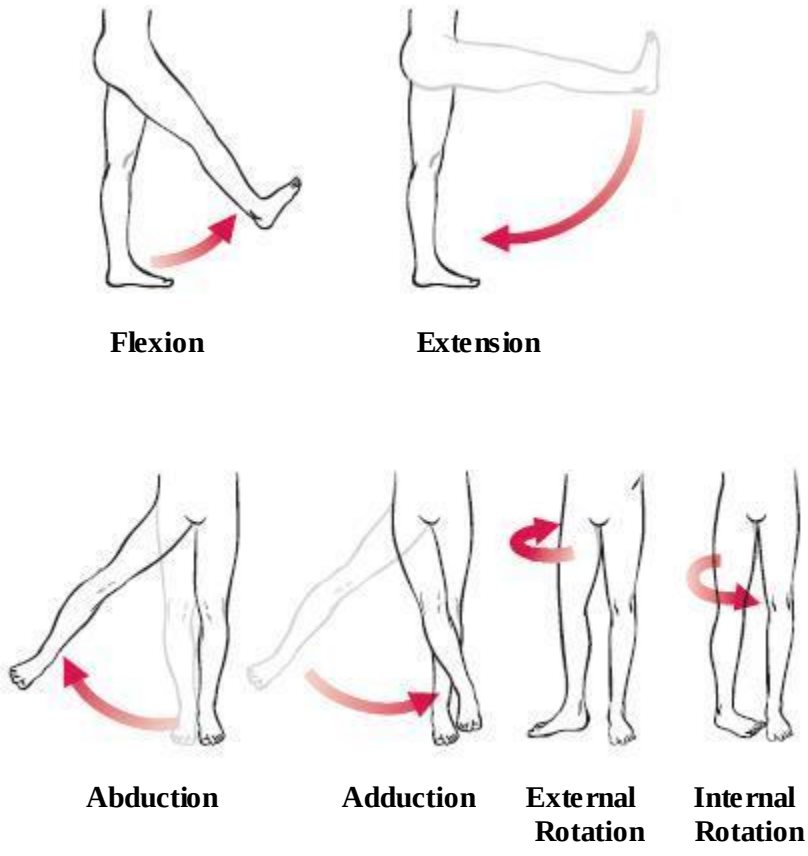


Figure 2.2.2 Hip joint movements. Lippert, 232

The hip joint allows the thigh to move through a wide range of motion as seen in figure 2.2.2. First, the thigh can move through 120° to 125° of flexion and 10° to 15° of hyperextension in the sagittal plane. These measurements are made with respect to a fixed axis and vary considerably if measured with respect to the pelvis, the thigh can abduct through approximately 30° to 45° and can adduct 15° to 30° beyond the anatomical

[12] Smith, 267
[13] Hamill, 195

position and finally, the thigh can internally rotate through 30° to 50° and externally rotate through 30° to 50° from the anatomical position. Range of motion in the hip joint is usually lower in older age groups, but the difference is not that substantial and is usually in the range of 3° to 5°.[14]

The hip joint is surrounded by four groups of muscles, the posterior, anterior, medial and lateral groups as seen in figure 2.2.3. The posterior muscles are the gluteus maximus, the biceps femoris, the semitendinosus, and the semimembranosus (called the hamstrings), and the posterior portion of the adductor magnus. In addition there is a deeply located group consisting of six small muscles that all externally rotate the hip, they have proximal attachments both inside and outside the pelvis, have more or less horizontal direction, and have distal attachements in the region of the greater trochanter. The uppermost is the piriformis and the lowermost is the quadrates femoris. The anterior muscles include the rectus femoris, the Sartorius, the tensor fasciae latae, the iliopsoas, and the pectineus. The tensor has an anterolateral location and the pectineus has an anteromedial location. The lateral muscles include the gluteus medius, the gluteus minimus, the tensor fadciae latae and the piriformis are located laterally, on the abductor side of the hip. The tensor lies anterolaterally and the piriformis posterolaterally. The medial muscles, which makeup the adductor group, are identified as the large masculare mass of the medial thigh, bordering anteriorly to the vastus medialis and the Sartorius and posteriorly to the hamstrings. This group is

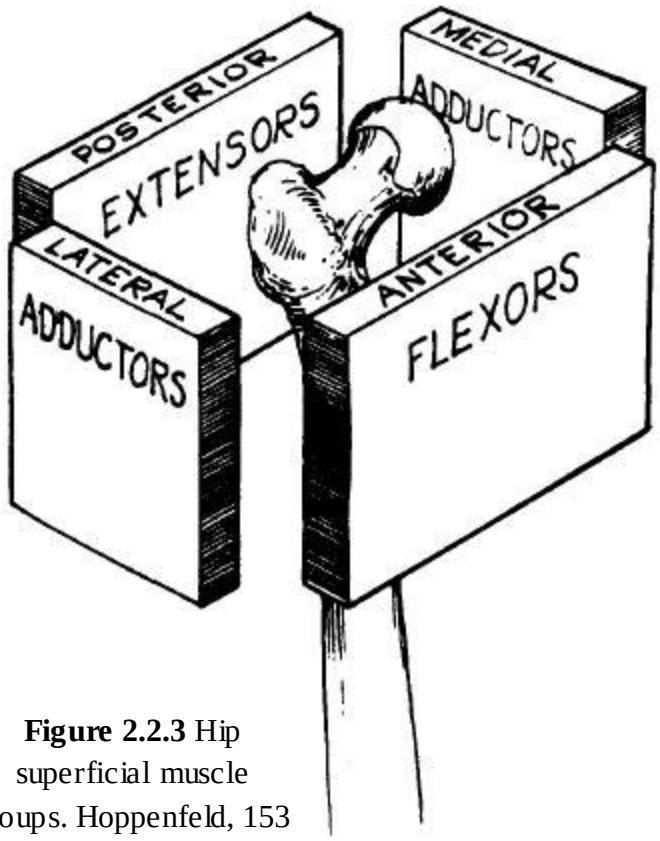


Figure 2.2.3 Hip superficial muscle groups. Hoppenfeld, 153

[14] Hamill, 197

comprised of the adductor magnus, adductor longus, adductor gracilis, adductor brevis and pectineus. The obturator externus, the quadrates femoris, and the lower portion of the gluteus maximus are also capable of adducting the hip but do not belong to the adductor group proper.[15] For better understanding of the muscles' function I have included table 2.2.1. The table summarizes the muscles and motions involved.

Muscle	*Flexion*	*Adduction*	*Int. Rotat.*	*Abduction*	*Ext. Rotat.*	*Extension*
Psoas major	x			x	x	
Iliacus	x			x	x	
Sartorius	x			x	x	
Pectineus	x	x				
Adductor long.	x	x	x			
Adductor brev.	x	x	x			
Gracilis		x				
Quadriceps	x					
Add. mag. (ant.)	x	x				
Obturator ext.		x			x	
Add. mag. (post.)		x				x
Ten. fas. lat.	x		x	x		
Gluteus minimus	x		x	x		
Gluteus medius	x		x	x	x	x
Gemelli inferior				x	x	
Quadratus fem.				x	x	
Semimembranosus			x			x
Semitendinosus			x			x
Gluteus maximus		x		x	x	x
Piriformis				x	x	x
Gemelli superior				x	x	
Obturator int.				x	x	
Biceps, long h.				x	x	x

Table 2.2.1 Hip muscles and movements. Kendall, 366

In the hip, three ligaments blend with the capsule and receive nourishment from the joint. The iliofemoral ligament primarily resists extension, external rotation, and some adduction, and is capable of supporting most of the body weight and plays an important role in standing posture. The second ligament on the front of the hip joint, the pubofemoral ligament, primarily resists abduction, with some resistance to external rotation and extension and the final ligament on the outside of the joint is the ischiofemoral ligament, on the posterior capsule, where it resists

[15] Smith, 279-296

extension, adduction, and internal rotation. None of the ligaments surrounding the hip joint resist during flexion movements, and all are loose during flexion. This makes flexion the movement with the greatest range of motion.[16]

In addition to transmitting large forces between the trunk and the ground, the hip region is a major component of the locomotor system. It participates in elevating and lowering the body, as in climbing or rising from a chair, and it is important in bringing the foot toward the body or hands, as in putting on a shoe. With every step, the hip abductor muscles (on stance leg) must create a force to balance about 85 precent of the body weight (head, arms, trunk, and opposite leg). The hip joint serves as the fulcrum in this system and therefore sustains more than twice the body weight with each step.[17]

The hip muscles generate the greatest strength output in extension. The most massive muscle in the body, the gluteus maximus, combines with the hamstrings to produce hip extension. Extension strength is maximum with the hip flexed to 90° and diminishes by about half as the hip flexion angle approaches 0°. Many muscles contribute to hip flexion strength, but many of the muscles do so secondarily to other main roles. It is primarily generated with the powerful iliopsoas muscle, although its strength diminishes with trunk flexion. Additionally, the flexion strength of the thigh can be enhanced if flexion at the knee joint increases the contribution of the rectus femoris to flexion strength. Abduction strength is maximal from the neutral position and diminishes more than half at 25° of abduction. The muscles contributing to the movement of adduction are massive as a group and can develop more force output than the abductors. Adduction, however, is not the primary contributor to many movements or sport activities, so it is minimally loaded or strengthened through activity. The strength output of both the internal and external rotators is greater in a seated position than in a supine one.[18]

Two examples of functional activities that demand reasonable hip strength are that of running and lifting. In running, the alternating opposite motions of the hips and knees drive the

[16] Lippert, 235-237
[17] Smith, 293-294
[18] Hamill, 202-203

running motion. Powerful hip extensors and knee flexors bring one leg back as the other drives forward using the hip flexors and knee extensors. The body maintains its sagittal plane motion through the stabilizing efforts of the deep six external rotators as well as the adductors and smaller gluteal muscles. In lifting, the hip and knee must work in concert with the trunk and upper body to lift objects from the ground. Powerful muscles like the gluteus maximus and quadriceps muscles drive the motion while stabilizers like gluteus medius and the adductor group maintain a steady body position.[19] [20]

[19] Cael, 366
[20] Reider, 177-179

2.3 Hip osteoarthritis

Hip osteoarthritis is one of the most common causes of hip pain in adults. Although patients with osteoarthritis of the hips usually present in their 60s or even 70s, the problem can present earlier, especially in patients with prior hip trauma or congenital abnormalities such as hip dysplasia.[21] Usually active individuals suddenly notice that enjoyment of active hobbies is curtailed and eventually life becomes sad for them.[22] [23]

Hip osteoarthritis is a condition that seem to have plenty of factors contributing to it as Frontera writes: "The significant mechanical forces (three to eight times body weight) that are exerted on the hip joint during weight-bearing activities such as walking, running, jumping, and lifting, the additional stresses created by recreational activities (e.g., impacts and falls during

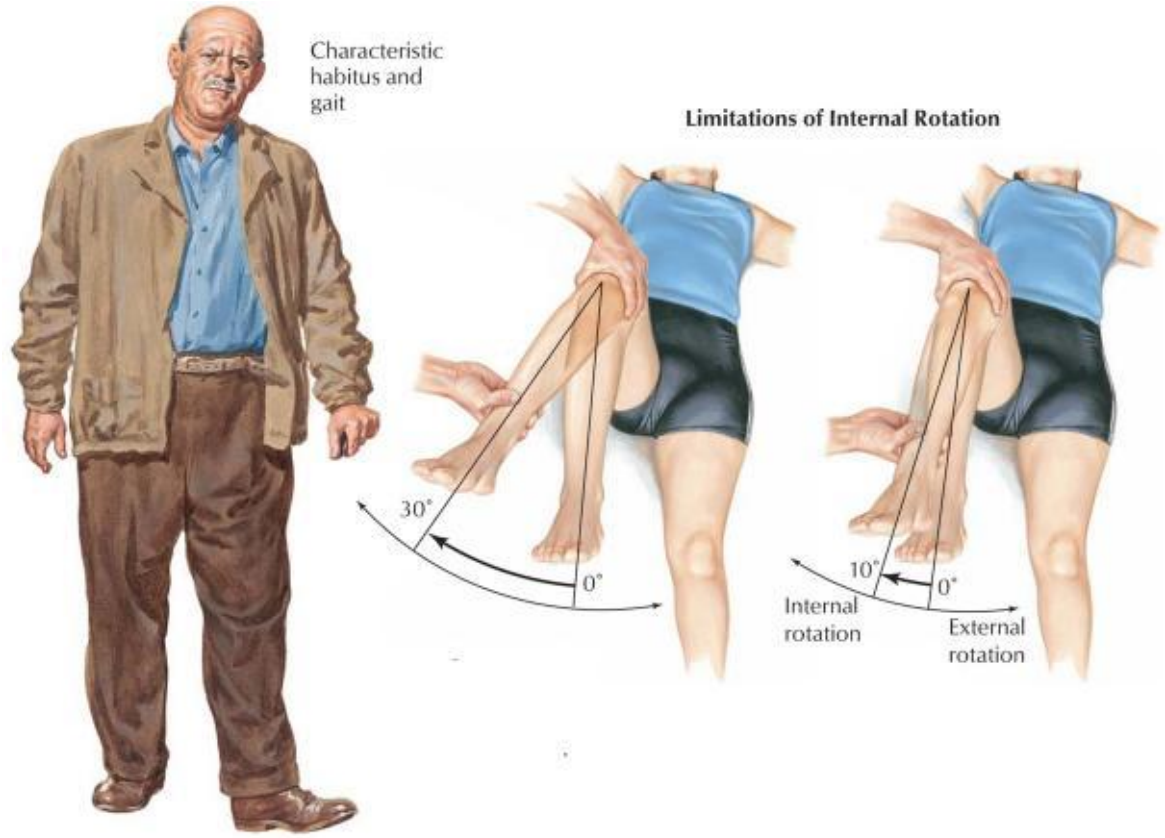


Figure 2.3.1 Typical presenting symptoms in hip osteoarthritis. Greene, 115

[21] Adebajo, 30
[22] Skinner, 382-383
[23] Luqmani, 233

sports), severe trauma (e.g., motor vehicle collisions), obesity, occupational heavy lifting and frequent stair climbing."[24]

The most sensitive sign of early osteoarthritis of the hip is loss of internal rotation. As the disease and joint contractures progress, decreased range of motion especially in abduction, flexion, and extension are observed (see Figure 2.3.1). Other typical presenting symptoms are indolent onset of anterior thigh or groin pain that is deep and activity related, and sometimes is referred to the buttocks or distal thigh. As degeneration of the articular cartilage progresses, the duration and the frequency of the pain intensifies. Furthermore, pain while at rest or pain that wakens the patient at night is a good sign that associates this pain with severe arthritis.[25]

Diagnosing hip osteoarthritis begins with a clinical examination of the patient who complains of hip pain. Initially the examination begins with history taking, during which the patient is asked mostly about his current functional status, past medical history, family history, medications, current symptoms, current health status, living environment, social history, hobbies, occupation and, most importantly, the level of pain perceived that can be assessed using a standardized pain assessment scale.[26]

Following history taking, the examiner checks for two main symptoms that are associated with hip osteoarthritis: the first symptom pain, the examiner palpates the anterior area of the hip. A typical result is increased pain sensation over the anterior hip capsule and also passive rotations of the affected hip that also result in increased pain.[27] The second symptom includes passive range of motion of the affected hip, mostly internal rotation and flexion limitations.[28]

Mobility skills are also examined with hip osteoarthritis, the patient may show a limp with associated stiffness. Furthermore, the patient may develop a Trendelenburg (see Figure 2.3.2) gait which is a direct cause of weakening of hip abductors. In extreme situations, leg

[24] Frontera, Essentials, 2nd ed., 274
[25] Ibid.
[26] Giles, 351
[27] Adebajo, 29-30
[28] Cleland, 289

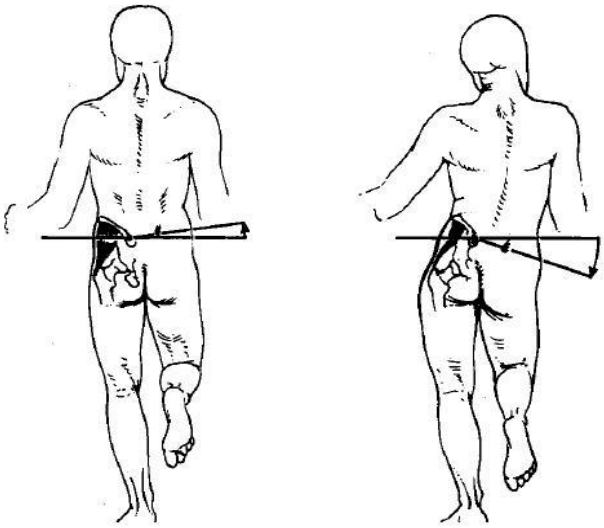


Figure 2.3.2 Trendelelenburg gait. Hoppenfeld, 164

length is lost, and the hip adopts a fixed flexion and adduction deformity that affects yet again the patient's mobility skills.[29]

Nonetheless, there are more clinical examinations that may be useful with diagnosis of hip osteoarthritis. I have selected six different clinical examinations and they are shown in the following table:

Resisted straight leg-raising test[30]

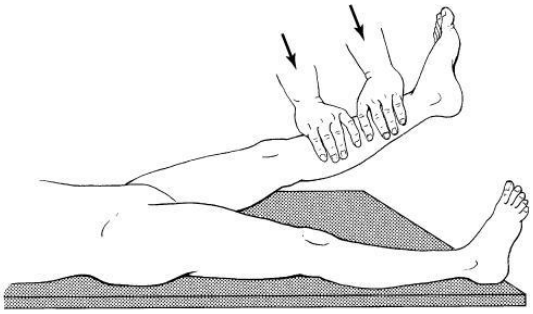


Figure 2.3.3 Resisted straight leg-raising test. Skinner, 376

The examiner asks the patient to actively raise the straight leg to approximately 30 degrees. This produces hip pain in severe arthritis.

Faber maneuver (Patrick test)[31]

Have the patient lie supine on the table and place the foot of his involved side on his opposite knee. In this position, inguinal pain is a general indication that there is pathology in the hip joint such as osteoarthritis.

Figure 2.3.4 Faber maneuver. Hoppenfeld, 262

[29] Adebajo, 29-30
[30] Skinner, 376
[31] Hoppenfeld, 262

Hip scouring or quadrant test[32]

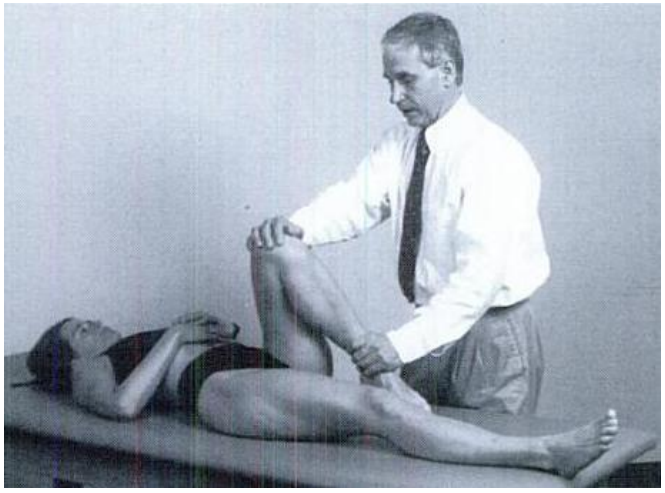


Figure 2.3.5 Hip scouring test. Konin, 208

With the subject supine, the examiner passively flexes and adducts the hip, and applies downward pressure along the shaft of the femur while simultaneously adducting and externally rotating the hip. Next, the hip is adducted and internally rotated, maintaining the downward pressure. The examiner notes any unusual movement (eg, catching, grinding) or subject apprehension. Pain or apprehension is indicative of hip joint pathology, such as arthritis.

Drehmann Sign[33]

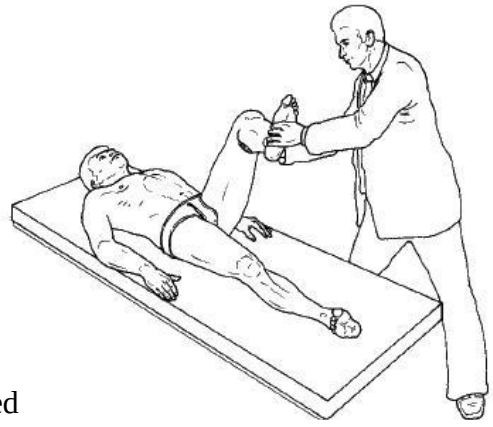


Figure 2.3.6 Drehmann sign. Buckup, 182

The patient is supine. The examiner grasps the patient's foot and knee and flexes the knee.
A hip disorder is present when flexion produces increased external rotation in the hip. The motion may be painless or it may cause pain. Osteoarthritis may produce positive test results.

[32] Bottomley, 432
[33] Buckup, 181-182

Anvil Test[34]

The patient is supine with legs extended. The examiner raises the extended leg slightly with one hand and hits the heel axially with the fist of the other hand. The force of the blow is transmitted to the hip. Pain in the groin or in the thigh adjacent to the hip suggests hip disease such as osteoarthritis of the hip.

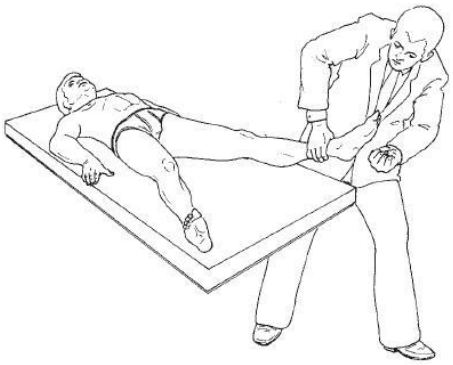


Figure 2.3.7 Anvil test. Buckup, 182

Leg Pain upon Axial Compression[35]

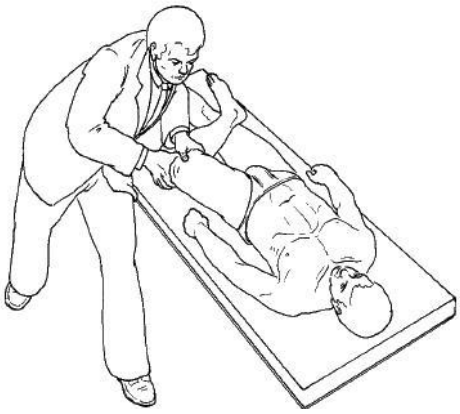


Figure 2.3.8 Leg pain upon axial compression. Buckup, 183

The patient is supine with one leg extended and the other flexed at the knee. The lateral malleolus of the flexed leg lies just superior to the patella of the contralateral leg. The examiner grasps the distal thigh of the flexed leg with both hands and compresses it axially. This motion compresses the hip joint and the affected side of the pelvis. Pain in the groin suggests hip disease such as osteoarthritis of the hip.

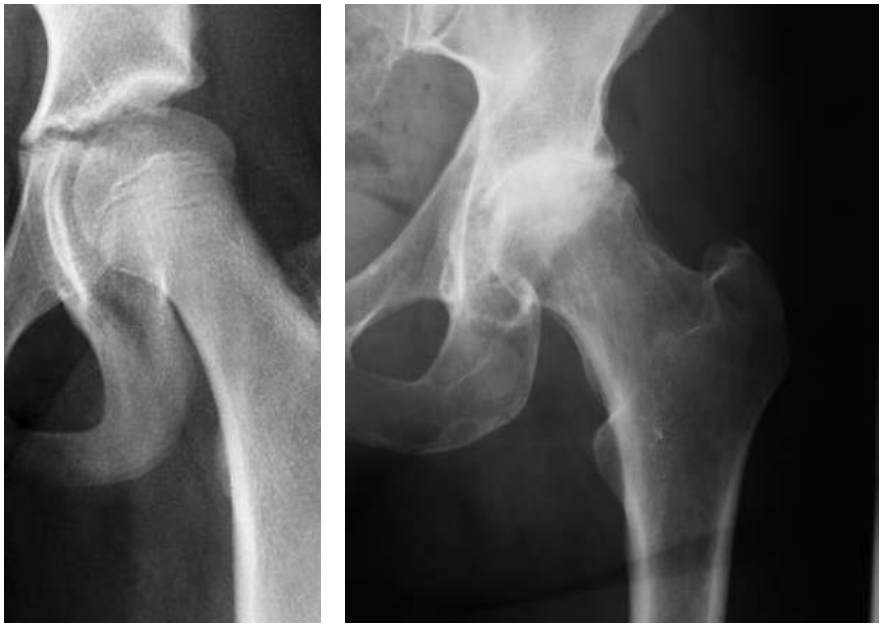
Table 2.3.1 Clinical examinations for hip osteoarthritis

[34] Buckup, 182
[35] Buckup, 183

Today, when technology plays a major role in physical medicine, radiographic techniques are the most reliable way to show the integrity of the joints and eventually diagnose a patient with hip osteoarthritis and include X-Ray, CT and Magnetic Resonance Imaging. A typical radiographic feature as seen in Figure 2.3.9 is primarily narrowing of the hip joint space, subchondral sclerosis, bony cysts, and marginal osteophytes. Severe cases of hip osteoarthritis are complicated by bony erosions, subluxation, loose bodies, and deformity.[36] Frontera[37] adds: "Magnetic resonance imaging is typically not needed for diagnosis of osteoarthritis but can be helpful in ruling out early osteonecrosis if osteoarthritis is not evident on plain radiographs of painful joints."

Figure 2.3.9 Primary osteoarthritis. Szendröi, 395

For clarity proposes I have attached Figure 2.3.10 and Figure 2.3.11 in order to point out the X-ray imaging differences between regular hip joint and one affected by osteoarthritis.



On right: **Figure 2.3.10** X-ray of a normal hip joint. Mettler, 321

On Left: **Figure 2.3.11** An advanced degenerative hip joint affected by osteoarthritis. Murray, 98

[36] Skinner, 384
[37] Frontera, Essentials, 2nd ed., 276

Treatments are predominantly directed at relieving symptoms, maintaining and improving joint function, and minimizing disability and handicap. Optimal management of patients with hip osteoarthritis is based on non-pharmacological and pharmacological treatments.[38] With both these treatments failing to relive the symptoms a surgical treatment may be indicated by the doctor.[39]

[38] Luqmani, 198
[39] O'Sullivan, 1072

2.4 Non-surgical treatment of hip osteoarthritis

2.4.1 Non-pharmacological treatment

Most patients are treated initially with conservative care that includes controlling pain and educating patients.[40] For clarity proposes I have included 2 tables. The first table 2.4.1.1 is evidence-based guidelines to non pharmacologic modalities for hip osteoarthritis management that summarizes the basic interventions, and the second table 2.4.1.2 is the European and US guidelines for management of osteoarthritis.[41] [42]

General Guideline	Intervention

• Patient education	• Information and options available
	  ○ Publications
	  ○ Web information
	  ○ Educational programs
	• Self-care courses
	  ○ Acquiring new skills
	  ○ Decreasing pain and fatigue
	  ○ Developing exercise program
	  ○ Using medications effectively
	  ○ Increasing relaxation
	  ○ Increasing self-confidence
	  ○ Decreasing depression
	  ○ Enhancing function

• Health professional • Social support	• Telephone contact • Direct health professional contact
• Weight loss (if overweight)	• Exercise • Dietary changes
• Physical therapy	• Range of motion exercises • Strengthening • Pain-relieving modalities • Assistive devices for ambulation
• Occupational therapy	• Joint protection • Energy conservation • Activities of daily living training
• Aerobic exercises	• Swimming

[40] Cooper, 279
[41] DeLisa, 202
[42] Adebajo, 69

	• Biking • Walking

Table 2.4.1.1 Guidelines to non pharmacologic modalities for hip osteoarthritis management. DeLisa, 203

The management plan must be individualized, taking into account the site and severity of OA symptoms, any co - morbidity, concurrent medications and patient acceptability
Non - pharmacological treatments are central — drug treatments are adjuncts
A core and option approach is required — all patients should be offered education, an exercise program, advice to reduce adverse mechanical factors and paracetamol as the first oral analgesic to try; there is a wide range of other treatment options from which to select additional treatments, as required

Table 2.4.1.2 European and US guidelines for management of osteoarthritis. Adebajo, 69

2.4.1.1 Patient education

As DeLisa writes: "A tenet of all health-care management is that the patient is an integral member of the team. Patient education as a planned, organized set of learning experiences designed to facilitate voluntary adoption of behaviors or beliefs conducive to health empowers the patient with new information, skills, beliefs, and attitudes to best influence health status, quality of life, and possibly health-care use."[43] Furthermore, Adebajo says: "Not only patient education is a professional responsibility but it also improves the outcome and the treatment in its own right".[44]

2.4.1.2 Weight loss

[43] DeLisa, 202
[44] Adebajo, 69

Obesity is a significant risk factor for the development of osteoarthritis and has been associated with radiologic progression of the disease and disability. To this end, weight reduction should be a key goal.[45]

Lotke adds: "Exercise increases aerobic capacity, muscle strength, and endurance, thereby facilitating weight loss, and all patients capable of participating in a low-impact aerobic exercise program (walking, biking, swimming) should be encouraged to do so."[46]

2.4.1.3 Physiotherapy

Stretching - Initial programs often begin with patients gently moving their joints through the available range of motion to maintain range of motion and then progress to regaining lost range of motion. Proper stretching should be sustained for at least 30 seconds while avoiding the sudden, jerky, or ballistic stretching that would be likely to exacerbate OA.[47] Most importantly, at least 30 degrees of passive hip flexion should be maintained bilaterally to allow for a normal gait pattern.[48]

Strengthening - Early hip joint strengthening can be started with static exercises, which are easily incorporated into a home program.[49] They should also address all planes of hip movement. Eventually, incorporation of dynamic exercises can maximize strength and function.[50]

Physical therapy modalities - In general, modalities such as transcutaneous electrical nerve stimulation also known as TENS and cryotherapy are probably most appropriate when used as a means of facilitating more active components of the exercise program, rather than as

[45] Lotke, 71
[46] Ibid.
[47] Frontera, Essentials, 2nd ed., 275-276
[48] Frontera, Essentials, 1st ed., 272
[49] Ibid.
[50] Frontera, Essentials, 2nd ed., 275-276

treatments given in isolation. They may also be used for short-term relief of acute exacerbations.[51]

Orthotics – Orthotic management of the lower extremity osteoarthritic patient can be invaluable for reducing ambulation-associated pain and thus promoting function. Additional benefits include energy conservation and joint protection, which potentially delay the onset of further degenerative changes.[52] Nonetheless, shoe lift can correct a leg length discrepancy caused by hip joint space narrowing or superior migration of the femoral head within the acetabulum.[53]

Assistive devices - With prescription of an assistive device, such as a cane or walker rapid symptomatic relief of unilateral hip pain from osteoarthritis may be achieved. Use of a single-point cane in the hand contralateral to the affected hip joint can reduce reaction forces in the hip by as much as 50%, which may improve both pain and walking tolerance.[54]

2.4.1.4 Occupational therapy

If there are deficits in functional activities such as lower extremity dressing, bathing, and home safety, the lower-limb osteoarthritis patient may benefit from a short course of occupational therapy. Occupational therapy can provide assistive devices, when appropriate, to help maximize the patient's independence and function for a wide variety of tasks. Items as seemingly simple as reachers, sock-donners, long-handled shoe horns, or elastic shoe laces may make the difference in whether a patient with limited lower-limb ROM can get dressed without additional help.[55]

2.4.1.5 Nutritional supplements

[51] DeLisa, 205
[52] Ibid.
[53] Frontera, Essentials, 2nd ed., 276
[54] Frontera, Essentials, 1st ed., 272
[55] DeLisa, 205

Also known as SYSADOA that stands for symptomatic slow-acting drugs in osteoarthritis is a general group of nutritional supplements that may include herbal remedies and the most popular used glucosamine sulfate and chondroitin sulfate.[56]

Glucosamine sulfate and chondroitin sulfate are derivatives of glycosaminoglycans that are naturally found in articular cartilage and are popular supplements for both osteoarthritis and rheumatoid arthritis patients and may serve as substrate for the reparative processes in cartilage. Although they both shown to have a small analgesic effect from recent studies, their use may provide safe and effective symptomatic relief in some patients with OA.[57]

2.4.2 Pharmacological treatment

Pain and disability can continue and preclude patients from making significant functional gains. In this particular case, pharmacologic intervention is an important and essential next step. Pharmacologic management should augment exercise and physical therapy and should be individualized following a careful assessment of symptom severity, comorbid conditions, drug side effects, cost of therapy, and patient preferences.[58]

Acetaminophen is often considered the drug of choice in mild-to-moderate osteoarthritis in patients who require pharmacologic therapy. It controls pain without anti-inflammatory effects and is therefore successful in reducing pain without causing gastric irritation, and it has been shown to be effective in relief of pain. Therefore, it is a relatively safe and effective form of analgesia for patients with osteoarthritis.[59] [60]

Both NSAIDs and COX-2 inhibitors may also reduce the pain but should be prescribed after careful consideration, as these drugs may worsen renal function.[61]

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[56] Lotke, 72
[57] Ciccone, 230-231
[58] Lotke, 71
[59] Ibid.
[60] Ciccone, 230
[61] Lotke, 71

Narcotic analgesics may be appropriate for short-term pain relief only associated with acute flares of osteoarthritic hip pain, in case of significant unremitting pain and appropriate diagnostic workup an intra-articular hip joint steroid injection may be performed.[62]

[62] Frontera, Essentials, 1st ed., 272

2.5 Surgical treatment of hip osteoarthritis

2.5.1 Overview

Total hip replacement (THR), also called arthroplasty, is an operative procedure in which the diseased hip joint is resected and replaced with a synthetic acetabulum, femur, and typically an ultrahigh molecular weight polyethelene liner.[63]

The goal of the surgery is to provide a long-lasting artificial joint that relieves pain and improves function while minimizing or avoiding surgical complications.[64] As seen today, modern hip replacement surgery has resulted in the restoration of pain free motion and improved quality of life for millions of people.[65]

Total hip replacement by itself is one of the most advanced developing technologies seen in the orthopedic medical field and is truly amazing as in John Vorhaus' example, whom subjectively writes after having his hip totally replaced twice: "Snip, zip, done. The surgery took 45 minutes, snip to zip. I found this astounding. Hell, I can't change the oil in my car in 45 minutes. But in a world where you can download ring tones of Burl Ives singing "Frosty the Snowman", I suppose nothing is impossible."[66]

Today, there are more than 300,000 THRs implanted worldwide annually.[67]

2.5.2 Indications

The primary indications for total hip arthroplasty include pain-limiting function secondary to osteoarthritis, rheumatoid arthritis, avascular necrosis, congenital dysplasia of the

[63] DeLisa, 855
[64] Ibid.
[65] Frontera, Essentials, 1st ed., 242
[66] Vorhaus, 81
[67] Cooper, 236

hip, dysfunction or a decline in mobility, self-care, and daily living activities despite conservative treatment.[68] [69]

Most of the times the surgeons have to base their decision regarding surgery in correspondence with their patient's symptoms such as severe pain on a daily basis, rest pain several days per week, and destruction of most of the joint space on a radiograph, furthermore, the patient's desire to return to work and an independent lifestyle plays a major role in the surgeons' final decision.[70]

2.5.3 Contraindications

As a general rule, sepsis of the involved hip joint is always an absolute contraindication.[71] Relative contraindications include active or recent joint infection, neurotrophic joints, inability of the patient to cooperate in the immediate postoperative period or with the rehabilitation program following joint implantation, serious co-morbid medical conditions that result in a higher surgical risk or compromised postoperative medical status, rapidly progressive or terminal cancer with shortened survival and/or severe debility, and severe nutritional depletion that jeopardizes postoperative wound healing, furthermore, some of the surgeons tend to avoid surgical procedure in case of patient's lack of motivation.[72]

2.5.4 Implants

An entire industry has evolved to produce new types of hip implants, including different head sizes, different femoral implant lengths, different cross sections, a porous coating for bone ingrowths' attachment, and metal cemented or porous coated backing for the acetabulum.[73]

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[68] Cooper, 236
[69] Frontera, Essentials, 2nd ed., 296
[70] Frontera, Essentials, 1st ed., 242
[71] Cooper, 236
[72] Frontera, Essentials, 1st ed., 242
[73] Miller, 241

Nonetheless, also a range of implant materials, including titanium or cobalt alloys, plastics, and ceramics are available.[74]

In general there are three common types of hip replacement implants: unipolar, bipolar, and true total hip that includes separate femoral and acetabular implant.[75]

The unipolar implant is a single machined metal alloy component; this often finds use in the minimally mobile elderly patient who sustains an intracapsular displaced femoral neck fracture.[76]

The bipolar implant (see Figure 2.5.4.1) design principle theoretically reducing stress, wear, or erosion of the acetabular cartilage. It can be used instead of the simpler unipolar implant for the same indications.[77]

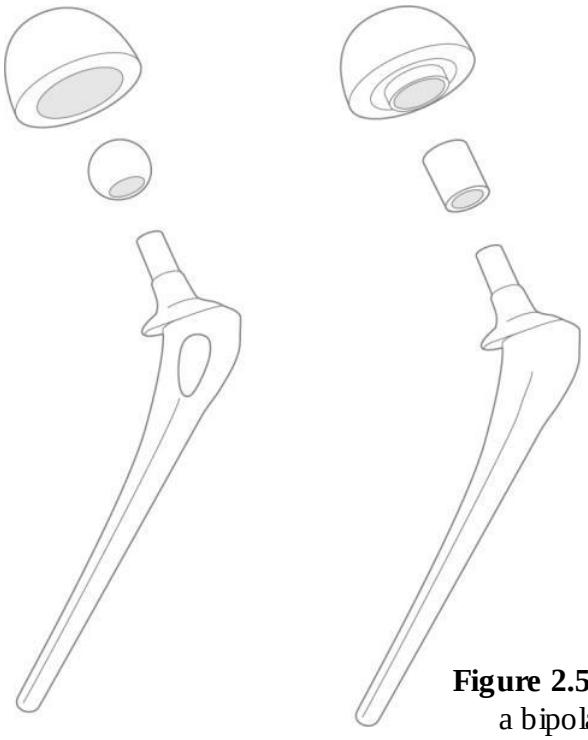

Figure 2.5.4.1 The components of a bipolar implant. Frontera, Essentials, 2nd ed., 300

The total hip implant components (see Figure 2.5.4.2) include a femoral stem in various sizes and shapes, a femoral neck in various angles and lengths, and an acetabular cup with a polyethylene liner of various sizes and inclinations. This allows the highest degree of customization for each individual and therefore is the most complex device of the three to insert properly but is used most commonly.[78]

[74] DeLisa, 855
[75] Frontera, Essentials, 1st ed., 242
[76] Frontera, Essentials, 2nd ed., 299
[77] Frontera, Essentials, 1st ed., 242
[78] Ibid.

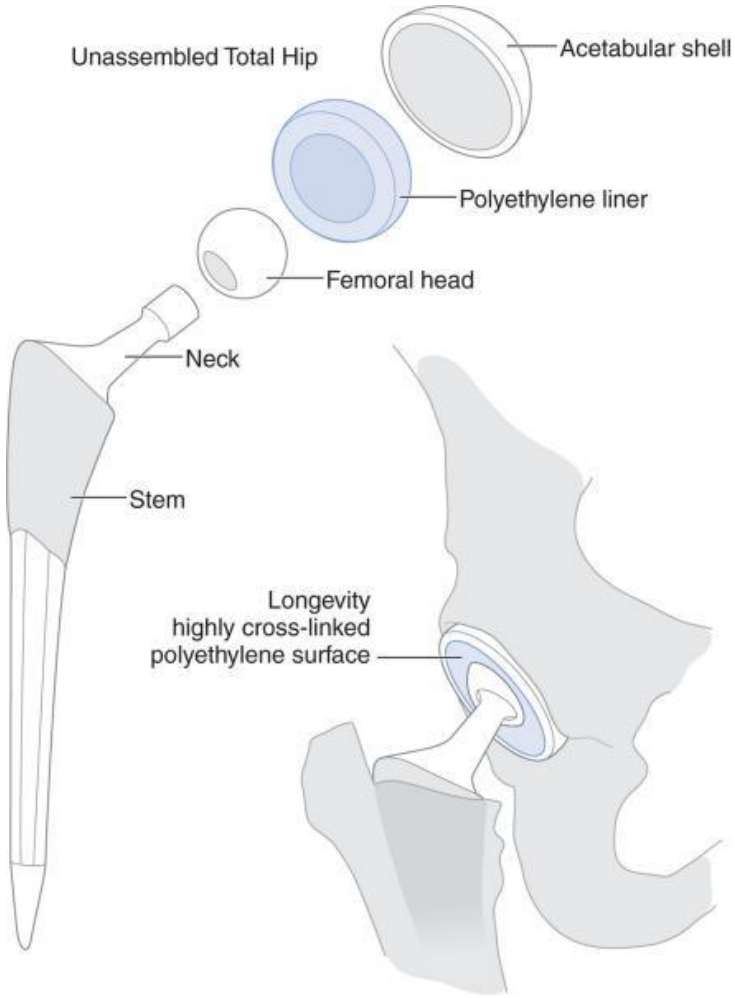

Figure 2.5.4.2 The components of a total hip replacement. Frontera, Essentials, 2nd ed., 300

2.5.5 Surgical approaches

There are three basic surgical approaches to total hip replacement. The posterolateral approach, which is the most common. The lateral approach which may be fraught with problems such as abductor weakness after surgery, and the result may be disappointing to the patient as well as the surgeon. And the anterolateral approach. Other approaches are also used and are successful according to the skill of the individual surgeon.[79]

Two newer THR surgical techniques are now or soon will be available to the younger, more active population. The first often referred to as the mini–hip replacement, is a standard THR done with minimally invasive surgical technique, requiring two small hip incisions. The

[79] Skinner, 402

surgery results in quicker return to full activities. And the second called the Birmingham Hip Resurfacing System results in possible increased prosthetic longevity and decreased risk of perioperative thromboembolic disease.[80]

2.5.6 Types of fixations

The method of long term fixation of the implant is done either with cement or with biologic intergitation of bone to the implant interface which is also known as non-cemented fixation.[81] The non-cemented is most commonly used in the younger, more active patient population, whereas the cemented is most commonly used with the less active elderly patient population.[82]

A patient with a cemented prosthesis, which is strongest immediately after curing, is allowed to weight bear as tolerated immediately, whereas the individual with a non-cemented implant which is at its weakest immediately after insertion of the device, often must wait for 6 to 8 weeks before fully weight bearing to allow for stability by bony in-growth.[83] [84] Nonetheless, studies have shown that non-cemented implants offer stronger long-term fixation and thus longer life of implants.[85]

[80] Frontera, Essentials, 2nd ed., 300
[81] Miller, 241
[82] Frontera, Essentials, 1st ed., 242
[83] Ibid.
[84] Cooper, 236
[85] Ibid.

2.6 Postoperative rehabilitation

2.6.1 Rehabilitation guidelines

General guidelines after total hip replacement that suppose to be clear to both the caregiver and the patient as Mosby writes include:[86]

- Guard against dislocation of the implant.
- Gain functional strength
- Strengthen hip and knee musculature
- Prevent bed-rest hazards such as thrombophlebitis, pulmonary embolism, decubiti and pneumonia.
- Teach independent transfers and ambulation with assistive devices.
- Obtain pain-free range of motion within precaution limits.

2.6.2 Patient education

Education of the surgical process and outcomes are given to the patient before surgery and should be reviewed after surgery.[87]

The surgical approach and the fixation used is of important information both to caregiver and the patient because they may impact the type of postoperative range of motion and weight bearing precautions as well as the early recovery of strength.[88]

Patients with cemented implants are prescribed partial weight bearing, usually defined as allowing pressure of about 70% of body weight, or full weight bearing. Whereas, patients with

[86] Brotzman, 285
[87] Cooper, 237-238
[88] DeLisa, 855

uncemented implants are often prescribed with restricted weight bearing, which allows pressure of 10% to 15% of body weight, for 6 to 12 weeks after surgery.[89]

Patients' education regarding ROM restrictions is highly important in order to prevent dislocations and vary depending on the surgical approach. After a posterior or lateral surgical approach, hip flexion of more than 90 degrees, hip adduction, and internal rotation past midline are avoided. And after anterior approach, hip extension and external rotation are additionally prohibited.[90] For better understanding, Brotzman summed up all instructions that should be provided to the patient after total hip replacement in posterior surgical approach and are seen in Figure 2.6.2.1.

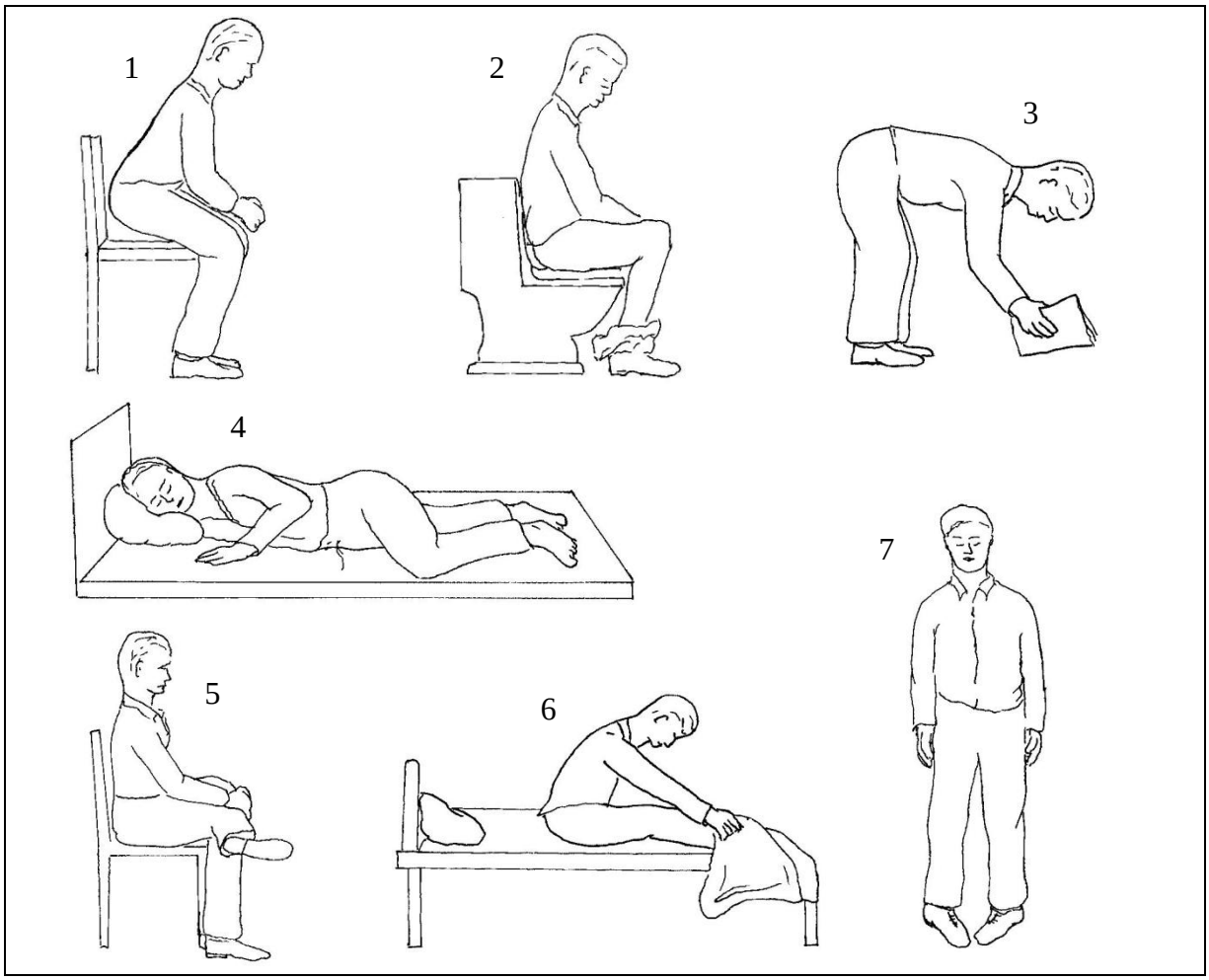

Figure 2.6.2.1 Instructions for patients after total hip replacement. Brotzman, 293-294

[89] DeLisa, 859-860
[90] DeLisa, 859-860

Key:

1. Do not lean over to get up. Instead, slide hips forward first, and then come to standing.
2. Do not sit low on toilet or chair.
3. Do not bend over too far. Use your reacher.
4. Do not lie down without a pillow between your legs.
5. Do not cross your legs.
6. Do not pull blankets up like this. Use your reacher.
7. Do not stand with toes turned it. Do not let knees roll inward while sitting.[91]

Furthermore, patients should be informed regarding use of adaptive equipments and assistive devices, such as elevated toilet seats, long-handled sponges, reachers, sock aids, dressing sticks, high toilet seats and tub benches for bathing to help patients to avoid the forbidden hip motions while performing functional tasks.[92] Also, it is important to instruct the patient to use assistive devices such as crutches until limp stops to avoid gait faults such as Trenelenburg gait. Patients also need to be informed regarding use of hip abductor splints or pillows to keep the legs in abduction during bed rest and when turning in bed.[93]

2.6.3 Physiotherapy

Early postoperative physical therapy vary among institutions and focuses on restoring mobility, strength, and flexibility; reducing pain; preventing deep vein thrombosis and other complications such as embolism with a use of stocking as an example.[94]

In general, inpatient rehabilitation length of stay ranges from 5 to 14 days. In order to achieve successful outcome and long-term satisfaction these patients should stay encouraged to walk to therapies and receive physical therapy treatment at least twice daily, including weekends while taking into consideration patients' individual impairments and their level of functionality

[91] Brotzman, 293-294
[92] Frontera, Essentials, 2nd ed., 301
[93] DeLisa, 859-860
[94] Ibid.

regarding activity of daily living. Also, their scar must be inspected daily, with attention to dressing changes and avoidance of infection.[95]

On postoperative day 1, the patient should perform bedside exercises, such as ankle pumps, quadriceps sets, and gluteal sets. Bed mobility and transfer training should begin at this time.[96]

On postoperative day 2, the patient should initiate gait training with the use of an assistive device and functional transfer training should continue.[97]

Postoperative days 3 to 5 should include progression of range of motion and strengthening exercises as tolerated. The patient should continue ambulation on level surfaces and then progress to stair training. At this time assistive devices should be mastered and hip abductor muscles should be strengthened.[98] [99]

After postoperative day 5, the patient will continue aggressive strengthening and stretching exercises targeting the hip. Within the first few weeks the patient should eventually be modified-independent in ADLs and achieve ambulation.[100]

2.6.4 Physiotherapy protocol

For better understanding, I have attached an example of a common physical therapy protocol after total hip replacement written by Godges see Figure 2.6.4.1. As I mentioned in Chapter 2.6.3 physical therapy protocols vary among institutions and may be changed as needed.

[95] DeLisa, 859-860, 865
[96] Cooper, 237-238
[97] Ibid.
[98] Frontera, Essentials, 2nd ed., 301
[99] Cooper, 237-238
[100] Ibid.

Phase I Hospital Phase: Days 1-2
Goals: Prevent complications – especially dislocation
Increase muscle contraction and control of involved leg
Help patient sit for 30 minutes
Intervention:
Day1
• Adjust abduction pillow
• Provide patient education regarding total hip precautions
• Begin exercises including: ankle pumps, quadriceps sets, gluteal sets, and upper extremity exercises
• Encourage use of cough and incentive spirometer
Day 2
Progress exercise program to include heel slides, isometric or active assistive hip abduction and short arc quadriceps sets
Bed mobility training
Transfer training
Gait training as appropriate (using a front-wheeled walker or crutches)
Phase II: Days 3-7
Goals: Promote transfers and gait independence
Continue to reinforce THR precautions
Discharge to home
Intervention:
• Continue interventions from phase I with progression of activity as tolerated
• Active range of motion with hip abduction, terminal knee extension, and upper extremity exercises
• Bed mobility training
• Transfer training; initiate car transfers when appropriate
• Gait training; initiate stair training when indicated ("up with good, down with bad")
• Evaluation of equipment needs at home
• Caregiver training
Phase III Return to Home (Home Care Phase): Weeks 1-6
Goals: Increase patient independence with gait and transfers
Evaluate safety of home
Plan return of patient to work or previous activities as indicated
Intervention:
- Closed-chain exercises such as heel raises and mini squats
- Cautious stretching of Achilles tendons in the standing position
- Progress from the use of a front-wheeled walker or crutches to single-point cane, this usually occurs 3-4 weeks after surgery (Use of cane is often discontinued after 3-4 more weeks)
- Normalize gait on level and sloped surfaces, jagged sidewalks, curbs, and stairs
- Car transfer instruction and practice

Phase IV Outpatient Clinic
Goals: Improve strength, endurance, and balance
Correct gait impairments
Independence with home exercise program
Intervention:
Strength, endurance and balance training
Pool exercise
Stationary bicycling, simulated cross-country skiing, and treadmill (as part of gym program)

Figure 2.6.4.1 Physical therapy protocol after total hip replacement. Godges

2.6.5 Outcome

A patient after total hip replacement will benefit from physical therapy and should attain an improved functional outcome. The patient should have diminished to no pain, increased strength and endurance, and improved mobility within six to eight weeks after surgery.[101]

The short-term prognosis for modern cemented or uncemented total hip replacement is excellent.[102] Long-term retrospective studies show that most patients are completely pain free. Most hip replacements are successful at the 10-year mark.[103]

Long-term use of a cane is recommended in the contralateral hand to minimize daily forces across the hip arthroplasty and, it is hoped, to prolong implant longevity as seen in Figure 2.6.5.1 as Brotzman explains "The use of a cane redirects the force across the hip. Without the

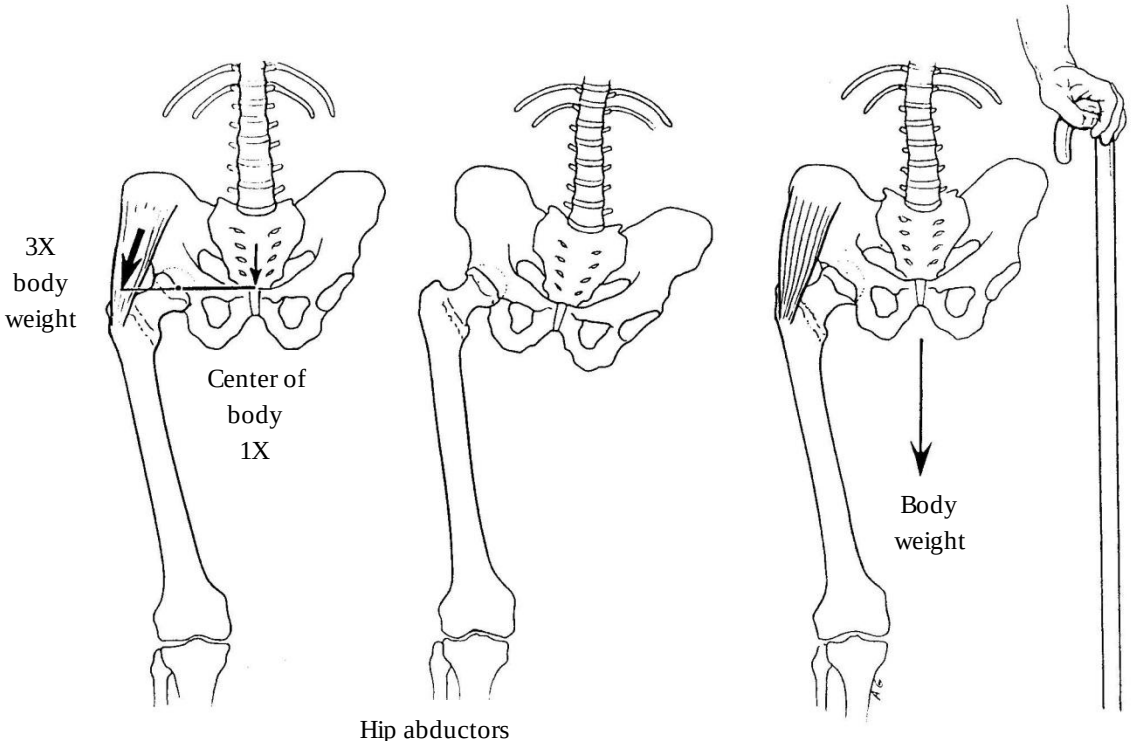

Figure 2.6.5.1 The use of a cane redirects the force across the hip. Brotzman, 301

[101] Giles, 352
[102] Frontera, Essentials, 2nd ed., 302
[103] Cooper, 237-238

cane, the resultant force across the hip is about 3 times body weight, because the force of the abductors acts on the greater trochanter to offset body weight and levels the pelvis in single stance".[104] Although most patients would be able to ambulate without an assistive device within 4 to 12 weeks after surgery.[105]

Activities such as cycling, golfing, and bowling should be encouraged, whereas running, jogging, water-skiing, cross-country skiing, football, baseball, handball, hockey, karate, soccer, and racket sports should be minimized or avoided.[106] Although some institutions may advice patients simulated cross-country skiing as part of gym program as I have shown in Chapter 2.6.4.

Long-term care should be preserved and should include medical follow-up, and follow-up rehabilitation services and must be communicated to the patient and family.[107]

2.6.6 Complications

Common complications of total hip replacements include aseptic loosening, infection, deep vein thrombosis, heterotopic bone formation, urinary tract infections, dislocations, and neurological deficits.[108]

Furthermore, a little less than half of these patients will have enough pain to require a revision of the implant. Also, over a prolonged period, wear can occur in the acetabular socket and can induce inflammation resulting in the thinning of the bone and thus, increase the risk for fracture.[109]

[104] Brotzman, 301
[105] Frontera, Essentials, 2nd ed., 302
[106] Ibid.
[107] Ibid.
[108] Cooper, 237-238
[109] Ibid.

2.6.7 Physical impairments

Common physical impairments after total hip replacements include decreased muscle strength, limited hip range of motion, limited flexibility, and abnormalities of gait and might last at least 1 year after surgery.[110] Furthermore, hip joint muscles weakness has been shown to persist at 2 years after surgery.[111]

[110] DeLisa, 864-865
[111] Frontera, Essentials, 2nd ed., 296

3 Case study

3.1 Methodology

This case study was conducted in order to evaluate the physiotherapy treatment for a patient after total hip replacement. In order to answer this research goal, a patient, B.V., after total hip replacement was randomly selected.

B.V. was born in 1947 and was diagnosed with left hip osteoarthritis (M160) that was treated with a surgical procedure of left total hip replacement. Furthermore, B.V. suffers from essential hypertension.

My case study followed B.V. from January 8th, the second day after the operation, and concluded on January 18th. Throughout that period I had a total of 8 sessions with approximately 60 minutes in length given to each one of the sessions with the patient personally, and additional 2 sessions that focused on initial and final kinesiologic examinations. The rehabilitation plan, as indicated, was based on a 1 session per day from January 6th to January 13th and 2 sessions per day from January 14th to January 18th. During this period a total of 3 sessions were provided by other physiotherapists and were clearly noted in this case study.

Throughout that period I gathered objective and subjective information regarding the present existing condition after B.V's total hip replacement and the physiotherapy treatment progress following an evaluation of the physiotherapy treatment and conclusion of this case study. The emphasis in this case study is on evaluating patient's progress with the physiotherapy treatment rather than on judging or interpreting the physiotherapy treatment.

All relevant data was taken during this period and was put in numerical data rather than words in order to better understand and follow the treatment progress. During this period of time certain aids were used which included: crutches, abduction pillow, shoehorn and special anti-thrombosis socks to insure patient's safety as well as comfort and progress in treatment. Therapeutic procedures which included: manual physiotherapy in active and passive range of

motion, isometric contractions, gait training, active movements, practical precautions education, transfer training, and physical therapy which included Rebox electrotherapy application, were used during this period of treatment.

As this study required the participation of human respondent, a professional physiotherapist supervised my treatment and certain ethical issues were addressed. The consideration of these ethical issues was necessary for the purpose of ensuring the privacy of the patient. The confidentiality of the patient was also ensured by not disclosing patient's name or face in photos in the case study. Only relevant details that helped in reaching the case study goals were included. Both, the informed consent of the patient and the approval of the case study by the ethics committee of the Faculty of Physical Education and Sport at Charles University number 003/2010 are attached to this case study (see Chapter 6).

3.2 Anamnesis

Family anamnesis:

Patient's dad suffered from 4 MI attacks, patient's mom is suffering from Diabetes type II, and currently following diet.

Patient's daughter suffered from congenital ip dysplasia in birth, treatment was composed from usage of different splinting devices.

Personal:

Past operations and injuries:

- Congenital hip dysplasia, left (inborn).
- Common child disorders.
- 1962 - Appendectomy.
- 1984 - Cholecystomy.
- 1992 - Plastic operation of urinary bladder.
- 1998 - Arterial hypertension.
- 2002 - Hysterectomy.
- 2007 - Cyst removal near the inguinal canal on the left side.

History of problem:

The patient have had pain in her left hip for a year, last month there was a sudden progression in pain and restriction of left hip movements. The pain was also felt during sitting.

The patient decided to visit an orthopaedic doctor that diagnosed osteoarthritis in left hip and offered her to be operated for a total left hip replacement.

Before the surgery the doctor prescribed the patient with bicycle conditioning in order to maintain strength and endurance to hip movements with increased emphasis to protect muscles around the hip from atrophy and maximize the prognosis of hip movements and strength of hip muscles after the surgery.

Medicine:

- Prestarium Neo (hypertension control).
- Uroflow (urinary incontinence control).

Abuses:

The patient in the last 10 years used to smoke 3 cigarettes per day, currently she smokes occasionally.

Allergies:

- Penicillin (antibiotic).
- Acid phosphatase (enzyme).
- Tetracaine (Pain medicament).
- Dolsin (Pain medicament).

Social anamnesis:

The patient leaves outside of the city in a 2nd floor apartment building with no elevator, the patient has no car and is dependent on her physical condition in order to run her daily errands and work.

Work anamnesis:

The patient is a nurse, works 8 hours per day, most of the time she stands and walks.

Aids:

The patient is using 2 forearm crutches.

Statement from the patient's medical documentation:

Doctor's notes before the operation:

- The external rotation on left extremity is 40 and internal rotation of left hip is restricted to 0 degrees.
- ROM- in left hip – flexion- 100, extension- 0, abduction- 30, adduction- 20.
- Pain is evident in all left hip movements.

- Thomas test – Positive in left side.
- Shortening of 2 cm in real left leg length of left extremity compared to the right leg.
- High sensitivity in left inguinal area and left trochanter major area.
- Patient is lucid.
- No evident neurological or other motoric problems.

X-ray (anterior imaging):

- Evident osteoarthritis of left hip.

Surgeon's notes:

- Surgery was done on 5.1.2010.
- The surgeon used an antero-lateral approach.
- The surgery was successful without any complications.
- No Thromboembolic signs.
- 3 drainage tubes were applied from the operated area.
- After surgery the left leg real length was measured and found to be shorter than the right in 1 cm.
- Bone density is normal.
- Total foot weight bearing is allowed up to 50% of total load on left hip with use of crutches for the next 6 weeks.
- After surgery local ice was applied on the operated area.

Indication towards rehabilitation by the surgeon:

1 session per day of physiotherapy was assigned to patient by the doctor for the next week in the orthopedic department.

The following week, on the 14th, the patient will move to an inpatient rehabilitation department where she will follow a 2 physiotherapy sessions per day, furthermore, the patient will follow an ergo-therapy daily sessions.

Present state:

- Blood pressure – 122/70
- Pulse- 73
- Breathing frequency – 18/min
- Heart function – normal
- Height - 160cm
- Weight – 59kg
- BMI - 23

Day to day therapy

Sessions 1 and 2

First two sessions were provided by a physiotherapist from the orthopedic department. The following session descriptions were taken from the patient physiotherapy file.

6.1.2010

Breathing exercises.

Isometric contractions of quadriceps and gluteus muscles on the left.

Active movements of left hip which include flexion, abduction and elevation of pelvis in supine position.

Patient education of transition in bed.

7.1.2010

Breathing exercises.

Isometric contractions of quadriceps and gluteus muscles on the left.

Active movements of left hip which include flexion, abduction and elevation of pelvis in supine position.

Patient education of transition in bed.

3.3 Initial kinesiologic examination

Session 3 (8.1.2010)

Initial kinesiologic examination:

Aspection:

- The patient is lucid and has no difficulties to communicate.
- The patient wears thrombolic socks on both legs up to her hips.
- The patient rates her pain in 1-10 grade as 1 representing – not painful and 10 representing very painful a 1.
- Slight left lateral thigh redness compared to the right leg is seen in supine position.
- The patient has no problems performing transitions in bed.
- The patient exhibits upper body type of breathing during which she slightly elevates her shoulders.
- From previous operations, the patient has an 2 square centimeters edema located cranio-medially to the scar in her left hip.
- The scar in patient's left hip is intact with stitches that can be seen in Photo 3.3.1.

Photo 3.3.1 Patient's left thigh scar in initial kinesiologic examination

- The patient has 2 scars, both of them from previous surgeries, the first, longitudinal, 3 centimeters long, on the left side of the trunk medially to the inguinal canal, the second scar, longitudinal, 30 centimeters long, to the left side of the linea-alba, skin turgor around these 2 scars is normal.

Posture evaluation (was examined while the patient was standing using both her crutches for support):

Body part	Front	Back	Right side	Left side
Foot and toes	-Both feet are externally rotated. -Weight borne on the lateral sides of feet.	-Weight is not borne on the left ankle.	-Right foot toes bend up at the first joint and down the middle joint so that the weight rests mostly on the tip of the toes (hammer toes).	-Left foot toes are extended in proximal and distal phalangial joints as the ankle is elevated.
Knees and legs	-The kneecaps are facing slightly outward (laterally rotated femurs).	-Semi-flexion of knees is noticeable.	-The right leg is semi-flexed at the knee joint.	-The left leg is slightly more semi-flexed at the knee joint than the right knee.
Hips, pelvis and spine	-The left hip has a noticeable edema around the scar.	-The spine is symmetrical.	-Semi-flexion of right hip. -Flat lower back. -Hyperkhyposis at the thoracic spine. -Slight lordosis	-Equal semi-flexion of left hip compared to the right, the hip area is covered with bandage and the edema around the

			at the cervical spine.	bandage is noticeable. -Flat lower back. -Hyperkhyposis at the thoracic spine. -Slight lordosis at the cervical spine.
Abdomen	-Both the upper and the lower parts of abdomen are flat.		-Flat.	-Flat.
Chest	-Depressed position of chest, "hollow-chest".		-Depressed position of chest, "hollow-chest".	-Depressed position of chest, "hollow-chest".
Arms and shoulders	-Both shoulders are hiked-up. -Shoulders are level with each other. -With arms (holding the crutches), the palms are facing forward.	-Both shoulders are hiked-up. -Shoulders are level with each other.	-Right shoulder is dropping forward. -Right arm is in semi-flexion at the elbow joint.	-Left shoulder is dropping forward. -Left arm is in semi-flexion at the elbow joint.
Head	-The head is slightly laterally	-The head is slightly laterally	-The head is protruding	-The head is protruding

	rotated to the left side.	rotated to the left side.	forward.	forward.

Table 3.3.1 Initial posture evaluation results

Pelvic position (was examined in standing position with the patient supporting herself using both her crutches):

Iliac crests were palpated, and found to be equally leveled.

Movement pattern examination:

Shoulder abduction

The patient was instructed to abduct both arms upwards while sitting on the bed, the movement pattern followed the correct sequence of muscle activation on both shoulders.

Hip extension

The patient was instructed to extend the left hip while in prone position; the contraction of the ipsilateral erector spinae muscle was noticed before the gluteus maximus muscle contracted to initiate the movement of the left hip.

Gait evaluation:

Using crutches, the patient is walking in a 4 point gait.

The gait is slow but stable with a pronounced longer stance phase on the right leg.

Head	Trunk	Shoulders	Arms	Pelvis
The chin is down during walk as the patient looks down to her feet.	There is no noticeable rotation of trunk during gait.	Are elevated as the patient contacts both crutches on the floor.	Are semi flexed at the elbow joints as they hold the crutches.	The rotation clockwise and anticlockwise are restricted.
Hips	Knees	Feet	Toes	
Both hips are	The patella in	Externally	Clawed 2nd and	

externally rotated, with slightly more external rotation of left hip.	both knees faces outwards, with slight more external rotation of patella of left foot.	rotated in both extremities.	3rd toes in both feet.
There is no extension in the left hip joint during the end of the stance phase.		Lateral loading on both feet.	

Table 3.3.2 Initial gait evaluation results

ROM:

Body part	Movement	Active\Passive	Degrees	Barrier
Left hip	Flexion	Active	80	
	Flexion	Passive	90	Firm with pain
	Abduction	Active	20	
	Abduction	Passive	25	Firm with pain
Right Hip	Flexion	Active	100	
	Flexion	Passive	105	Soft
	Abduction	Active	30	
	Abduction	Passive	35	Soft
Left ankle	Plantar flexion	Active	35	
	Plantar flexion	Passive	45	Firm
	Dorsal flexion	Active	15	
	Dorsal flexion	Passive	20	Firm

Right ankle	Plantar flexion	Active	40	
	Plantar flexion	Passive	45	Firm
	Dorsal flexion	Active	15	
	Dorsal flexion	Passive	20	Firm
Left knee	Flexion	Active	140	
	Flexion	Passive	145	Soft
	Extension	Active	0	
	Extension	Passive	-5	Firm
Right knee	Flexion	Active	145	
	Flexion	Passive	150	Soft
	Extension	Active	-5	
	Extension	Passive	-5	Firm

Table 3.3.3 Initial ROM results

Anthropometry:

Circumference/Length and Body part	Side	Centimeters
C of hips		97
C of calves	R	34
	L	33
*C of thigh	R	44
*C of thigh	L	54
L of leg, Real	R	84
	L	84
L of leg, Functional	R	88
	L	88

* Was taken 20 centimeters above the midline of the patella, to assess the decrease in edema around the upper part of the left thigh compared to the right upper part of the thigh, as seen in Photo 3.3.2.

Table 3.3.4 Initial anthropometry measurements results

Photo 3.3.2 Circumference of thigh was taken 20 centimeters above midline of the patella

Manual Muscle Testing:

Body part	Left\Right	Movement	Grade
Knee	R	Extension	4+
	L	Extension	3+
	R	Flexion	4+
	L	Flexion	3
Hip	R	Abduction	4
	L	Abduction	3-
	R	Flexion	4+
	L	Flexion	4
	R	Extension with flexed knee	4-
	L	Extension with flexed knee	2+
Ankle	R	Plantar Flexion	5
	L	Plantar Flexion	4+
Arm	R	Flexion	4+
	L	Extension	4+

	R	Flexion	4+
	L	Extension	4+

Table 3.3.5 Initial manual muscle testing results

Muscle tone examination:

Lateral part of the left thigh and lower leg muscles were palpated on supine position and compared to the lateral part of the right thigh and lower leg muscles and the following muscles in left lower extremity were noted to be in hypertone:

- TFL
- Rectus femoris
- Sartorius.
- Vastus Lateralis
- Peroneus longus
- Illiopsoas

In prone position, the gluteus muscles on both sides where palpated for tone, the left glutues maximus was noted to be in hypertone.

Joint play examination:

Joint and direction	Left\Right	Movement
Talocrural in lateral and dorsal directions	L	Normal
Talocrural in lateral and dorsal directions	R	Normal
Lisfranks in dorsal, plantar, supination and pronation movements	L	Normal
Lisfranks in dorsal, plantar, supination and pronation movements	R	Normal
Fibular movement in dorsal and ventral directions	L	Slightly restricted in dorsal and ventral directions.
Fibular movement in dorsal and ventral directions	R	Normal
Cuboid movement in dorsal and ventral directions	L	Normal

Cuboid movement in dorsal and ventral directions	R	Normal
Interphalangeal 2nd to 5th toes in all directions	L	Normal
Interphalangeal 2nd to 5th toes in all directions	R	Normal
Interphalangeal of big toe in all directions	L	Normal
Interphalangeal of big toe in all directions	R	Normal
Metatarsal 1st to 5th toes in all directions	L	Normal
Metatarsal 1st to 5th toes in all directions	R	Normal
Metatarsaophalangial 1st to 5th toes in all directions	L	Normal
Metatarsaophalangial 1st to 5th toes in all directions	R	Normal

Table 3.3.6 Initial joint play examination results

Neurological examination

Sensory Testing:

Sense tested	Result
Light touch	L3, L4, L5 dermatomes in the left lower extremity are hypersensitive to touch, mostly around upper thigh dermatomes. No deficit was noted in the right lower extremity.
Deep pain	Normal
Superficial pain	L3, L4, L5 dermatomes in the left lower extremity are hypersensitive to the touch of pin used. No deficit was noted in the right lower extremity.
Proprioception	Normal
Kinesthesia	Normal
Stereognosis	Normal
Graphesthesia	Normal

Table 3.3.7 Initial Sensory testing results

Deep tendon reflexes:

DTR tested	Result on left side	Result on right side
Patellar (L3-L4)	2	2
Achilles (S1-S2)	2	2

Table 3.3.8 Initial deep tendon reflexes results

Balance testing:

One legged stance test (on the right leg)	Negative.
Nudge/push test, deep sensitivity test (in sitting position while patient's shoulders are being pushed and nudged from side to side and front to back)	The patient's trunk is more stable when being pushed from her right side to left than from her left side to right.

Table 3.3.9 Initial balance testing results

Summary of results:

- The patient mentions that she has no pain around the left hip, she seems to be motivated and cooperative.
- The patient has poor left hip abduction, and extension muscles strength.
- Muscle tone of TFL, rectus femoris, Sartorius and Vastus lateralis is in hypertone.
- ROM is restricted in left hip abduction and flexion with painful barriers.
- Circumferences of calves and thighs are unequal, edema and muscles in hypertone stage may cause the deviations in circumferences.
- The patient's erector spinae the gluteus maximus prevents itself from functioning as the primary muscle initiating on the left side became the primary muscle initiating the left hip extension. Weakness of the extension of the left hip.
- The patient is using analgesic pattern of gait, which is noticeable mostly at the end of the stance phase of the left leg during which, there is no extension of the left hip.
- The patient has a flat back posture and shoulders are "hiked-up" due to the high position of the forearm crutches.

3.4 Short-term and long-term physiotherapy plan

The following short and long term plans were set after the kinesiological examination:

Short term plan

Phase I (during orthopedic department stay): Week 1

Goals:

- Educate patient regarding total hip replacement precautions:
  - Do not flex or bend the hip more than 90 degrees.
  - Do not twist or pivot on the operated leg.
  - Keep legs apart and do not cross them at the knees or ankles.
- Help patient become independent in exercise for postoperative phases.
- Prevention of dislocation.
- Prevention of thrombo-embolic complications
- Instructions how to use of crutches.

Intervention:

- Adjusting and educating patient to use an abduction pillow as needed for positioning.
- Provide patient education regarding total hip precautions
- Begin exercises including: ankle pumps, quadriceps sets, gluteal sets, and upper extremity active exercises.
- Active range of motion with hip abduction, knee extension, and upper extremity active exercises.
- Bed mobility training
- Transfer training.
- Gait training as appropriate (using crutches)
- Active movements exercises such as heel slides, isometric or active assistive hip abduction and short arc quadriceps sets.

- Promote transfers and gait independence.
- Scar therapy using Soft tissue techniques such as pressure massage, avoiding the stitches.

Phase II (during rehabilitation department stay): Week 2-3

Goals:

- Scar care using soft tissue techniques and physical therapy modalities such as laser, hydrotherapy and cryotherapy, after removal of stitches.
- Increase muscle strength and control of involved leg.
- Prevention of dislocation.
- Prevention of thromboembolic complications.
- Instructions how to use proper gait.

Intervention:

- Progress with exercise program to include heel slides, isometric or active assistive hip abduction and short arc quadriceps sets.
- Active range of motion with hip abduction, knee extension, and upper extremity active exercises.
- Evaluation of equipment needs at home.
- Gait training as appropriate (using crutches)
- Active movements exercises such as heel slides, isometric or active assistive hip abduction and short arc quadriceps sets.
- Active range of motion with hip abduction, knee extension, and upper extremity exercises.
- Scar therapy using soft tissue techniques such as skin folds, and other physical therapy modalities such as laser, hydrotherapy and cryotherapy after removal of stitches.
- Pool exercise, after removal of stitches and in case of good scar tissue healing, such as active movements of involved leg.

Phase III (return to home): Week 4-6

Goals:

- Increase patient independence with gait and transfers.
- Plan return of patient to work or previous activities as indicated.
- Improve strength, endurance, and balance.
- Correct gait impairments.
- Independence with home exercise program.
- Evaluate safety of home.
- Plan return of patient to work or previous activities as indicated with or without the crutches as indicated by the rehabilitation doctor.

Intervention:

- Closed-chain exercises such as heel raises and mini squats.
- Cautious stretching of Achilles tendons in the standing position.
- Normalize gait on level and sloped surfaces, jagged sidewalks, curbs, and stairs.
- Pool exercise, such as active movements of involved leg.

Long term plan

(Long-term outpatient clinic): Week 7 and on

Goals:

- Improve hip strength, endurance, and balance.
- Correct gait impairments.
- Independence with home exercise program.
- Improve trunk mobility for maximum function, stability and endurance.

Intervention:

- Training, aiming mainly for strength, endurance and balance.
- Stationary bicycling, simulated cross-country skiing, and treadmill (as part of gym program).

- Using special self-care devices to maintain an active life style such as shoe spoon to avoid extreme hyper-flexion of the hips.
- Pool exercise such as swimming backstroke and freestyle to facilitate left hip extension and overall endurance.
- Include active trunk and hip muscles stretching, for muscles such as iliopsoas and quadratus lumborum for maximum trunk mobility.

No therapy was provided after the initial kinesiologic examination.

Patient's crutches were adjusted slightly upwards for better positioning and functional mobility.

3.5 Therapy progress

Because the patient was treated twice as I mentioned before with orthopedic department physiotherapists and then was evaluated with the initial kinesiological examination for my case study in her third session, therapy session began in the fourth session.

Session 4 (11.1.2010)

The patient feels fine, although she mentions she hasn't slept well at night because of her inability to turn on stomach during sleep. Farther information was provided to the patient regarding transfers in bed.

From initial sight the bandage which was covering the scar on the lateral part of left hip was removed and now the scar tissue is seen with slight edema around the scar.

Examination

Examination	Result (R)	Result (L)
Active abduction of hip		20
MMT, abduction of hip		3-
MMT, flexion of hip		4
MMT, extension of hip with flexed knee		2+
Circumference of calves	34	33.5
Circumference of thighs	44	47

Table 3.5.1 Session 4 examination results

Soft tissue techniques around the scar

Were applied in supine position, including: soft pressure hold relax, skin folds and "S" shaped skin folds.

Active movements

In both upper extremities in all directions without resistance and assistance with corrected upper body breathing pattern, as well as active movements without resistance and assistance in lower extremities using ankle flexion and extension, knee flexion and extension, hip flexion and extension and hip abduction.

Bed mobility and transfer training

The patient was instructed and educated on proper transfers and mobility in bed from supine to prone positions using an abduction pillow, and from sitting to standing position.

Gait training (using crutches)

The patient was instructed to use correct position of both feet during her gait cycle and to consider right position of left foot during the toe-off stage.

The patient was instructed not to load the left foot more than 50% of her total body weight, approximately 30 kilograms.

Furthermore the patient was instructed how to walk upstairs and downstairs using crutches.

The patient fully tolerated the therapy although the patient felt the pain around the left hip.

Session 5 (12.1.2010)

The patient is feeling good, had a good sleep, no complaints were noted.

Examination

Examination	Result (R)	Result (L)
Active abduction of hip		20
MMT, abduction of hip		3-
MMT, flexion of hip		4
MMT, extension of hip with flexed knee		2+
Circumference of calves	34	33.5

Circumference of thighs	44	47

Table 3.5.2 Session 5 examination results

Soft tissue techniques for scar

Were applied in supine position, including: soft pressure hold relax, skin folds and "s" shaped skin folds.

Auto-therapy:

The patient was instructed to provide soft pressure by pressing and releasing her fingers on skin at the sides of the scar.

Active movements

In both upper extremities in all directions, as well as active movements in lower extremities with ankle pumps, knee flexion and extension, hip flexion and extension and hip adduction and abduction, later holding a bar in standing position and abducting the left hip with extended.

Isometric contractions

Were applied against abduction and then against flexion of left hip in supine position, and later against left hip extension in prone position.

Gait training (using crutches)

The patient was instructed to use correct position of both feet and "toe off" consideration during stance phase and allow the hip to extend in "toe off" stage.

The patient fully tolerated the therapy although the pain is felt, not as much as after yesterday's session.

Session 6 (13.1.2010)

The patient feels good, although she complains of low back pain on her left side.

Examination

Examination	Result (R)	Result (L)
Active abduction of hip		20
MMT, abduction of hip		3
MMT, flexion of hip		3+
MMT, extension of hip with flexed knee		2+
Circumference of calves	34	33.5
Circumference of thighs	43.5	45

Table 3.5.3 Session 6 examination results

Palpation of the low back area in prone position, which was pointed by the patient to be around left sacroiliac joint, the painful area was found, palpated and noted as left sacroiliac pain.

Soft tissue techniques around the sacroiliac area

Friction massage was applied for the trigger point which was found around the left sacroiliac joint.

Soft tissue techniques for scar

Were applied in supine position, including: soft pressure hold relax, skin folds and "s" shaped skin folds.

Active movements

Were performed by the patient, at first in supine position, flexion and extension of ankles, flexion and extension of knees while ankles are on the bed, later, flexion and extension of hips with knees flexed, then abduction of both hips with legs extended.

In side lying, abduction of hips.

In prone position, extension of legs with flexed legs at the knees and then with extended legs at the knees.

Isometric contractions

Against one left joint hip flexors in supine with flexed leg at the knee.
Then against left hip abductors in sideling position on the right.

Gait training

The patient was instructed to try and extend both the hips during walk, furthermore to contact the ankles first and then continually the toes just before the swing phase.
Later the patient trained walking upstairs and downstairs.

The patient fully tolerated the therapy, the pain around the sacroiliac joint is still felt but according to the patient it is a bit better.

Session 7 (14.1.2010)

Today the patient moved to the rehabilitation department, beginning with a two per day physiotherapy sessions.

The patient complains of lower back pain, bit less pain compared to the pain she had last time.

Examination

Examination	Result (R)	Result (L)
Active abduction of hip		20
MMT, abduction of hip		3
MMT, flexion of hip		3+
MMT, extension of hip with flexed knee		2+
Circumference of calves	35	34
Circumference of thighs	47	44

Table 3.5.4 Session 7 examination results

Soft tissue techniques around the sacroiliac area

Friction massage was applied on top of the painful left sacroiliac joint.

Soft tissue techniques for scar

Were applied in supine position, including: soft pressure hold relax, skin folds and "s" shaped skin folds.

Active movements

In supine position, flexion and extension of ankles, flexion and extension of knees while ankles are on the bed, later, flexion and extension of hips with knees flexed, and then abduction and adduction of both hips with legs extended.
In sideling position, abduction and adduction of hips.
In prone position, extension of legs with flexed legs at the knees and then with extended legs at the knees.

Isometric contractions

Against one left joint hip flexors in supine with flexed leg at the knee.
Then against left hip abductors in sideling position on the right.

Gait training

The patient was instructed to try and extend both the hips during walk, furthermore to contact the ankles first and then continually the toes just before the swing phase.
Also, the patient was instructed to keep the feet straight mid-line, between external and internal rotation.

The patient is tired and the pain around the sacroiliac joint is still felt. Physical therapy modalities such as Rebox should be used in the next session in case the patient will complain again.

Session 8 (15.1.2010, 1st session of the day)

The patient complains of lower back pain yet again, the left hip pain doesn't seem to bother the patient as much as the lower back pain.

Examination

Examination	Result (R)	Result (L)
Active abduction of hip		20
MMT, abduction of hip		3
MMT, flexion of hip		3+
MMT, extension of hip with flexed knee		2+
Circumference of calves	34.5	34
Circumference of thighs	46	46

Table 3.5.5 Session 8 examination results

Soft tissue techniques for scar

Were applied in supine position, including: soft pressure hold relax, skin folds and "s" shaped skin folds.

Active movements

In supine position, flexion and extension of ankles, flexion and extension of knees while ankles are on the bed, later, flexion and extension of hips with knees flexed, and then abduction and adduction of both hips with legs extended.

Pelvis raises were preformed with knees flexed.

In sideling position, abduction and adduction of hips.

In prone position, extension of legs with flexed legs at the knees and then with extended legs at the knees.

Isometric contractions

Against one left joint hip flexors in supine with flexed leg at the knee.

Then against left hip abductors in sideling position on the right.

Physical therapy, Rebox

To promote analgesic effect, was applied with patient in prone position around the area of pain on left sacroiliac joint. 6V current was applied for 5 minutes in standard mode in under threshold intensity.

Gait training

Emphasis was put into right extension of the left hip during the pre-swing phase.
Later the patient was able to go upstairs and downstairs without assistant.

The patient noted that the pain subside a little bit after the application of the Rebox. Furthermore, the patient fully tolerated the therapy and seems to be quite satisfied from her rehabilitation progress.

Session 9 (15.1.2010, 2nd session of the day)

The patient still complains of lower back pain, same pain she had last times.
Furthermore the patient doesn't complain of any hip joint pain around the operated left leg.
Rebox as analgesic modality will be used to treat patient's left sacroiliac joint pain at the end of the session.

Soft tissue techniques for scar

Were applied in supine position, including: soft pressure hold relax, skin folds and "S" shaped skin folds.

Active movements

In supine combined with isometric contractions toward flexion, and abduction were provided in supine position.
Later active and isometric contractions in prone position toward extension of both hips with emphasis of right left hip extension pattern.

Gait training

Emphasis was put into correction of extension of the left hip during the pre-swing phase.

Later the patient was able to go upstairs and downstairs without assistant.

Physical therapy, Rebox

To promote analgesic effect, was applied with patient in prone position around the area of pain on left sacroiliac joint. 6V current was applied for 5 minutes in standard mode.

The patient fully tolerated the therapy, although she still has the pain and still complains of its nature.

Session 10 (16.1.2010)

The session was provided by a Saturday shift physiotherapist, the description of the session was written according to the notes which were taken by the physiotherapist.

- Active movement in supine, prone and side lying.
- Isometric contractions toward abduction, extension and flexion of hip.
- Rebox for 5 minutes, intensity of 6V to relieve left sacroiliac joint pain.
- Gait training.

Session 11 (18.1.2010)

Today the patient will be examined for the "final kinesiological examination" throughout the whole session, later in the day the patient will get another physiotherapy session.
The patient noted that she received an analgesic injection into her left gluteus area to relieve the pain around the left sacroiliac joint earlier today. Furthermore, the stitches were removed yesterday (on the 17th) with no complications noted in her medical record.

3.6 Final kinesiological examination

Aspection:

- The patient is lucid and has no difficulties to communicate.
- The patient complains of lower back (left sacroiliac point) pain which is bothering her throughout the day, although the current sessions are decreasing the perceived pain.
- The patient wears thrombolic socks on both legs up to her hips.
- The patient rates her pain in 1-10 grade as 1 representing – not painful and 10 representing very painful a 1.
- Left hip slight redness only around the scar compared to the right leg is seen in supine position.
- The scar is intact with no stitches with slight edema where the stitches were as seen in Photo 3.6.1.

Photo 3.6.1 Patient's left thigh scar in final kinesiologic examination

- From previous operations, the patient has a 2 square centimeters edema located cranio-medially to the scar in her left hip.
- The patient has no problems performing transitions in bed.

- The patient exhibits upper body type of breathing during which she slightly elevates her shoulders.
- The patient has 2 scars, abdominal and inguinal, the skin turgor around these 2 scars is normal.
- The patient is able to bear weight on both her feet, but is advised to still use both her forearm crutches for support.

Posture evaluation (was examined while the patient was standing using both her crutches for support):

Body part	Front	Back	Right side	Left side
Foot and toes	-Both feet are externally rotated. -Weight borne on the lateral sides of feet.	-Weight is mostly borne on the right Ankle compared to the left.	-Right foot toes bend up at the first joint and down the middle joint so that the weight rests mostly on the tip of the toes (hummer toes).	-Left foot toes are extended in proximal and distal phalangial joints as the ankle is elevated.
Knees and legs	-The kneecaps are facing slightly outward (laterally rotated femurs).	-Semi-flexion of knees is noticeable.	-The right leg is semi-flexed at the knee joint.	-The left leg is semi-flexed at the knee joint.
Hips, pelvis and spine	-Both hips are symmetrical.	-The spine is symmetrical.	-Semi-flexion of right hip. -Flat lower back. -Hyperkhyposis at the thoracic spine.	-Semi-flexion of left hip. -Flat lower back. -Hyperkhyposis at the thoracic spine.

			-Slight lordosis at the cervical spine.	-Slight lordosis at the cervical spine.
Abdomen	-Both the upper and the lower parts of abdomen are flat.		-Flat.	-Flat.
Chest	-Depressed position of chest, "hollow-chest".		-Depressed position of chest, "hollow-chest".	-Depressed position of chest, "hollow-chest".
Arms and shoulders	-Both shoulders are slightly hiked-up. -Shoulders are level with each other. -With arms (holding the crutches), the palms are facing forward.	-Both shoulders are slightly hiked-up. -Shoulders are level with each other.	-Right shoulder is dropping forward. -Right arm is in semi-flexion at the elbow joint.	-Left shoulder is dropping forward. -Left arm is in semi-flexion at the elbow joint.
Head	-The head is slightly laterally rotated to the left side.	-The head is slightly laterally rotated to the left side.	-The head is protruding forward.	-The head is protruding forward.

Table 3.6.1 Final posture evaluation results

Pelvic position (was examined in standing position with the patient supporting herself using both her crutches):

Iliac crests were palpated, and found to be equally leveled.

Movement pattern examination:

Shoulder abduction

The patient was instructed to abduct both arms upwards while sitting on the bed, the movement pattern followed the correct sequence of muscle activation on both shoulders.

Hip extension

The patient was instructed to extend the left hip while in prone position; the contraction of the ipsilateral erector spinae muscle was noticed before the gluteus maximus muscle contracted to initiate the movement of the left hip.

The patient was instructed to provide the left hip extension without contracting the ipsilateral eractor spinae muscle with concentration in gluteus maximus muscle contraction first.

The patient was able to perform the left hip extension in right pattern after providing it couple of times using instructions. ipsilateral gluteus maximus was noted to work as a primary mover in this movement before contraction of ipsilateral biceps and ipsilateral eractor spinae muscles.

Gait examination:

Using crutches, the patient is walking in a 4 point gait.

The gait is slow but stable with a pronounced longer stance phase on the right leg.

Head	Trunk	Shoulders	Arms	Pelvis
The chin is down during walk as the patient looks down to her feet.	There is slight a rotation of trunk during gait.	Are slightly elevated as the patient contacts both crutches on the floor.	Are semi flexed at the elbow joints as they hold the crutches.	The rotation clockwise and anticlockwise are slightly seen.
Hips	Knees	Feet	Toes	
Both hips are externally	The patella in both knees faces	Externally rotated in both	Clawed 2nd and 3rd toes in both	

rotated, with slight more prononed external rotation of left hip.	outwards, with slight more prononed external rotation of patella in the left foot.	extremities.	feet.
There is only slight extension in the left hip joint during the stance phase of the right extremity.		Lateral loading on both feet.	

Table 3.6.2 Final gait evaluation results

ROM:

Body part	Movement	Active\Passive	Degrees	Barrier
Left hip	Flexion	Active	80	
	Flexion	Passive	90	Firm with slight pain
	Abduction	Active	25	
	Abduction	Passive	30	Soft with slight pain
Right Hip	Flexion	Active	100	
	Flexion	Passive	105	Soft
	Abduction	Active	30	
	Abduction	Passive	35	Soft
Left ankle	Plantar flexion	Active	35	
	Plantar flexion	Passive	45	Firm
	Dorsal flexion	Active	15	
	Dorsal flexion	Passive	20	Firm

Right ankle	Plantar flexion	Active	40	
	Plantar flexion	Passive	45	Firm
	Dorsal flexion	Active	15	
	Dorsal flexion	Passive	20	Firm
Left knee	Flexion	Active	140	
	Flexion	Passive	145	Soft
	Extension	Active	0	
	Extension	Passive	-5	Firm
Right knee	Flexion	Active	145	
	Flexion	Passive	150	Soft
	Extension	Active	-5	
	Extension	Passive	-5	Firm

Table 3.6.3 Final ROM results

Anthropometry:

Circumference/Length and Body part	Side	Centimeters
C of hips		94
C of calves	R	35
	L	34
*C of thigh	R	48
*C of thigh	L	46.5
L of leg, Real	R	84
	L	84
L of leg, Functional	R	88
	L	88

* Was taken 20 centimeters above the midline of the patella, to assess the decrease in edema around the upper part of the left thigh compared to the right upper part of the thigh.

Table 3.6.4 Final anthropometry measurements results

Manual Muscle Testing:

Body part	Left\Right	Movement	Grade
Knee	R	Extension	4+
	L	Extension	4
	R	Flexion	4+
	L	Flexion	3+
Hip	R	Abduction	4
	L	Abduction	3
	R	Flexion	4+
	L	Flexion	4
	R	Extension with flexed knee	4-
	L	Extension with flexed knee	2+
Ankle	R	Plantar Flexion	5
	L	Plantar Flexion	4+
Arm	R	Flexion	4+
	L	Extension	4+
	R	Flexion	4+
	L	Extension	4+

Table 3.6.5 Final manual muscle testing results

Muscle tone examination:

Muscles around the hip joints were examined in prone and supine positions.

The lateral part of the left thigh was palpated on supine position and compared to the lateral part of the right thigh and the following muscles were noted to be in hypertone:

- TFL
- Rectus femoris
- Illiopsoas

Joint play examination:

Joint and direction	Left\Right	Movement
Talocrural in lateral and dorsal directions	L	Normal
Talocrural in lateral and dorsal directions	R	Normal
Lisfranks in dorsal, plantar, supination and pronation movements	L	Normal
Lisfranks in dorsal, plantar, supination and pronation movements	R	Normal
Fibular movement in dorsal and ventral directions	L	Normal
Fibular movement in dorsal and ventral directions	R	Normal
Cuboid movement in dorsal and ventral directions	L	Normal
Cuboid movement in dorsal and ventral directions	R	Normal
Interphalangeal 2nd to 5th toes in all directions	L	Normal
Interphalangeal 2nd to 5th toes in all directions	R	Normal
Interphalangeal of big toe in all directions	L	Normal
Interphalangeal of big toe in all directions	R	Normal
Metatarsal 1st to 5th toes in all directions	L	Normal
Metatarsal 1st to 5th toes in all directions	R	Normal
Metatarsaophalangial 1st to 5th toes in all directions	L	Normal
Metatarsaophalangial 1st to 5th toes in all directions	R	Normal

Table 3.6.6 Final joint play examination results

Neurological examination

Sensory Testing:

Sense tested	Result
Light touch	L3 and L4 dermatomes in left lower extremity are hypersensitive to light touch. Normal sensitivity to light touch was noted in right lower

	extremity.
Deep pain	Normal
Superficial pain	L3 and L4 dermatomes in left lower extremity are hypersensitive to the touch of the pin used. Normal sensitivity to superficial pain was noted in right lower extremity.
Proprioception	Normal
Kinesthesia	Normal
Stereognosis	Normal
Graphesthesia	Normal

Table 3.6.7 Final Sensory testing results

Deep tendon reflexes:

DTR tested	Result on left side	Result on right side
Patellar (L3-L4)	2	2
Achilles (S1-S2)	2	2

Table 3.6.8 Final deep tendon reflexes results

Balance testing:

One legged stance test (on the right leg)	Negative.
Nudge/push test, deep sensitivity test (in sitting position while patient's shoulders are being pushed and nudged from side to side and front to back)	The patient's trunk is more stable when being pushed from her right side to left than from her left side to right.

Table 3.6.9 Final balance testing results

Summary of results:

- The patient mentions that she has no pain around the left hip; she is motivated, cooperative and satisfied from the results so far.

- The patient has normal left hip abduction, and extension muscles strength but still weaker strength compared to the right hip.
- Muscle tone of TFL, rectus femoris, sartorius and vastus lateralis is in hypertone.
- ROM is restricted in left hip abduction and flexion with slight painful barriers compared to the same movements in the right hip.
- Circumferences of calves and thighs are about the same with no pathological deviations.
- The patient‘s erector spinae the gluteus maximus prevents itself from functioning as the primary muscle initiating on the left side became the primary muscle initiating the left hip extension. Weakness is noticed in extension of the left hip.
- The patient is using analgesic pattern of gait, which is noticeable only at the end of the stance phase of the left leg during which, there is only slight extension of the left hip.
- The patient is using crutches independently and is seen to ambulate freely during the day with no complications.
- Noticeable flat back posture is noticed.
- There are no joint play restrictions in both feet.
- From the neurological point of view there are no noted complications.

3.7 Therapy effect

- The low back pain which the patient complained of, might have been caused be the therapy, although there is a slight decrease in pain in the area.
- Left hip redness which appeared mostly around the lateral side of the left thigh at the beginning decreased and is now mostly seen only around the scar.
- The patient understood the precautions she has to take in order to prevent complications as learned during the rehabilitation as well as the usage of assistive devices and is completely independent in transfers and ADL.
- As seen in posture evaluation, the patient bears more weight on the left foot compared to her initial posture where the left foot bore less weight, although still using the forearm crutches to hold upright position.
- As seen in posture evaluation, the patient currently flexes the left knee less compared to the initial stage where the left knee was more flexed, as seen from left side.
- As seen in movement pattern examination, currently the patient is able to provide the right left hip extension movement after being corrected, whereas at the beginning the pattern was provided wrong also after being corrected.
- In gait, the patient is seen to improve both the rotation clockwise and anticlockwise and the trunk rotation compared to no movement seen of both the pelvis and trunk during initial evaluation of gait.
- Due to corrected crutches height, the patient is walking and standing with less elevation of shoulders, although the shoulders are slightly elevated.
- As seen in gait evaluation, the patient currently slightly extends the left hip during gait whereas at first the patient wasn't able to provide any extension at the left hip during gait.
- The range of motion in passive left hip flexion was not noted as painful in barrier as at the beginning.
- Left hip range of motion both in active and passive abduction was improved in 5 degrees, including noted soft barrier with slight pain in passive range of motion in left hip abduction compared to a firm and painful barrier noted at the beginning.
- Hips circumference decreased in 3cm from 97cm at the beginning to a 94cm as noted.

- Calves circumference was increased due to a possible claves muscles tone increase during this phase of therapy in 1cm around each leg.
- Right hip circumference increased in 4cm and might be due to thigh muscles tone increase during this phase of therapy.
- Left hip circumference decreased from 54cm to 46.5cm as noted and might have caused due to a gradual release in muscle tone around thigh muscles as well as reduction in inflammatory process that took place around the area of the hip.
- The patient noted to gained strength in left knee extension movement from 3+ to 4, in left knee flexion from 3 to 3+ and from 3- to 3 in left hip abduction and are mainly the direct cause of strengthening exercises that took place up to date during all therapy sessions.
- Tone of saratorius, vastus lateralis and peroneus longus muscles along the left thigh decreased as noted, although these muscles weren't treated directly.
- As noted in joint play examination, the joint play of left fibula in dorsal and ventral directions improved to normal in current stage although this joint play wasn't treated through therapy sessions.
- From neurological point of view, both sensory feelings in light touch and superficial pain were noted to improve to normal sensation around left L5 dermatomes of the upper thigh from initial hypersensitivity around left L5 dermatomes of upper thigh.

For clarity proposes I have included the following table to clearly evaluate the efficiency of therapy:

Category	*Part of examination*	*Change noted*	*Therapy procedures provided*	*Goals reached*	*Other therapy procedures to consider*
Patient education	Aspection	• Correct assistive devices use. • Independent transfers. • Precautions understood.	• Transfer training. • Teaching a correct usage of assistive devices. • Teaching precautions.	Effective patient education.	Long term education regarding assistive devices in the home is needed.

Edema	Aspection	Reduction of edema around left thigh.	• Soft tissue techniques.	Reduction of edema.	• Hydrotherapy • Cryotherapy
Posture	Posture evaluation	• More weight is borne on left foot. • Decreased flexion of left knee. • Decreased shoulders elevation.	• Gait training. • Active movements. • Strength exercises.	Increase in posture efficiency.	• Proprioceptive exercises.
Move. pattern	Movement pattern examination	Ability to provide correct hip extension.	• Hip extension movement pattern reeducation. • Active movements. • Strength exercises.	Minimize abnormal movement patterns.	• Aquatherapy
Gait	Gait evaluation	• Improved trunk and pelvis rotation. • Decreased shoulders‘ elevation. • Improved left hip extension.	• Gait training. • Active movements. • Passive ROM. • Strength exercises.	Increase gait efficiency.	• Aquatherapy
Range of motion	ROM	• Pain reduction in left hip flexion and abduction. • Increased left hip abduction. • Improved barrier of left hip abduction.	• Active movements. • Passive ROM. • Strength exercises.	• Increase hip range of motion. • Decrease pain.	• Aquatherapy • Cryotherapy • Hydrotherapy • Use of stationary bicycle.

Circumf.	Anthrop.	• 3cm decrease in hips. • 1cm increase in calves. • 4cm Increase in right hip. • 7.5cm decrease in left hip.	• Soft tissue techniques. • Active movements. • Passive ROM.	Reduction of tone around left hip.	• Cryotherapy • Hydrotherapy
Strength (left)	Manual muscle testing	• Knee extension 3+ to 4. • Knee flexion 3 to 3+. • Hip abduction 3- to 3.	• Active movements. • Strength exercises.	Increase left hip strength.	• Use of stationary bicycle. • Aquatherapy
Tonicity (left thigh)	Palpation	Decreased in saratorius, vastus lateralis and peroneus longus.	• No specific therapy was provided.	Decrease tonicity in hypertone muscles around left hip.	N/A
Joint play	Joint play examination	Left fibula joint play improved to normal.	• No specific therapy was provided.	N/A	N/A
Sensation (left upper thigh)	Neurological examination	• Improved light touch around L5 dermatomes. • Improved superficial pain around L5 dermatomes.	Soft tissue techniques.	Improve sensory function around left thigh L5 dermatomes.	• Hydrotherapy • Aquatherapy

Table 3.7.1 Therapy evaluation

4 Conclusion

In this case study I was able to gain not only the knowledge needed for the physiotherapy treatment after total hip replacement surgery but also the experience firsthand with a patient after total hip replacement that was fascinating from day one by itself. Being able to see the progress made by the patient in accordance with the physiotherapy treatment, I gained both the confidence and the belief that physiotherapy is a truly awarding profession.

From my practice I understood that the treatment after hip replacement surgery is a long term treatment. The patient progresses slowly and should be encouraged by the physiotherapy to keep his/her motivation level high. The patient has to be educated regarding the precautions after the surgery to avoid complications as well as using special aid devices such as crutches to avoid postural and gait abnormalities.

Furthermore, the short and long term physiotherapy plans may vary among patients and should be based partially on patients own goals. Also, the physiotherapists have to base their treatment in accordance to the implant's fixation and surgical approach that were used in the surgery.

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6 Supplement

Figures:

Tables:

Photos: