Use of Joint Mobilization in a Patient With Severely Restricted Hip Motion Following Bilateral Hip Resurfacing Arthroplasty

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Background and Purpose. Hip resurfacing arthroplasty (HRA) is an alternative for management of end-stage osteoarthritis (OA) in young patients with high activity demands and offers several advantages over total hip arthroplasty. Severely restricted hip motion is a rare complication of the surgery. The purpose of this case report is to describe the treatment for a patient who developed severely restricted hip motion following bilateral HRA.

Case Description. A 43-year-old, athletic man underwent bilateral HRA and developed severely restricted hip motion. At 3 months postoperatively, the patient had approximately 90 degrees of hip flexion and 10 degrees of lateral rotation bilaterally. A multimodal treatment approach with an emphasis on joint mobilization was incorporated to improve hip joint mobility by restoring accessory motion.

Outcomes. The patient’s passive range of motion (PROM) and Harris Hip Score (HHS) at the time of discharge showed clinically significant improvements. Total disability, as measured by the HHS, improved by 13 points, and total PROM increased 82 degrees in the right hip and 101 degrees in the left hip. The patient became independent and had full return to all activities and sports.

Discussion. The patient showed clinically meaningful improvements in PROM measurements and functional activities during a course of care using a multimodal treatment approach with an emphasis on joint mobilization. This is the first case report to describe the treatment for a patient who developed severely restricted hip motion following bilateral HRA.
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The current treatment for end-stage hip osteoarthritis (OA) is total hip arthroplasty (THA), which involves the replacement of the proximal femur with a stemmed device and prosthetic head. The acetabulum is replaced with a hemispherical-shaped cup. Total hip arthroplasty provides improvement in a patient’s quality of life and has been shown to be durable in older patients. However, young and active patients have higher revision rates compared with older patients, and they often develop THA-associated problems, such as loosening of the femoral stem, that require another revision or lifestyle restrictions. Long-term effects of THA in younger patients indicate that 25% to 30% may require revisions within 15 years compared with less than 5% at 10 years for older patients. As a result of this, hip resurfacing arthroplasty (HRA) was developed in the early 1990s and was called “metal-on-metal hip resurfacing.” Hip resurfacing arthroplasty involves removal of the damaged surfaces of the head of the femur, sparing the femoral neck and acetabulum. The femoral head is fitted with a metal surface, and the acetabulum is lined with a metal cup to form a pair of metal bearings. Several theoretical advantages of HRA include bone preservation, stress transfer, and lower dislocation rate. In addition, revisions of the femoral component can easily be converted for THA, if necessary.

The Birmingham Hip Resurfacing System* received US Food and Drug Administration approval in May 2006. At present, there is limited research on this new procedure, and no research was found that specifically described the use of joint mobilization. However, research does exist on the use of joint mobilization in patients with hip OA to improve range of motion (ROM) and decrease pain. Howard and Levitsky used manual therapy techniques in a patient who had a THA to eliminate hip and buttock symptoms.

No long-term results of hip resurfacing have been published. One study demonstrated that 95% of the resurfacing components remained intact at 7 years postoperatively. Some potential complications include the risk of femoral neck fracture (0%-4% incidence), aseptic loosening (1.8% incidence), and increased risk of metal degradation and ionization and may lead to severely restricted hip motion. This case report describes the treatment for a patient who developed severely restricted hip motion following bilateral HRA.

Patient History and Review of Systems

Patient Characteristics

The patient was a 43-year-old, athletic man who underwent bilateral HRA secondary to severe OA. He had a long history of bilateral hip pain and attributed the arthritis to playing football and weight lifting as a youngster. He described a constant, sharp, acute pain in his left hip and a constant dull pain in his right hip. The patient was limited in his activities of daily living (ADL) due to pain and decreased hip ROM. He was limited in donning his socks and shoes, was unable to walk more than a few city blocks or ascend more than one flight of stairs, and could sit only about 5 minutes. Lastly, he stopped all recreational sports and activities due to pain and lack of ROM. Formerly, he had participated in tennis, golf, cycling, and weight lifting.

Preoperative Examination

According to the medical notes preoperatively, the patient walked with increased pelvic and trunk rotation and with bilateral abductor lurches and was limited in sitting, walking, and stair climbing. Upon palpation, the patient had no tenderness over either hip and no obvious joint ecchymosis. Sensation to light touch was intact, and he had good palpable pedal pulses. He had no pain with lumbar spine forward flexion or extension, but all hip ROM extremes were painful and grossly limited.

The patient’s presurgical diagnosis was severely debilitating bilateral hip degenerative joint disease. Radiographic examination revealed severe degenerative changes and osteophyte formation, which suggested subclinical slipped capital femoral epiphysis (SCFE) deformity and femoral-acetabular impingement. Slipped capital femoral epiphysis is defined as a posteroinferior slippage of the proximal femoral epiphysis on the metaphysis occurring through the physeal plate. Patients with SCFE who demonstrate increased slippage have shown increased risk for the development of OA.

Operative Findings

A bilateral Birmingham HRA was performed with no complications. The posterior approach was used, which required a capsulotomy, beginning with the superior acetabulum, continuing with the lateral femoral neck, and finally the inferior femoral neck. The hip was dislocated, and a capsulotomy was performed anteriorly, which allowed for a 360-degree exposure. The acetabulum was first addressed, and a significant amount of acetabular wear was noted anteriorly and osteophytes were removed posteriorly. The rest of the bone stock was in good condition and could support the resurfacing. After the hip was relocated, a dynamic examination of all motion planes showed that they were within functional range.

Postoperative Course of Physical Therapy

Gait training was initiated during the hospitalization. The patient was al-

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Allowed to bear weight as tolerated using bilateral axillary crutches. Hip precautions (avoiding hip flexion beyond 90° and no hip adduction or medial rotation beyond 45° for 6 weeks postoperatively) were instituted, which was the surgeon’s (EPS) protocol at the time to allow capsular healing and avoid dislocation. The patient was in the hospital for 5 days, then started home physical therapy at week 2. The plan of care mostly focused on transfers, gait, and stair climbing. The patient walked with bilateral axillary crutches for 3 weeks, then progressed to a straight cane for another 2 weeks.

At 3 months postoperatively, the patient attended our physical therapy practice. He attended another physical therapy facility prior to ours but was dissatisfied with his lack of improvements in ROM and stretching.

The patient was given a baseline Harris Hip Score (HHS),9,12 followed by a comprehensive history and physical examination. The historical examination included patient’s age, duration and location of symptoms, factors that exacerbated or eased symptoms, recreational activities and hobbies, patient’s goals, and medical, surgical, and social histories.

The patient’s history was consistent with a diagnosis of severely restricted hip motion, based on his documented pain, weakness, and severely restricted hip motion. The examination incorporated measurements of ROM and flexibility and a gait analysis to confirm or refute our diagnosis.

**Examination**

**Physical Examination**

The physical examination included measurement of hip passive range of motion (PROM),4,13–17 muscle length testing,17 manual muscle testing (MMT),17 postural assessment,17 and gait assessment.17 Passive range of motion was measured using a standard dual-arm goniometer with the patient in a supine position, and the data are shown in Table 1. The documented bilateral PROM of hip flexion (90°) and lateral rotation (10°) was restricted compared with the expected ROM for a patient 3 months after HRA. Good reliability and validity have been shown with a standard dual-arm goniometer for hip PROM in patients with OA.18,19 On muscle length testing, tightness of the iliopsoas muscle and iliotibial band was noted bilaterally, as well as a spring-like capsular end-feel. Manual muscle strength testing was normal throughout the lower extremities, except for hip abduction, which was 3+/5.

A visual assessment of the patient’s spine and pelvis was done to identify any obvious deviations, both statically and dynamically. The patient was observed to stand with a narrow base of support. A gait assessment on a level surface also was done. Deviations included increased trunk rotation, increased pelvic rotation with elevation and depression, and a mild bilateral Trendelenburg gait, presumably to compensate for decreased hip motion.18

The patient’s examination revealed pain, weakness, gait deviations, functional limitations, severely restricted hip motion, and decreased flexibility. Based on the spring-like capsular end-feel and severely restricted hip motion, the intervention of joint mobilization was initiated.

**Outcome Measures**

The multidimensional HHS (Tab. 2) is a disease-specific index that has been used to evaluate outcome following surgery.9,12 It contains 10 items, including pain, walking function, ADL, and hip ROM, and includes both self-reported and clinician-observed items.9 Scores range from 100 (no disability) to 0 (maximum disability). Kirmit et al15 reported that the HHS has excellent interobserver reliability (kappa = .91). Hoekema et al14 reported a minimal clinically important difference of 4 points for the HHS. The same physical therapist (JBC) administered the HHS at the patient’s initial visit and at discharge. The patient’s baseline total HHS score was 83 (Tab. 2).

**Intervention**

The patient attended our physical therapy practice to focus on increasing hip ROM to allow him to return to recreational activities such as golf, tennis, weight lifting, and roller blading. This was the shared goal of the patient, his physical therapists, and his physician.

Two physical therapists completed all examinations and patient interventions for this case report. The physical therapists’ clinical experience varied from 1 year (JBC) to 19 years (BG). Beginning at 3 months postoperatively, treatment consisted of mobilization of the hip joint, with 4 sessions the first week and then approximately 2 sessions a week, for a total of 18 visits over 20 weeks. Hip joint mobilization techniques usually involved 2 to 3 oscillations per second for 20 to 30 seconds, with 6 to 12 sets per mobilization technique, for a total treatment time of 45 minutes.18,20,21

Grade IV mobilizations were delivered to restore hip mobility.19–21 Mobilizations were intended to increase hip flexion and lateral rotation to allow the patient to sit cross-legged to put on his socks and shoes. The procedures and their operational definitions are described in Appendix 1.

Long axis distraction was used to encourage relaxation of the hip muscles and improve the elasticity of the joint capsule.4,17,18,21 This technique was performed at the beginning of each intervention, followed by examination of hip ROM and then other mobilizations.
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Table 1. Measurements of Bilateral Passive Range of Motion (in Degrees) at Initial Evaluation and at Discharge

| Movement         | Right Hip | Left Hip |
|------------------|-----------|----------|
|                  | Initial Evaluation | Discharge | Initial Evaluation | Discharge |
| Hip flexion      | <90       | 115      | <90       | 115          |
| Hip extension    | 5         | 17       | 5         | 14           |
| Hip abduction    | 40        | 40       | 45        | 47           |
| Hip adduction    | 25        | 30       | 25        | 30           |
| Medial rotation  | 10        | 30       | 10        | 40           |
| Lateral rotation | 10        | 30       | 10        | 40           |

Lateral femoral mobilization with a mobilization belt, as shown in Appendix 1, was used with the intent to improve hip abduction and rotation. All mobilizations were oscillatory glides at the end-range of osteokinematic motion.4,18,21

Inferior hip mobilizations with lateral and medial rotations using a mobilization belt were used to improve hip flexion and rotation.1 A second mobilization belt was used to secure the patient’s pelvis in order to obtain maximal hip flexion, as shown in Appendix 1, and to provide a sustained static hip flexor stretch.

Anterior hip mobilization with lateral rotation was done with the intent to increase anterior femoral glide, lateral rotation, and anterior capsule to allow for increases in gross extension,4,18,21 as shown in Appendix 1. After each mobilization was performed, PROM was assessed to determine whether any changes in mobilization technique were needed as the PROM increased.

Following the mobilizations, the patient was prescribed a home program of exercises for hip stretching and strengthening based on flexibility restrictions and weakness found on examination. The home exercise program was primarily completed in one set of 5 repetitions and was prescribed to the patient to address his bilateral iliopsoas contractures and tensor fasciae latae muscle/iliotibial band complex tightness and gluteus medius muscle weakness. A complete list of the exercises is shown in Appendix 2.

Outcomes

Outcomes were evaluated upon the patient’s discharge. The patient had a decrease in disability status, as assessed with the HHS. Total disability, as measured by the HHS, demonstrated a 13-point improvement (from 83 points at baseline to 96 points at discharge) and was clinically significant (Tab. 2). The patient also demonstrated improvements in hip mobility. Table 1 presents the patient’s bilateral PROM measurements at initial evaluation and at discharge. The improvement in total hip PROM was 82 degrees in the right hip (from 180° at baseline to 262° at discharge) and 101 degrees in the left hip (185° at baseline to 286° at discharge). Total PROM is illustrated in the Figure. The patient was discharged from physical therapy after he achieved functional ROM (sitting and able to sit cross-legged), which allowed him to return to all of his recreational activities, and was independent with his home exercise program.

Discussion

This case report describes a multimodal treatment approach including exercise and with an emphasis on joint mobilization for a patient who had severely restricted hip motion following bilateral HRA. The physician (EPS) described the surgical protocol as a capsulotomy, which is performed with a posterior approach. In this procedure, part of the capsule is spared, which can lead to severely restricted hip motion if early ROM is not initiated. Because the HRA procedure involves a complete 360-degree capsulotomy for exposure, scar tissue may form circumferentially around the joint. Furthermore, with the deliberate retention of bone at the femoral neck, a situation is created in which the capsule and neck may become adherent. Thus, the physician concluded that an HRA, as opposed to total hip replacement, may place the patient at greater risk for the development of severely restricted hip motion.

Although more research is needed for this patient population, some research has already established a positive outcome with manual therapy and improved function and ROM with exercise in patients with hip OA following bilateral HRA.9,18,19 as well as following a total hip arthroplasty revision.4 Howard and Levitsky,4 in their case report, described a positive outcome in a patient who received manual therapy following a total hip arthroplasty revision. Hoekema et al.18 found that manual therapy was more effective than exercise alone in reducing pain and stiffness and improving ROM and function in patients with hip OA. However, no research exists on the relationship between the use of joint mobilization and severely restricted hip motion following HRA. This case report shows clinically significant changes in function as measured by the HHS and increases in hip ROM similar to the results of pre-
Joint mobilization was used in this case because it hypothetically allows joint capsule stretching\(^5,21,25\) in order to regain normal joint mechanics.\(^3,18,20\) The physical therapists chose grade IV accessory movements according to the Maitland classification system\(^21\) because, upon examination, significant restrictions in capsular end-feel and PROM were identified in both extremities. A grade IV accessory movement is a small-amplitude movement that begins at the very end of the available ROM.\(^20,21\) This limitation falls within the restricted capsular patterns, as described by Cyriax.\(^15\) A capsular end-feel was originally defined by Cyriax as the quality of resistance at the end-range.\(^15,16,25\) For the purpose of this report, we defined a spring-like end-feel before full range is reached as capsular end-feel. The capsular pattern includes flexion, medial rotation, and abduction,\(^16,25\) which is consistent with our patient.

This intervention is intended to restore functional mobility and arthrokinematics of the severely restricted hip joint by improving the extensibility of the ligament-capsular tissue.\(^3,8,14,18,21,23–28\) Furthermore, joint mobilization is intended to break up adhesions, realign collagen, decrease pain secondary to the stimulation of mechanoreceptors, and diminish

| Category      | Points | Initial Evaluation | Discharge |
|---------------|--------|-------------------|-----------|
| Pain          |        | 40                | 44        |
| None          |        | 44                |           |
| Slight, occasional | 40 |          |           |
| Mild, normal activity concessions | 30 |          |           |
| Moderate, activity concessions | 20 |          |           |
| Marked, severe concessions | 10 |          |           |
| Totally disabled | 0 |          |           |
| Range of motion\(^a\) | 2 | 4 |           |
| Full          | 5      |                  |           |
| Partial       | 4      |                  |           |
| Limited       | 2      |                  |           |
| Gait/limb     | 5      | 8                 |           |
| None          | 11     |                  |           |
| Slight        | 8      |                  |           |
| Moderate      | 5      |                  |           |
| Unable to walk| 0      |                  |           |
| Gait/support  |        | 11                | 11        |
| None          | 11     |                  |           |
| Cane for long walks | 7 |          |           |
| Cane, full time | 5 |          |           |
| Crutch        | 4      |                  |           |
| 2 canes       | 2      |                  |           |
| Unable to walk| 0      |                  |           |
| Gait/distance |        | 11                | 11        |
| Unlimited     | 11     |                  |           |
| 6 blocks      | 8      |                  |           |
| 2 or 3 blocks | 5      |                  |           |
| Indoors only  | 2      |                  |           |
| Bed and chair | 0      |                  |           |
| Function/stairs| 2     | 4                 |           |
| Normal        | 4      |                  |           |
| Normal with banister | 2 |          |           |
| Any method    | 1      |                  |           |
| Unable        | 0      |                  |           |
| Socks and shoes| 2     | 4                 |           |
| Easy          | 4      |                  |           |
| With difficulty| 2     |                  |           |
| Unable        | 0      |                  |           |
| Sitting       |        | 5                 | 5         |
| Any chair 1 hour | 5 |          |           |
| High chair ½ hour | 3 |          |           |
| Unable to sit ½ hour | 0 |          |           |

(Continued)
muscle spasms and guarding due to nociceptive stimulation. These mechanisms are all hypothetical, and there is a lack of evidence to date from basic and patient-oriented studies that can support these mechanisms convincingly.

Research has shown that physical therapists differ in the amount of pressure applied during the grades of mobilization, but the most important variable seems to be the verbal interaction between the patient and the therapist to make necessary pressure adjustments to keep the joint mobilizations within a pain-free range. It should be noted that exercise was used in conjunction with joint mobilization to maintain the increased ROM and improvements in joint mechanics and, ultimately, to normalize the patient’s ADL and function. The patient’s improvement cannot be attributed to the intervention alone because causality cannot be determined from a case report. One limitation of this report is that the same rater (JBC) delivered the intervention and conducted the ROM for the HHS. This limitation introduces the potential for unintended bias. The patient had received an earlier course of physical therapy intervention that did not include manual therapy at another facility. However, at the time of the initial evaluation in our physical therapy practice, the patient’s presentation of ROM was already behind the natural course of recovery.

It is possible that our patient’s outcome could have been attributable, in part, to the natural course of recovery, but based on our experience, 90 degrees of hip flexion and 10 degrees of lateral rotation are not within normal limits for a patient 3 months after HRA. Normal hip ROM for these patients at 3 months postoperatively would be approximately 110 degrees of hip flexion and 30 degrees of lateral rotation. We speculate that the intervention probably helped the patient restore his lost ROM. However, despite the limitation noted above, the outcome of this report is promising for the utilization of joint mobilization in clinical practice for the treatment of patients who have severely restricted hip motion. The experience with this particular patient has led the surgeon (EPS) to alter his postoperative protocol by disregarding hip precautions and beginning early ROM of the hip.

Further research is needed to investigate the efficacy of using joint mobilization in the treatment of severely restricted hip motion. Randomized clinical trials should include multiple individuals with severely restricted hip motion so a cause-and-effect relationship can be established. These trials should include muscle strength (force-generating capacity), ROM measurements, and functional measures such as the HHS as outcome measures.

This report described a case involving the emphasis on joint mobilization in a patient with severely restricted hip motion. The multimodal treatment ap-
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approach with emphasis on joint mobilization was intended to restore the patient’s functional ROM. The patient had a loss in functional ROM and was unable to participate in recreational activities prior to the start of treatment. At the time of discharge, the patient had made significant gains in ROM and was able to return to all recreational activities.

Dr Crow and Mr Gelfand provided concept/idea/project design and the patient. All authors provided writing and consultation (including review of manuscript before submission). Dr Crow provided data collection and analysis, project management, and clerical support. Mr Gelfand provided facilities/equipment and institutional liaisons.

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Appendix 1.
Operationally Defined Hip Mobilization Procedures\textsuperscript{a}

**Long axis distraction\textsuperscript{21}:** Patient positioned supine with hip in 30 degrees of flexion and abduction and slight lateral rotation, with the contralateral limb flat. Progressive long axis distraction oscillations were performed with a 2-handed hold by the therapist proximal to the ankle, as shown. Intensity was increased with each subsequent oscillation while ensuring the patient was without pain or apprehension. Progressive distraction was based on the therapist’s assessment of joint restriction during the mobilization.

**Lateral femoral mobilization\textsuperscript{21}:** The patient is positioned supine with the involved knee flexed to 90 degrees and the foot flat on the plinth. A mobilization belt was used to deliver a lateral glide to the proximal femur as the hands of the therapist stabilize the knee. The mobilization was an oscillatory glide at the end of the range of motion, and towels were placed between the patient and belt to help improve the patient’s tolerance. The amount of force was based on the therapist’s assessment of joint restriction during the mobilization.

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Appendix 1.
Continued

Inferior hip mobilization with lateral and medial rotations: With the patient positioned supine, a mobilization belt was placed as proximal to the hip joint as possible. A second belt was used to secure the patient’s pelvis in a neutral tilt on the plinth in order to obtain maximal hip flexion, as shown, and to provide a sustained static hip flexor stretch. The therapist first performed an inferior glide with the patient’s affected leg over the therapist’s shoulder. The mobilization was an oscillatory glide at the end of the range of motion, and towels were placed between the patient and belt to help improve the patient’s tolerance. Then the therapist placed the affected leg first into lateral rotation and then into medial rotation and performed another inferior glide. The amount of hip flexion and rotation was varied to find the position that the therapist believed most effectively stretched the hip joint and was tolerated by the patient. This was based on the therapist’s assessment of joint restriction during the mobilizations.

Anterior hip mobilization with lateral rotation: The patient was positioned prone with the affected knee flexed to 90 degrees and a half bolster placed superior to the knee. The therapist’s hand was placed on the posterior aspect of the greater trochanter and delivered a posterior-to-anterior oscillatory glide through the proximal femur. The therapist’s other hand was placed at the patient’s ankle to laterally rotate the affected leg. The amount of lateral rotation was varied to find the position that the therapist believed most effectively stretched the hip joint and was tolerated by the patient. This was based on the therapist’s assessment of joint restriction during the mobilization.

*Arrows in the photographs represent force vectors applied to the extremity.*
Appendix 2.
Home Exercise Program

Exercises were introduced after joint mobilizations in the clinic and then given as a home exercise program. Exercises were performed daily.

• Closed-chain hip abduction on a stair stepper for gluteus medius muscle strengthening: 5 minutes
• Isometric side-lying hip abduction: holding 10 seconds with 2.27 kg (5 lb) around ankle: 1 set of 10 repetitions
• Prone hip extension with leg straight and 2.27 kg (5 lb) around ankle: 3 sets of 10 repetitions
• Closed-chain hip lateral and medial rotation with one foot on towel to allow for rotation, holding 5 seconds in each direction: 1 set of 10 repetitions
• In quadruped position from 90 degrees to patient’s maximum tolerated end-range of hip flexion. Patient holding end-range position for 30 seconds: 1 set of 5 repetitions

• Supine hip flexor and iliotibial-band stretch with 2 pillows under hips. Patient adducts involved extremity, holding in place with opposite lower extremity, as shown above. Patient holding stretch for 5–10 minutes.