Published in final edited form as:

PM R. 2015 August ; 7(8): 895–900. doi:10.1016/j.pmrj.2015.04.002.

Successful rehabilitation of a young adult with total hip arthroplasty a decade after a Girdlestone procedure: a case report

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Abstract

This is a case report of a female who underwent a Girdlestone arthroplasty at age 10 and a total hip arthroplasty at age 21. Despite early post-operative rehabilitation, the patient experienced increasing pain, progressive gait deviations and functional limitations during the year following surgery. This course of care was initiated one year after surgery and focused on motor retraining to address pain and gait deviations. This case demonstrates that positive outcomes can be achieved after longstanding musculoskeletal dysfunction is corrected, but that prolonged rehabilitation may be necessary to produce changes in movement patterns at both the local (joint and muscle) and central (cortical) levels. Correction of both the structural problem and the learned movement patterns is necessary for a successful outcome.

Keywords

Girdlestone; hip arthroplasty; gait; movement system; physical therapy

INTRODUCTION

Girdlestone arthroplasty was first described by GR Girdlestone (1) as a radical surgical technique to address complications from hip joint infections. Today, it is considered a salvage procedure done as a last resort in the presence of significant infection, poor bone stock, or failed total hip arthroplasty (THA) (2, 3). The surgery involves removal of the femoral head to the lesser trochanter, approximation of the femur into the acetabulum and reattachment of associated soft tissue. While the procedure is considered appropriate and effective in the presence of a hip infection and in reducing pain, complete return to

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This case report was previously presented in poster format at the Combined Sections Meeting of the American Physical Therapy Association held in Las Vegas, NV, February 2014 and in platform format at the 2014 meeting of the Gait and Clinical Movement Analysis Society (GCMAS), in Newark, DE, in June 2014.

Conflict of Interest Disclosure: None.

functional activities may be limited (2). Limitations in active and passive range of motion, gait, and function are commonly reported (4, 5). Conversion to THA often results in better function than Girdlestone alone, but over 50% continue to have poor function (6). The THA can provide restoration of joint structure; however, directed motor retraining may be necessary for optimal tissue healing and restoration of functional movement. The purpose of this case report is to describe the value of comprehensive rehabilitation to improve function in a patient with complex orthopedic impairments following a Girdlestone procedure at age 10 and a THA at age 21.

CASE DESCRIPTION

A 22-year-old female had undergone a Girdlestone procedure at age 10 for avascular necrosis of the right femoral head. After the procedure, she was ambulatory with a large lift due to the resulting leg length discrepancy and no assistive devices. However, she had chronic weakness of the hip region and limited hip range of motion (ROM) that inhibited her ability to participate in recreational activities. As she matured through high school and college, she began to have progressively worsening episodes of hip and low back pain. The pain and continued ROM and strength deficits interfered more with her daily activities and prevented her from undergoing a complete gynecological exam. Therefore, at the age of 21, she chose to undergo a THA via a posterolateral approach. Post-operatively, she was placed in traction to facilitate connective tissue lengthening to accommodate the additional leg length from the inserted prosthesis, and completed 10 weeks of home physical therapy. She was discharged when she was able to ambulate independently within the community and access public transportation despite continuing to have gait deviations and limited hip motion. By one year following surgery, she had returned to full-time work as a research assistant but had significant pain throughout her involved hip and low back, pronounced gait deviations, and functional deficits interfering with her ability to work or ambulate at a community level. At this point, she sought out a referral for physical therapy evaluation because she was dissatisfied with the outcome of her THA and felt that it provided her with no improvement in function or ROM. At the time of the initial physical therapy evaluation, her verbal pain rating on an 11-point rating scale (7) was 8/10 at worst and 4/10 at best in past 24 hours with consistent use of acetaminophen with codeine 2-3 times/day. Her Lower Extremity Functional Scale (LEFS) score was 32/80 (40%) with 0% being complete disability and 100% being full function (8). She also demonstrated significant passive ROM deficits (Table 1). Strength testing revealed that she was unable to move her right hip within the available ROM without substitution, limiting standard manual muscle testing. She also had weakness in the knee and ankle (Table 1). Standing postural alignment demonstrated lumbar lordosis, right hip and knee flexion, and lateral trunk lean to the left, indicating decreased weight bearing on the right lower extremity. All active movements of the right hip were performed with compensatory motion of the lumbopelvic region potentially indicating decreased neuromuscular control and muscle weakness.

Initial Motion Analysis

In addition to the physical therapy examination, the patient voluntarily participated in a biomechanical evaluation and provided written informed consent as approved by the

Institutional Review Board of Boston University. Reflective markers were placed on the patient's trunk and lower extremities. Marker positions were collected using a motion capture system (100Hz, Vicon Motion Systems Ltd., Centennial, CO) and ground reaction forces were measured using an instrumented force treadmill (1000Hz, Bertec Corporation, Columbus, OH). We used commercially available software (Visual3D, C-Motion, Inc, Rockville, MD) to calculate joint kinematics. The patient performed three functional tasks: walking at a self-selected speed, single-leg squat and single-leg step-down.

During gait, the patient demonstrated increased right hip internal rotation during stance and significant lateral trunk flexion to the right during right stance, a common gait deviation in patients following Girdlestone arthroplasty (5, 9) or subsequent conversion to THA (9). She walked in substantial anterior pelvic tilt and had decreased right hip excursion (Figure 1). During the single-leg weight-bearing tasks, she exhibited poor control of the lower extremity, pelvis, and trunk on the right compared to the left. When squatting as low as possible, the single-leg squat on the right was limited to 47° of knee flexion compared to 71° of flexion on the left. During a step-down and return from a 16cm step, she required the handrails for balance in 2 of the 5 repetitions for this task while standing on the right. She also exhibited excessive hip adduction during the task, adducting the right hip to a peak of 25°.

CLINICAL COURSE

The patient was seen in outpatient physical therapy two times per week initially and then reduced due to insurance restrictions on total visits. Initial intervention focused on increasing ROM using manual stretching of the hip and surrounding musculature. Long axis and short axis manual traction with a belt stabilizing the pelvis was used to passively stretch hip joint structures. Hip muscles were stretched passively with a focus on increasing the length of the rectus femoris, iliopsoas, and hip adductors. Stretching was followed by active-assisted and active therapeutic exercise through the available ROM. Exercises were prescribed and progressed as she was able to move her hip and knee without compensatory motion of the lumbopelvic region (10). Initially, hip and knee movements were assisted by pulleys and deloading devices, and then gradually progressed to anti-gravity resistive exercise (Figure 2). As isolated hip motion was a major challenge for this patient, we used a stabilizing belt over the pelvis to enhance isolated joint movement and decrease lumbar compensation. During all exercises, substantial visual and verbal feedback was used to improve the quality of movement and limit compensatory motion. Exercises were performed in a pain-free range with high volume and low load. Typically, three sets of 15 to 40 repetitions were performed at an endurance level to promote neuromuscular retraining (11). Once pain-free isolated hip motion was restored, intervention progressed to functional tasks including sit-to-stand, step-ups and gait training with emphasis on speed necessary for community ambulation.

OUTCOMES

Patient was seen in physical therapy over 9 months for a total of 22 visits (Table 2). At discharge, LEFS Score had improved to 56/80 (60%), an improvement of 24 points. While

this is above the standard error for the tool (5.31 points) and the minimal detectable change (9 points), the score still indicates decreased function (8). Her verbal pain rating on an 11-point rating scale had improved to 0/10 over the past 72 hours, with 3/10 at the worst, and only infrequent use of acetaminophen with codeine (1 dose within past 3 weeks). Her range of motion and strength had improved (Table 1). Her resting standing posture revealed knees and hips in neutral flexion / extension, a reduction in her lumbar lordosis, and only slight lateral lean to the left. She was able to isolate hip motion against gravity without compensatory motion, indicating improved strength and neuromuscular control (Table 1). She was able to ride a stationary bicycle and ambulate within the community.

Follow-up Motion Analysis

At the one-year follow-up, the patient demonstrated significant improvements in her gait and single-leg weight bearing tasks. During walking, she had less trunk shift to the right, less anterior pelvic tilt, and improved but still asymmetric hip excursion. During the single-leg weight-bearing tasks, she exhibited improved control on the right. She was able to squat to 54° of right knee flexion. She was able to complete the 5 repetitions of the step-down task from the 16cm box without the use of handrails, and did so with only 7° of right hip adduction.

DISCUSSION

The functional outcomes following conversion of a Girdlestone to THA are highly variable with less than 50% reporting a good or very good outcome (6). This case study highlights the extensive rehabilitation program which resulted in improved function for a patient after conversion of a longstanding Girdlestone arthroplasty to THA. For this patient, the surgery itself was a structural success with implantation of a prosthetic hip and lengthening of the associated hip musculature. Early post-operative rehabilitation provided the minimal restoration of hip range of motion and muscle strength necessary for activities of daily living and limited community ambulation. However, the continued presence of pain one year post-operatively and the patient's perception of no functional improvement suggest the rehabilitation was not complete. The physical therapy examination and motion analysis measures at the initiation of our course of care (one year following THA) demonstrated abnormal movement and compensatory strategies similar to those noted in patients with a Girdlestone hip (4, 5, 9). Her continued lower extremity and low back pain after surgery may have been due to persistent use of the involved hip in a limited range of movement that resulted in increased stress to the lumbar spine, pelvis and associated soft tissue. Abnormal motor function can occur at the local (eg, muscle and joint) (10) or central level (eg, spinal cord and brain) (12, 13, 14). While the THA and initial physical therapy may have addressed the muscle and joint impairments, current evidence in the area of cortical plasticity suggests that high repetition exercise (15) with goal directed tasks (16) is necessary for motor re-learning at the central level. Therefore, our intervention focused not only at the local muscle and joint level, but also at the neuromuscular and cortical levels to effectively retrain lower limb neuromuscular control to fully engage her reconstructed musculoskeletal structures. We focused on movements specific to the physical demands of urban ambulation versus isolated muscle strength training. We also focused on developing lumbopelvic stability as a

means of addressing chronic back pain and enhancing muscle control around the hip girdle. At the time of discharge, nearly two years following the THA, she had substantially improved her movement patterns such that her impairments were no longer visually obvious.

Another challenge in the patient with longstanding orthopedic problems, especially ones that occur prior to full maturation, is that the goal of intervention is not to return to a prior level of function, but instead to improve function. Again, achievement of this goal requires prolonged intervention first to address existing tissue impairments and second as the patient learns, potentially for the first time, how to move more efficiently. Despite all the positive gains for this patient, some abnormal motor strategies were not fully retrained as demonstrated by the persistent decreased excursion of the right hip during gait despite the available range of motion. None-the-less, by the end of our intervention, the patient was extremely satisfied with the outcome of her THA, which is vastly different from her view from 6 months to 1 year post-op. For the first time that she could remember, she was able to hop, skip, jog, ride piggy-back, wear high heels, dance, and even consider having children.

CONCLUSION

This case demonstrates the value of well-structured therapeutic interventions for patients with chronic orthopedic conditions. A prolonged rehabilitation course may be necessary to produce changes in movement patterns as adaptations are needed at both the local level (joint mobility and muscle strength) and the central level (cortical). While not all impairments may be completely remedied, substantial improvements in function and quality of life can still be achieved.

Funding Acknowledgement

Research reported in this manuscript was supported by the Peter Paul Career Development Professorship and by the National Institute of Arthritis and Musculoskeletal and Skin Diseases of the National Institutes of Health under Award Numbers R21 AR061690 and K23 AR063235.

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Figure 1.

Sagittal pelvis, hip, knee and ankle angles during gait. Initially, the patient walked with significant anterior pelvic tilt (average of 22° , first row, dashed line), decreased right hip excursion (28° right compared to 48° left, second row, dashed line), and maintained the right hip in flexion through the gait cycle ($\dagger$). At follow-up, less anterior pelvic tilt (average of 14° , first row, solid line), improved but still asymmetric hip excursion (32° right compared to 46° left, second row, solid line) and achieved similar hip extension on the right as on the left (3° , $*$).

Figure 2.

Exercises: A. Controlled hip abduction and external rotation: this exercise targets dissociation of hip motion with pelvic stability. B. Passive knee flexion with resisted extension: the goal of this exercise is to facilitate lengthening of the rectus femoris with a pelvic stabilization belt. C. Combined hip and knee flexion: this exercise targets pain-free combined motion of the hip and knee with lumbopelvic stability in standing. D. Deloaded squats: This exercise promotes pain-free symmetrical lower limb movement for activities such as “sit to stand”.

Table 1

Range of motion and strength findings pre- and post-intervention. **Normal hip ranges of motions:** Flexion 0-120°, Extension 0-30° Abduction 0-45°, Internal rotation 0-45°, External rotation 0-45°.

Hip Motion	Initial ROM	Final ROM	Strength Initial	Strength Final
Flexion	35-78° firm and painful endfeel	0-90° firm painfree endfeel	3/5 within available ROM	4/5
Extension	No available ROM	0-5° firm painfree endfeel	2/5 within available ROM	3/5
Abduction	0-5° firm and painful endfeel	0-25° firm painfree endfeel	1/5 Unable to move in isolation	3/5
Internal Rotation (seated)	0-20° firm and painful endfeel,	0-30°	1/5 Unable to move in isolation	4/5
External Rotation (seated)	No available ROM (seated)	No available ROM (seated)	1/5 Unable to move in isolation	3/5 from full IR to neutral
Knee Extension	Full ROM	Full ROM	4/5	5/5
Ankle Plantar flexion	Full ROM	Full ROM	Unable to test in standing 4/5 tested in supine	5/5 standing single leg raise 25 times

Table 2

Summary of weekly exercise program with progression

Weeks	Exercise	Manual Treatment
1-3 (2 times/week) 60 min/visit	Initiated: <ul style="list-style-type: none"> Supine pulley assisted abduction Supine assisted flexion, resisted extension Seated resisted knee flexion Training in abdominal bracing during leg movements 	Initiated: <ul style="list-style-type: none"> Manual stretching to adductors, hamstrings, quadriceps at the knee Hip joint traction with pelvic stabilization
4-8 (2 times/week) 60 min/visit Added 30 min of pool program at the end of week 6	Continued with above exercise Initiated: <ul style="list-style-type: none"> Sidelying pulley assisted hip abduction with external rotation Standing deloaded squat in partial ROM Prone pulley assisted knee flexion, resisted extension Quadruped alternate leg lifts isolated hip movement with lumbopelvic control in supine and sidelying In pool: using floatation devices, began reciprocal lower extremity movements including kicking, walking and squats 	Continued: with manual techniques above Initiated: <ul style="list-style-type: none"> Prone anterior hip stretching including iliopsoas and rectus femoris as patient could now tolerate Gastrocsoleus in standing added Discontinued joint mobilization to hip week 6
9-12 (1 times/week) 60 min per visit	Initiated: <ul style="list-style-type: none"> Sidebridging, planks on knees added Standing exercise for hip and knee flexion progressed to active control against gravity Side stepping with visual feedback to maintain trunk upright Stationary bike with partial range of motion of pedal stroke week 8 progressed to full rotation by week 11. Able to ride for 15 minutes prior to fatigue by week 12 Home Exercise week 8 for standing balance lumbopelvic control Discontinued: <ul style="list-style-type: none"> Pool program week 11 	Initiated: <ul style="list-style-type: none"> Stretching after exercise for quadriceps, hamstrings, adductors, and gastrocsoleus
13-discharge (1 time/week progressed to 1 time every other week, variable due to insurance restrictions)	Initiated: <ul style="list-style-type: none"> Elliptical trainer for up to 10 minutes Standing single limb support with upper extremity challenges and balance perturbation Step ups Single limb split squats Side walking with theraband resistance around ankles Timed ambulation with obstacles for speed and direction change 	Patient independent in stretching for rectus femoris, adductors, hamstrings, gastrocsoleus. Discontinued manual techniques.