EFFECT OF AN INITIAL AQUATIC THERAPY PROGRAM WITH PROGRESSION TO LAND PROGRAM FOR ADULT FOLLOWING THREE TOTAL HIP ARTHROPLASTY REVISIONS

A Case Report
Presented to
The Faculty of the College of Health Professions and Social Work
Florida Gulf Coast University
Submitted in partial fulfillment of the requirements for the degree of Doctor of Science in Physical therapy

By
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2015
Effects of an Aquatic Therapy Program

APPROVAL SHEET

This Case Report is submitted in partial fulfillment of the requirements for the degree of

Doctor of Physical Therapy

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The final copy of this Case Report has been examined by the signatories, and we find that both the content and the form meet acceptable presentation standards of scholarly work in the above-mentioned discipline.
Acknowledgements

I would like to thank several people for assisting in the development and final completion of this scholarly paper. Firstly, to a wonderful and knowledgeable committee, specifically Dr. Kathleen Swanick and Dr. Stephen Black, who provided me with great insight and inspiration as I began to narrow the focus of my Independent Study, and with finalizing this paper, I sincerely thank you. I also would like to thank Gaynell Anderson and Andy Hovanec who were the case patients primary PT’s they provided all the information for the case and encouragement to pursue the idea for the paper. Finally, the greatest amount of appreciation and thanks goes to Todd Mortenson, my husband, Logan Mortenson, Colin Mortenson, and Justin Mortenson, my sons for always being there for me, encouraging me to pursue my dreams and for putting up with me as I underwent this great undertaking in the development of this paper. I cannot thank you enough for providing me with the love and support I needed to achieve my dreams.
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Abstract

Background and Purpose: According to the Centers for Disease Control and Prevention (CDC) Osteoarthritis (OA) is the most common form of arthritis, it affects 33.6% of adults aged 65 and older an estimated 26.9 million adults in the US in 2005, which is up from 21 million in 1990. Eighty-eight out of ten thousand of these patients will suffer from hip OA leading to hospitalizations and potentially hip replacement procedures. Patients suffering from OA who have opted to have a total hip replacement may present with barriers to conventional land based therapy due to inability to bear full weight on the affected extremity. Evidence has shown that aquatic therapy is a good initial intervention for THA patients. The unique qualities of water make it well matched for patients who are unable to exercise on land, or find land-based activity too demanding. Aquatic therapy provides an alternative strategy (Batterham, Heywood & Keating, 2011).

Case Description: The purpose of this case study is to describe the evaluation, intervention, and outcome of a patient following a THA with 3 subsequent revision surgeries who successfully participated in an aquatic therapy program. The patient is a 54-year-old male referred to physical therapy following a THA and 3 revision surgeries resulting in impaired gait positive Trendelenberg, impaired balance, and overall decrease in functional mobility and subjective pain stated 10/10 at worst and average of 6/10. The aquatic therapy sessions were three times per week for the initial 4 weeks then the patient was progressed to land based therapy for an additional 8 weeks.

Results: The aquatic program included progressive strengthening, gait training, and balance activities. After
three weeks, the patient reported a significant decrease in subjective pain levels and demonstrated increased static standing balance with improved hip stabilization. He also demonstrated improved strength, increased weight bearing tolerance, and increased functional mobility. Demonstrated by manual muscle testing, improved activities of daily living, and subjective increased functional mobility. **Conclusions:** This case report advocates that aquatic therapy may be valuable for patients with impaired weight bearing tolerance that would not be able to progress with land therapy or are unable to tolerate land activities.
Background and Purpose

Total hip arthroplasty (THA) procedures are one of the most common and successful orthopedic surgeries for patients suffering from osteoarthritis (Passias & Bono 2006). Approximately 1-3% of the senior adult population will elect to have a THA at some point making it one of the most prevalent elective orthopedic surgeries (Passias & Bono 2006). Most frequently reported complications following THA include dislocation, pulmonary embolism and deep infection. These complications are highest immediately following surgery however; they continue to rise over the first three months post surgery (Phillips et al., 2003). The economic burden of arthroplasty revision has yet to be systematically studied however it is considered to be substantial and if the incidence of revision surgeries is not controlled it will likely continue to increase (Ong et al., 2006).

Revision surgery can be defined as a procedure in which the exchange of the acetabular components and/or liner, or the femoral or modular head, or any combination thereof is involved (Wetters, et.al. 2012). Dislocation is said to be the most frequent complication following revision of a total hip. A study was done in 2012 to determine the risk factors involved in dislocation. Possible risk factors were divided between patient factors and surgery specific factors. Patient factors included age, sex, BMI, the femoral and acetabular classification, history of instability prior to revision, number of hip surgeries, and abductor integrity. Procedure-specific factors included cup diameter of the acetabular, femoral head diameter, head to cup ratio, length of the femoral neck, use of constrained or
effects of an aquatic therapy program (wetters et al., 2012). results showed that femoral head size appeared to cause the highest risk for dislocation along with trochanter nonunion/abductor deficiency, and previous revision surgeries. further analysis demonstrated that for patients receiving the anterior surgical approach bmi was the only risk factor for dislocation (wetters et al., 2012).

the revision of tha poses a challenge for even the greatest qualified surgeon. common indications for tha revision surgeries include loosening of the implant resulting in pain, infection in the joint, or fracture (drake, ace & maale, 2002). frequent dislocations often contradict the overall benefit of tha. a recent study from hip international showed dislocation rates with the posterior approach to be 4.1%, while the transgluteal approach was 3.4% (rogers, blom, barnett, karantana, & bannister, 2009). there are many revision strategy procedures currently being performed. however, regardless of the method successful surgery for recurrent dislocation cannot be guaranteed. outcomes will depend on the initial approach used and the direction in which the dislocation occurred (rogers et al., 2009).

there are two standard surgical approaches that are currently used for tha procedures they include posterolateral approach (p-l) and the anterolateral approach (a-l) (madsen et al. 2004). the p-l approach is the most common
approach. This approach affects the posterior joint capsule the gluteus maximus, which is separated in line with the fibers, and the external rotator group (figure 1). The external rotators (ER) are principally responsible for stability laterally and posteriorly. The ER's are bisected near the insertion. This method subsequently spares the gluteus medius and vastus lateralis muscles (Madsen et.al., 2004). Another benefit is that a trochanteric osteotomy is not performed. The main disadvantage in this approach is the high incidence of joint instability resulting in dislocation or subluxation of the hip (Kisner & Colby, 2007), (Madsen et.al., 2004). Due to the proximity of the sciatic nerve to the surgical field using the posterolateral approach there is an increased potential of damage to the sciatic nerve (Lohana, Woodnutt, & Boyce, 2010). The A-L approach typically affects gluteus minimus, gluteus medius, tensor fasciae latae and vastus lateralis muscle function. Much of the torque necessary for hip abduction and pelvic obliquity control during normal gait comes from the gluteus medius and minimus (Madsen et.al., 2004). The A-L approach has been revealed to yield more positive Trendelenburg signs (figure 2) (Madsen et. al., 2004). The anterior lateral approach has gained in popularity in some populations due to the decreased incidence of dislocations (Palan, Beard, Murray, Andrews & Nolan,
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The advantages to the A-L approach include a reduction in leg discrepancy length, decreased sciatic nerve damage, and dislocation due to preservation of the posterior hip musculature (Pour, Parvizi, & Rothman, 2005). In more recent years minimally invasive hip replacement procedure have been introduced with some controversy in respect to the benefits. However, studies have shown that these procedures can improve the immediate outcomes in regard to decreased blood loss, shorter hospitalization and a faster recovery for the patient (Pour et al., 2005).

Physical therapy following THA is a significant component in improving overall functional outcomes of patients. In the acute care phase physical therapy may decrease the cost of care and accelerate the time to discharge, thereby decreasing the length of stay in the hospital (Freburger, 2000). Numerous studies have been conducted to determine discharge destination. One study done in 2001 looked at 541 patients following THA, total knee replacement or hip fracture. The research reviewed clinical outcomes and reimbursement for care either at an inpatient facility (IPR) or skilled nursing facility (SNF). The researchers determined that patients admitted to an IPR had shorter lengths of stay and substantially better functional outcomes than those who were discharged to SNF. However, the downside to the IPR was that it was significantly more expensive that the SNF (Herbold, Bonistall & Walsh, 2001, 2011). Regardless of the location of discharge for rehabilitation or the surgical approach used it is clear that patients require skilled rehabilitation following THA to regain functional abilities.
The principal goals of physical therapy after THA are to reestablish function, reduce pain, and increase muscle control in order to return the patient to his/her prior level of function (O’Sullivan & Schmitz, 2007). Standard initial physical interventions include therapeutic exercise, gait and transfer training and ADL instruction and precaution education. A targeted strengthening program in the postoperative rehabilitation period has shown to be effective in improving muscle atrophy and weakness in the affected lower extremity (Galea et.al., 2008). In order to improve gait and decrease pelvic drop during the swing phase of gait the rehabilitation should include hip abduction specific strengthening (Madsen et.al., 2004).

Aquatic therapy is a good initial rehabilitation intervention for THA patients. Water offers unique properties that make it well matched for rehabilitation of a variety of disorders. These properties include: buoyancy, resistance, hydrostatic pressure, specific heat, and thermal conductivity (Cameron, M.H., 2009). The buoyancy effects in particular allows for decreased weight bearing, off loading joint compressive forces and relieving stress on connective tissues which provides benefits to patients in the early stages of rehabilitation and provides gradual transition from non weight bearing to full weight bearing. When patients are unable to exercise on land, or find land based activities too demanding, aquatic therapy programs provide an alternative strategy (Batterham, Heywood & Keating, 2011). Recent evidence shows there is an increase in skin blood flow to the affected tissues due to the moisture content.
of the heat of the water as it interacts with the tissue leading to faster healing (Petrofsky et.al., 2010).

**Review of Literature**

A review of the literature demonstrates that aquatic therapy has shown to be an effective treatment for patients with a variety of conditions such as osteoarthritis, balance deficits, musculoskeletal conditions, and post-surgical joint replacement rehabilitation. Many researchers have sought to show that there is a significant benefit to aquatic based therapy over land-based therapies. However, most research has been unable to show a difference between the two interventions.

Studies reviewed comparing aquatic therapy to land based therapy using outcome measures such as pain, flexibility, and strength did not exhibit statistically significant difference between the therapies. However, aquatic therapy was found to have fewer adverse effects on patients (Lund et al., 2008). One study used a two group randomized control. They chose 38 subjects from a local community and assigned them to either a 12-week aquatic program, a land based therapy group, or a non-exercise control condition. The results showed that the aquatic exercise had statistically significant improvement in knee flexibility, strength, and aerobic fitness. However, it did not show improvements in function or pain (Wang, Belza, Thompson, Whitney & Bennett, 2006).

Another study showed that both land and aquatic therapies showed improvements in quality of life, knee range of motion, and reducing pain. However, aquatic therapy was not superior to land therapy when it came to
reducing pain (Wang et al. 2011). A third study however, showed that even though there were no clinical benefits detected when compared with the control group, there were significantly fewer adverse effects when compared with the land therapy group (Lund et al., 2008). Aquatic therapy appears to provide short-term benefits for patients with knee or hip OA suggesting it as a viable initial treatment option particularly with patients with severe disease (Hammer, Naylor, Crosbie & Russell, 2009). Aquatic programs are expensive and potentially labor intensive. However, the benefits to the patients, and potential for business diversification can make an aquatic program a successful one.

**Case Description**

The case patient was a 54-year-old male referred to outpatient physical therapy five months after undergoing a third revision of his total hip arthroplasty secondary to anterior dislocation. Following surgery patient was non-weight bearing for 2 month. Patient reports recent MRI of spine showing signs of lumbar stenosis. Prior to surgery patient was independent with ambulation, able to work full time as a financial planner, and golf without any functional limitations pain free. Patient presented with a chief complaint of inability to ambulate independently without crutches. Since returning to weight bearing he reports bilateral buttock and hamstring pain 6/10, which is aggravated with sit to stand transfers and walking. Alleviating factors include the use of pain medication, and cold pack as per patients report. He also complains of left plantar foot numbness, which occurs intermittently with sitting and is alleviated with walking. Patient has returned to work progressively working part time as tolerated.
Specific occupational requirements as a financial planner include long durations of sitting and standing. He is independent with self-care utilizing adaptive equipment for showering. He requires a modified sitting position for dressing and needs assistance for don/doff socks and shoes. Past medical history includes spinal stenosis and recent pulmonary embolism. Patient is currently taking Gabapentin for peripheral neuropathy, tramadol for pain and Xarelto for pulmonary embolism.

**Tests and Measures**

**Differential Diagnosis Screening**

The initial examination included a differential diagnosis consistent with clinical practice guidelines. A system review was completed including screening of the cardiopulmonary, neurological and integumentary systems. The screening was found to be unremarkable for any systemic pathology. The patient was considered appropriate for physical therapy.

**Observation**

Following the subjective interview portion of the initial examination the physical exam was started with a postural assessment including sitting, standing posture and gait analysis. Patient showed both sitting and standing postures to be unremarkable. Gait analysis showed the patient ambulated with an antalgic gait utilizing bilateral crutches demonstrating an alternating gait pattern. During the initial contact phase of gait the patient displayed right-sided foot drop. Initial contact also called heel strike occurs when the first limb contacts the ground. Normal initial contact is with a heel strike however in an
abnormal gait the entire foot may initially make the first contact. Dorsiflexors
muscles weakness, peroneal neuropathy, or a nerve root lesion at L4 can all lead
to foot drop (Magee, 2008). The patients BMI was found to be 31.19 (Obese
Class 1). According to the Center for Disease Control and Prevention anyone
who is overweight is at higher risk for other conditions such as high LDL
cholesterol, high blood pressure and diabetes (Center for Disease Control,
05/04/2011). Also, this puts the patient at risk for dislocation (Wetters, et.al.,
2012).

**Cardiovascular Screening**

Baseline vital signs were taken at the initial exam. Blood Pressure was
assessed in the sitting position back supported and arm supported at the level of
the heart. It was 128/82 this recording falls within the normal range for adults.
The normal range for adults is systolic 110-130 diastolic 80-90 (Magee, 2008).

**Neurological Testing**

Bilateral muscle deep tendon reflexes were tested at the patella, tibialis
tendon, and Achilles tendon. The patella and Achilles were rated 2+ (normal)
and the tibialis was diminished, rated 1+. Reflexes are graded on a scale from 0
no response to 4+ being hyperactive. Normal deep tendon reflexes are 2+
(O’Sullivan & Schmitz, 2007). Sensation was assessed using light touch over the
lower extremity dermatomal distribution and found to be intact, however, the
patient complained of intermittent left plantar foot numbness.
Strength Testing

Manual muscle testing was performed to assess gross strength deficits in the lower extremities. Manual muscle testing is subjective therefore it is accepted that for conventional reliability the examiner should adhere to the same procedure for each test (Hislop & Montgomery, 2007). The 0-5 rating scale was used. Initial and follow up findings are provided in Table 1.

Table 1 - Manual Muscle Testing

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<tr>
<th></th>
<th>Initial Exam</th>
<th>Discharge</th>
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<tbody>
<tr>
<td></td>
<td>Right Lower Extremity</td>
<td>Right Lower Extremity</td>
</tr>
<tr>
<td>Hip Abduction</td>
<td>2+/5</td>
<td>4/5</td>
</tr>
<tr>
<td>Hip Flexion</td>
<td>3-/5</td>
<td>4/5</td>
</tr>
<tr>
<td>Hip External Rotation</td>
<td>3-/5</td>
<td>4/5</td>
</tr>
<tr>
<td>Knee Flexion</td>
<td>3/5</td>
<td>4+/5</td>
</tr>
<tr>
<td>Knee Extension</td>
<td>3/5</td>
<td>4+/5</td>
</tr>
<tr>
<td>Dorsiflexion</td>
<td>3-/5</td>
<td>5/5</td>
</tr>
<tr>
<td>Platarflexion</td>
<td>4/5</td>
<td>5/5</td>
</tr>
<tr>
<td>Gr. Toe Extension</td>
<td>3-/5</td>
<td>5/5</td>
</tr>
</tbody>
</table>

Active Range of Motion

Flexibility of the hamstring muscles was tested by performing the straight leg raise (SLR). A positive SLR done unilaterally is a sign of possible nerve entrapment. The SLR can also be performed bilaterally one leg at a time to assess flexibility and extensibility of the hamstrings as compared bilaterally. When performing the test the patient’s leg is passively lifted off the table with knee maintaining full extension and hips remain on the table. Test results for the
case patient we 90 degrees bilaterally, therefore showing no soft tissue limitation.
Dorsiflexion was measured using goniometry and found to be 0 bilaterally.

**Palpation**

Fascia restrictions were found at the thoracolumbar junction. Tenderness was discovered at spinal segments of L5-S1, and at the lateral insertion of the right hamstring. The patient also noted aching over the posterior lower extremities with a stabbing pain along the lateral border of bilateral thigh and legs. Patients also noted some numbness over the left anterior thigh. (Figure 3)

Figure 3 – Palpation chart

**Pain intensity level**

Pain intensity was quantified using a 10-mm visual analogue scale (VAS). The patient reported a level of 10 at worst, and on average 6 occurring at mid range squat during sit to stand transfer Figure 4.
Figure 4 – Pain Rating Scale

![Pain Rating Scale]

**Functional screening**

The patient works as a financial planner but has been unable to return to work full time since the surgery. Patient is unable to ambulate independently without bilateral crutches. Patient has difficulty transferring from sit to stand independently, requiring the use of his upper extremities to initiate movement. Patient has adapted his activities of daily living and self care by utilizing adaptive equipment for showering, dressing and don/doff socks and shoes. Patient’s prior level of function included working full time, golfing with no functional limitations and pain free. No functional outcome measures were taken at initial examination. A recent study showed that 50% of physical therapists do not use functional outcome measure despite much development and testing of its effectiveness (Jette, Halbert, Iverson, Miceli & Shah, 2009).

**Special Tests - Trendelenberg Test**

The Trendelenberg sign (Figure 2) is a respected test used to assess the external rotators of the hip. (Asayama, I., Naito, M., Fujisawa, M., & Kambe, T., 2002). A positive Trendelenburg sign accompanies gait abnormalities. The test can be used to determine the condition of the mechanics of hip function. In many patients with hip dysfunction the pelvis on the non-stance side moves downward beneath the level of the stance side in comparison to the severity of the abductor
dysfunction (Asayama, et. al., 2002). The test when used to predict a tear of the gluteus medius is neither sensitive nor specific, however the likelihood ratio is fair (Cook & Hegedus, 2013). The case patient displayed a positive right Trendelenberg sign when tested at the initial examination the patient was unable to perform the single leg stance. The patient's left side demonstrated hip instability; patient was able to stand for 2 seconds on the left side.

Evaluation

Findings from the initial examination, the patient in this case report presented with a primary chief complaint of the inability to ambulate independently without the use of bilateral crutches. Aquatic therapy decreases axial loading of the spine and peripheral joints through the effects of buoyancy. By using the unique properties of water rehabilitation program coupling the aquatic setting with land-based exercises will provide the patient the desired outcome of independent ambulation and reduced pain.

Prior to the initiation of any aquatic program it is imperative to question the patient about potential contraindications to aquatic therapy (Table 2). Preferred practice pattern: Musculoskeletal H: Impaired joint mobility, motor function, muscle performance, and ROM associated with joint arthroplasty. The rehabilitative prognosis considered good potential to reach the established goals.
Table 2 – Contraindications for Aquatic Therapy

<table>
<thead>
<tr>
<th>Contraindications for Aquatic Therapy</th>
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<tr>
<td>• Fever</td>
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<tr>
<td>• Incontinence of bowel</td>
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<tr>
<td>• Uncovered open wounds, incisions, or skin lesions</td>
</tr>
<tr>
<td>• Blistering</td>
</tr>
<tr>
<td>• Boils that have the potential to rupture soon</td>
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<tr>
<td>• Any communicable disease</td>
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<tr>
<td>• Skin infections</td>
</tr>
<tr>
<td>• Uncontrolled seizures</td>
</tr>
<tr>
<td>• Untreated Cardiac conditions</td>
</tr>
<tr>
<td>• Intolerance to water pressure, impaired vital capacity</td>
</tr>
<tr>
<td>• Acute lung infection</td>
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<tr>
<td>• Catheter or other lines that cannot be clamped off, or covered</td>
</tr>
<tr>
<td>• Tracheotomies</td>
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<tr>
<td>• No internal protection during the menstrual cycle</td>
</tr>
<tr>
<td>• Excessively high or excessively low blood pressure</td>
</tr>
<tr>
<td>• An extreme fear of water</td>
</tr>
<tr>
<td>• Patients that show an inappropriate or disruptive behavior that is uncontrolled</td>
</tr>
</tbody>
</table>

Interventions

A plan of care was established for three times per week for 4 weeks. At the re-evaluation additional visits were recommended. Aquatic sessions were introduced initially followed by land-based therapy. Early goals included reduction of swelling, reduce pain, offload the joints and facilitate comfortable correct biomechanical ROM training. According to a study with 71 subjects randomly chosen for a six-week aquatic therapy program the results showed decreased pain and joint stiffness, greater physical function and increased hip strength (Hinman & Heywood, 2007). The water temperature in the pool was maintained at approximately 90 degrees. Research shows that aquatic exercise can be performed in a wide range of temperatures however; warmer temperatures appear to be more favorable for nonswimming activities (Becker & Cole, 2003).
According to the American Arthritis foundation water temperatures between 83 and 92 degrees are ideal and are a safe range for patients with arthritis and up to 100 degrees for patients with cardiovascular concerns (Arthritis Foundation). The pool depth was up to the patient’s xiphoid thus providing joint off loading of approximately 67%. The sessions were guided by a physical therapist with experience in aquatic therapy.

Aquatic therapy interventions were initiated at the second visit. The aquatic portion of the rehabilitation focused on decreasing pain and introducing exercises that improved hip girdle strength, muscle control, core stabilization and gait training. Each session consisted of a 5-minute warm-up period that included walking forward and backward. Aquatic walking provides resistance as the patient walks through the water. Studies have shown that walking in the water burns more calories than water jogging (Melillo, 1991). Patient was instructed to roll from heel to toe going forward and toe to heel moving backward to engage the pelvic and core stabilizing musculature. Backward walking as compared to forward walking can result in significantly higher muscle activation (Masumoto & Mercer, 2008). Side stepping and heel raises were also included in the aquatic program. Patient was given a home exercise program consisting of land based supine exercises including bridging, supine marching and lumbar rotation exercises. (Appendix A) As the patient progressed balance activities were also incorporated. A study done in 2000 compared 24 women with lower extremity arthritis either Rheumatoid or osteoarthritis. Subjects were randomly assigned to an aquatic therapy group or a control group. Pretest and posttests were done to
assess postural sway before and after a six-week program. Results showed that the aquatic therapy group significantly reduced lateral sway and total sway scores. Scores were higher under the no-vision condition than under the vision condition in each group for both sessions (Suomi & Koceja 2000). Improving balance has also been linked to improved psychological benefits (Colcombe & Kramer, 2003). Balance activities included progression of narrow stance coupled with upper extremity motions to challenge the core stabilizers.

At 3 weeks the patients reported subjective pain levels had significantly decreased with patient also reporting that he felt much stronger since starting PT. Land-based therapy began with therapeutic exercise including upright bike, total gym mini squats, and heel raises, and hamstring curls and 4-inch step-ups forward. Verbal cueing was given to engage gluteal and quadriceps muscles. Exercises were progressed to include standing marches, sidestepping at cables; hip abduction resistance training, marching on blue foam, and outside ambulation among other exercises and progressed accordingly as patient strength progressed (Appendix B).

Results

Patient adherence was 100% with the patient completing 25 visits none missed. Upon discharge patient reported only occasional soreness in posterior thigh mainly in the morning. Patient’s strength in lower extremities has improved significantly right hip abduction strength improved by 67%, hip flexion 44%, extension 44%, knee flexion 40%, extension 40%. Dorsiflexion improved by 55% and great toe extension improved by 55% (Table 3). Patient reports ambulating
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independently without a cane 100% of the time this is progressed from the patient needing to use bilateral crutches to ambulate. Sit to stand transfers have improved to maximum level of function independently without upper extremity use. Activities of daily living and occupational activities have improved to 90% of prior level of function. Patient demonstrated increased walking tolerance and the ability to walk and stand for longer periods of time before fatigue. Trendelenberg sign is negative bilaterally patients able to perform single leg stance right side for 8 seconds, left side for 14 seconds. Patient was discharged to the land and aquatic HEP with excellent adherence.

Table 3 - Strength Comparison of Right Lower Extremity Initial exam to Discharge
Discussion

Initiation of the rehabilitation program with aquatic therapy allowed the patient to fully benefit from the therapeutic effects of buoyancy, hydrostatic pressure and viscosity. Buoyancy decreases weight bearing and joint compression forces along with decreasing the risk or fear of falling. The property of hydrostatic pressure supports the resolution of edema, helps to counterbalance blood pooling in the lower extremities, and aids in the strengthening of the muscles of inspiration and assists with exhalation. Viscosity provides resistance to movement and increases with speed. This property gives the patient more response time to counteract for balance or equilibrium deficits (Schoedinger, 2002).

The findings in this case report indicate that a 12-week program combining aquatic and land based therapy is beneficial in improving pain levels, strength, mobility, and functional outcomes. Objective measurements such as increased strength ratings, increased single leg stance time and negative Trendelenberg sign show evidence of significant improvement.

Upon discharge the patient reported decreased subjective pain response to mobility at 1/10, as compared to levels reported at the initial evaluation when the patient reported average pain to be 6/10 and 10/10 at its worst. A study by Hinman, Heywood, and Day found that compared with the control group which received no therapy, a 6-week program of aquatic physical therapy resulted in significantly less pain. Although, it is undistinguishable whether the benefits were
causal to effects of the intervention or a placebo response (Hinman, Heywood & Day, 2007).

In the 3-month time period the patient showed increased strength measures in both lower extremities. The patient went from a 2+/5 manual muscle testing in his right hip abduction to a 4/5 rating which is considered “good” the improvement is 67% from the initial evaluation. It has been theorized that the primary function of the gluteus minimus and medius is to act as the prime femoral head and pelvis stabilizer (Levangie & Norkin, 2011). The patient’s gait was also improved. At the initial evaluation they patient was unable to ambulate independently without bilateral crutches this was due to extreme hip abductor muscle weakness causing the pelvis to drop to the unsupported side. Prolonged gait abnormalities can lead to knee, ankle and foot problems as well (Levangie & Norkin, 2011).

The case patient attending all of his scheduled visits demonstrated adherence in the program. A study by Resnick and Spellbring showed that there are 6 main factors that affect adherence in adults to improve rehabilitation. The 6 factors are 1) beliefs about exercise; 2) benefits of exercise; 3) past experiences with exercise; 4) goals; 5) personality; and 6) unpleasant sensations associated with exercise (2000). To promote our patient’s adherence we discussed the benefits of exercise. He was a believer in exercise and his goal was to improve his lower body strength to be able to return to his previous level of function. Our case patient also loved to play golf, so we came up with an exercise program that incorporated lower extremity strengthening and activities that would enhance his
golf game. We used our client’s goals to tailor an exercise program that was specific for him. The case patient also has a great social support network with his family, which helped to enhance his rehabilitation.

**Study Limitations**

Although this case study obtained relevant objective findings there were some limitations to be considered when interpreting the results and making assumptions. The study was lacking the use of outcome measures. A study was done in 2009 to determine the extent of using standardized outcome measures in outpatient clinics and the opinions regarding the benefits and difficulties of their use by therapists (Jette et.al., 2009). The researchers found that more than 50% of the respondents in the study reported that they do not use the standard outcome measures. The most common response was that they were not familiar with the measures or that they did not feel they had sufficient time to complete the testing (Jette et. al., 2009).

Self-reporting outcome measures such as the Lower Extremity Functional Scale (LEFS) can be a convenient way to track improvement. The patient is asked a series of questions regarding their activities of daily living and the degree of difficulty. Patients rate the difficulty on a scale of 0-4 with 4 being no difficulty and 0 being extremely difficult. Scores are figured the higher the score the better the function of the patient. Internal reliability of the LEFS test is excellent, and validity is comparable to the SF-36. The limitations in using self-reporting questionnaires to measure the outcomes include self-reporting may be inaccurate if the patient does not fully understand the questions. As well as
adherence and subjective information may be over-estimated or under-estimated. The case patient likely would have showed significant improvements in regard to his activities of daily living however.

In this particular case patient scenario the use of the Dynamic Gait Index (DGI) may have enhanced the overall outcome by demonstrating significant improvement before and after rehabilitation. The DGI is used to assess an individual’s ability to modify balance when presented with external demands. It is specifically designed to assess postural control during gait. The test includes 8 gait activities. The results determine risk of falling. Interrater/Intrarater reliability is excellent as well as concurrent validity (Jonsson et. al., 2011). It is likely the case patient would not have been able to perform most of the test prior to therapy but would have made significant improvements following the 12-week therapy program. It is unclear why the patients did not begin lateral step-ups upon his initial treatment of land-based therapy. However, following that initial land treatment a focus on hip abduction strength was implemented and progressed throughout. It may have been beneficial for the patient to combine aquatic and land based activities.

**Conclusion**

In conclusion, the results in this case report indicate that physical therapy interventions consisting of an aquatic and land-based therapy exercise program positively impacts decreased pain, strength, and functional measures.
References

Allison, R. D., & Roth, G. M. Central and peripheral vascular effects during cigarette smoking. *Archives of Environmental Health: An International Journal, 19*(2), 189.


Doi:http://dx.doi.org.ezproxy.fgcu.edu/10.1016/j.berrh.2009.08.013.


Appendix A – Home exercise program

Supine marching

Supine Bridging

Supine Lumbar Rotation
Appendix B - Interventions

Intervention week 1 – Aquatic

- Forward Walk
- Backward Walk
- Weight shift gluteal isometrics
- Side step
- March (hip flexion to approx. 60 degrees
- Heel raises with gluteal squeeze
- Corner cycle

- Conclude with cold pack and e-stim to R hip and low back

Intervention week 2 – Aquatic

- Forward walk focus on heel strike
- Backward walk
- Weight shift gluteal isometrics
- Side stepping
- March to approximately 60 degrees of hip flexion
- Heel raises with gluteal squeeze
- Balance challenge shoulder horizontal abd/add verbal cues for gluteal squeeze
- Balance challenge shoulder horizontal abd/add with staggered stance
- Mini squats

- Deep-water exercises
  - Leg scissoring abd/add
  - Leg scissoring flex ext.
  - Corner cycle

- Conclude with cold pack and e-stim. To R hip and low back

Intervention week 3 – Initiation of land based program

- Upright Bike 5 minutes
- Standing Calf Stretch
- Total Gym mini squats with yellow Spoband around knees
- Total Gym heel raises
- Total Gym march with verbal cueing to stabilize using gluteal and quadriceps
- Hamstring curls concentric /eccentric
• Forward and lateral step-ups to 4-inch step verbal cueing to engage gluteal musculature

Interventions – Progression of Land program re-evaluation 4 weeks
• Upright bike 6 minutes
• Standing Calf Stretch
• Total Gym mini squats with yellow Spoband around knees 3x15
• Total Gym heel raises 3x10 level 2
• Total Gym march with verbal cueing to stabilize using gluteal and quadriceps 2x20
• Hamstring curls concentric /eccentric 3x10.
• Stand march with cane
• Ambulation gait training 2x around gym with standard cane left hand

Interventions - Progressed of Land program re-evaluation at 8 weeks
• Upright bike 6 minutes
• Hamstring curls concentric /eccentric 3x10
• Stand march with cane
• Side step at cable 6 each direction
• Forward/ backward walk cables 5x
• Backward/forward walk cables 5x
• Hip abduction 2x10
• Sit to Stand 10x
• March on blue foam 2x10 verbal cues to stabilize gluteal muscles

Interventions – At Discharge 12 weeks
• Hamstring curls concentric /eccentric 3x10
• Side step at cable 6 each direction
• Forward/ backward walk cables 5x
• Backward/forward walk cables 5x
• Hip abduction 2x10
• Sit to Stand 10x
• March on blue foam 2x10 verbal cues to stabilize gluteal muscles
• Cable march 5kg 10 steps x2
• Side step over cups on green foam 3 minutes
• Side shuffle with green spoband around knees
• Cable down swing focusing on engaging abdominal muscles 2 x15