Outcomes Following Functional Interventions on a Person with a Megaprosthesis and Metastatic Breast Cancer

A Capstone Project for PTY 768
Presented to the Faculty of the Physical Therapy Department
The Sage Colleges
School of Health Sciences

In Partial Fulfillment
of the Requirements for the Degree of
Doctor of Physical Therapy

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May 2011

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2010-2011
ABSTRACT

Background and Purpose: Megaprostheses are joints that replace large segments of bone after tumor resection and are not affected by ongoing chemotherapy and radiotherapy. The specific interventions used on people with the diagnosis of cancer after megaprosthetic replacement have not been described. The purpose of this case report was to describe outcomes following an intervention designed to increase mobility in someone with a megaprosthesi and metastatic breast cancer. Case Description: The participant was a 62 year old Caucasian female with a history of metastatic breast carcinoma and a femur fracture. She underwent megaprosthesi reconstruction surgery of the left leg. Methods: She participated in a 2 week restorative subacute rehabilitation program that focused on repetitive bed mobility, transfer training, gait and endurance training; stair/ uneven surface education; wheelchair management and propulsion; therapeutic exercise; cryotherapy; participant/ family education; discharge planning and a home exercise program. The outcome measures consisted of pain intensity, range of motion, manual muscle testing, static sitting and dynamic standing balance, and the FIM. Outcomes: The participant showed improvements in pain intensity, range of motion, strength, balance and overall functional mobility following her rehabilitation program. Discussion: Pain intensity improved by 3 points which demonstrates a true change on the Numerical Pain Rating Scale. We feel her improvements in range of motion, muscle strength and balance were a direct result of her individualized exercise program. The repetitive nature of the participant’s functional training program most likely helped to make improvements with sit to stand transfers, stand pivot transfers, short distance ambulation, and stair negotiation.
BACKGROUND AND PURPOSE

It is essential for physical therapists to be aware of the technological advances that have been made within the last several decades with regards to biomedical engineering, surgical techniques, and effective chemotherapy in order to become more autonomous practitioners.1 These advances can be applied to widely accepted reconstructive techniques used with limb salvage surgery.2 One such technique is the use of metallic implants known as megaprostheses that are used in the management of pathological fractures secondary to cancer.2 Megaprosthesis replacement is most commonly used with soft tissue and bone sarcomas however it can also be used with carcinomas which metastasize from other organs such as the breast. Breast cancer is known to metastasize to the bone which is the most common site for recurrence of this type of cancer. Bone metastases can lead to severe pain, and pathological fractures that will eventually impair a person’s quality of life.3 For this reason current emphasis has been placed on enhancing functional and oncological outcomes after megaprosthetic replacement.1

Megaprostheses are joints that replace large segments of bone after tumor resection and are not affected by ongoing chemotherapy and radiotherapy.4 The megaprosthesis consists of a femoral shaft, condylar and median component, thrust bearing pad, pivot pin, and collar bushes that provide weight bearing and a rotating axis mechanism.1,5 See Figures 1 and 2 for an anterior and lateral view of a distal femoral megaprosthesis. The most common locations for megaprosthetic replacement include the proximal femur, distal femur, proximal tibia, and proximal humerus.6

The advantages of the megaprosthesis include its modular design, stability, and durability which allows for multiple pieces to be replaced individually, immediate full weight
bearing, and early rehabilitation. Megaprosthetic replacement is also associated with remarkably low morbidity from infection when compared to reconstruction procedures like osteoarticular allografts, allograft prosthesis composites and allograft-arthrodesis after tumor resections. Complications related to megaprosthetic replacement include infection (.07-15.8%), aseptic loosening (.02-.11%), dislocation (.05-.12.9%), subluxation (.02-15.5%), common peroneal nerve palsy (5.3%), femoral artery thrombosis (.004%), skin necrosis (.01-.11%), fracture of the prosthesis (.07-.11%), malposition of the prosthesis (.02%), local recurrences of cancer (.05-.07%) and metastases (.07-.11%).

Several studies evaluated functional scores following megaprosthetic surgery and rehabilitation using the Musculoskeletal Tumour Society scoring system (Enneking functional evaluation) as an outcome measure. This assessment evaluates pain; function; emotional acceptance; use of support, walking ability, and gait in the lower extremities; and hand positioning, dexterity, and lifting ability in the upper extremities. These six categories are assigned numerical values 0 to 5; which are added up and given a percentage of the maximum possible score. The closer to 100 percent, the better the functional outcome. The scores in these six categories can help in identifying the impairments and functional limitations specific to each person after surgery and after physical rehabilitation.

Natarajan et al reported a mean functional score of 66.6%; Tan and Tan reported a mean functional score of 78.3%; Park reported a mean functional score of 73%; and Natarajan et al reported a functional score of 82.5%.

Like any other reconstructive surgery, people who have undergone megaprosthetic replacement need to participate in physical rehabilitation. However the plan of care for people with cancer can be complicated by the amount of fatigue, secondary to other ongoing
therapies and additional comorbidities. The plan of care should incorporate functional interventions throughout therapy in order to restore independence with activities of daily living. These functional tasks typically include bed mobility, sitting, transfers, and standing skills, as well as walking and stair climbing. The integration of these skills can be used with anyone, regardless of diagnosis or condition. No studies were found on functional training in those with megaprosthetic replacement or cancer, however functional training has been found to improve function in older adults.

In a study by Peri et al., life satisfaction and mobility of older people living in residential care was evaluated to determine if a repetitive activities of daily living program improved health status. They incorporated bed mobility, sit to stand transfers, and transferring to various surfaces and heights in order to increase strength, balance and endurance. The participants transferred from bed to chair several times a day, completed repetitive sit to stand transfers in the bedroom, dining room, and lounge, and increased walking distances both inside and outside. It was found that this program improved health status for a short period of time and may have contributed to an increase in mobility.

While a thorough review of the literature did not produce articles describing the rehabilitation needs after megaprosthetic replacement, there has been recent evidence on the benefits of physical rehabilitation in those with breast cancer. Fialka-Moser et al. found aerobic exercise, as an additive treatment to breast cancer, helped ease the effects of decreased physical performance, psychological distress, fatigue, weight gain and changes in body image. The results showed that hospital admission length was significantly shorter in the aerobic exercise group and people were more active with reduction in fatigue, which led to an increase in quality of life.
A pilot study by Campbell et al\textsuperscript{16} examined whether exercise as an adjunctive rehabilitation therapy could benefit women who had early stage breast cancer and were currently receiving chemotherapy and/or radiotherapy. Women assigned to the exercise group received their usual care and in addition attended a supervised exercise program twice weekly for 12 weeks. The classes consisted of a warm-up, 10–20 minutes of exercise including walking, cycling, low-level aerobics, muscle-strengthening exercises, or circuits, followed by a cool down and relaxation period. The results suggested that a structured group exercise program during chemotherapy and/or radiotherapy is a safe, well tolerated and efficient way of providing physical and psychological health benefits.

In a study by Irwin et al\textsuperscript{17}, physical activity was suggested to improve quality of life in survivors of breast cancer as well as effectively prevent weight gain and bone loss. The results from this study found that aerobic exercise, specifically brisk walking, showed positive changes in body fat, lean body mass, and maintenance of bone mineral density in postmenopausal survivors of breast cancer. A study conducted by Drouin et al\textsuperscript{18} examined erythrocyte changes from aerobic exercise during radiation treatment for breast cancer. The twenty participants were randomized to either an aerobic exercise group consisting of walking for 20-45 minutes at 50-70\% of their maximum heart rate or a placebo stretching group. The results showed that moderate intensity aerobic exercise maintained erythrocyte levels during radiation and walking provided a safe and economic method to improve fitness during treatment of breast cancer.

A systematic review and meta-analysis conducted by McNeely et al\textsuperscript{19} identified 14 studies that provided evidence that aerobic and resistance exercise improved physical functioning, peak oxygen consumption, and reduced symptoms of fatigue in those with
cancer. It was also evident that there were statistically significant improvements in the quality of life in people with breast cancer. A second systematic review by Knols et al\textsuperscript{20} investigated the effect of physical activity on daily walking in survivors of cancer. The five randomized control trials that were identified suggested that physical activity and counseling together can potentially increase daily step activity in individuals with breast cancer.

The current literature discusses the functional outcomes of the megaprosthesis as well as the impact that exercise has on cancer; however, the specific interventions used on people with the diagnosis of cancer after megaprosthetic replacement have not been described. Therefore, the purpose of this case report was to describe outcomes following an intervention designed to increase mobility in someone with a megaprosthesis and metastatic breast cancer.

**METHODS**

**Case Description**

The participant was a 62 year old Caucasian female with a history of metastatic breast carcinoma. In 2004, she had an intramedullary rod surgically implanted into her left thigh as a preventative measure against fracturing. One year later she fractured her femur when sitting down in the driver’s seat of her car. Nothing was done for the femur until June 2010 when the femur fractured a second time as a friend pulled on her foot to help her get out of the front seat of a car. She presented to the hospital with complaints of left thigh and femur pain. X-rays revealed a non healing fracture as well as a subsequent fracture with fragmentation of the distal femur. The participant underwent surgical removal of the intramedullary rod and a megaprosthesis reconstruction was completed. The reconstruction consisted of a small tibial implant, femoral implant, hinge mechanism, and resurfacing of her patella. The participant remained in the hospital for five days following surgery where she
started physical and occupational therapy. It was then determined that she would benefit from continued therapy at a subacute rehabilitation facility.

At the time of transfer, the participant was given two units of packed red blood cells secondary to postoperative anemia and her chemotherapy was put on hold until she stabilized. The participant’s past medical history was significant for breast cancer of the left breast with bone metastases, lumbar disc pathology, atrial fibrillation, hypertension, coronary artery disease, gastroesophageal reflux disease, diabetes mellitus type 2, neuropathy secondary to chemotherapy, narrow angle glaucoma, and obesity. She was 66 inches tall and weighed 250 pounds with a body mass index of 40.3 kg/m². Her past surgical history was significant for a partial seventh rib removal secondary to the cancer, left lumpectomy, cholecystectomy, 4 cortisone shots to the spine, eye surgery for the narrow angle glaucoma, and placement of the Port-A-Cath for her chemotherapy. The participant’s medications at the time of admission into the subacute rehabilitation facility included Qualaquin, Nexium, Digoxin, Metformin, Pioglitazone, Celebrex, Atenolol, Paroxetine, Furosemide, Fentanyl patch, Morphine sulfate, OxyContin-SR, Oxycodone, Acetaminophen, Colace, Ferrous sulfate, Lyrica, and Coumadin.

The participant was retired, had no history of smoking and occasionally drank alcohol. Prior to admission she was dependent on her husband and daughter for activities of daily living. Specifically she needed assistance with lower extremity dressing and getting her legs in and out of the bathtub. She was able to ambulate with a cane independently, occasionally used her wheelchair at home, and was independent with driving. She wore bilateral hearing aids and her leisure activities consisted of playing with her grandchildren,
reading and knitting. Human subject’s approval was obtained through The Sage College’s Institutional Review Board.

A system’s review revealed the participant’s temperature was 97.4 degrees; her pulse was 78 beats/minute; her respiratory rate was 18 breaths/minute; and her blood pressure in supine was 94/48. She reported shortness of breath but her lungs were clear to auscultations. S1 and S2 heart sounds were present and the rhythm was slightly irregular. Her abdomen was obese, soft, nontender and bowel sounds were present. She had 55 staples in the left lower extremity, otherwise skin integrity was intact. Edema was present in the left lower extremity secondary to surgery, bruising was present on both inner arms secondary to blood work and she had a bandage to the right side of her neck due to removal of a triple lumen catheter.

Tests and Measures

The participant rated her pain intensity at the time of admission to the subacute rehabilitation facility as 8/10 to her left lower extremity and lower back. She was allowed weight bearing as tolerated on her left lower extremity. The participant’s bilateral upper extremity range of motion (ROM) was within functional limits (WFL) and her strength was 3+/5 throughout. Her cervical ROM was WFL except for bilateral sidebending and her trunk ROM was not tested due to disc pathology in the lumbar spine and metastases in the vertebrae. Her lower extremity ROM was limited with bilateral hip flexion, abduction and knee flexion due to her recent surgery, adipose tissue and bone metastases. Her left lower extremity strength ranged from 2-/5 to 2+/5 proximally and 3-/5 to 2+/5 distally, while right lower extremity strength ranged from 2+/5 to 2/5 proximally and 3/5 distally. Refer to Table 1 for specific lower extremity ROM and strength measurements.
Sensation was diminished over the lateral aspect of her left lower leg, and she reported sensitivity to heat in both hands. At admission, the participant’s static sitting balance was rated as good as she could hold her balance through moderate perturbations and her dynamic standing balance was rated as fair as she needed contact guard during gait. The participant’s functional independence measurement (FIM) scores at admission to the subacute rehabilitation facility were as follows: transfers 3; wheelchair propulsion 2; ambulation 2; stairs 0; eating 7; grooming 5; bathing 4; dressing UE 5; dressing LE 2; toileting 4; communication 6; expression 7; social interaction 5; problem solving 5; and memory 5.

Overall she required moderate assist for sit to and from stand transfers; moderate assist for stand pivot transfers; and minimal assist for mat mobility. She was able to ambulate 75 feet with a forward flexed posture, using a wheeled walker with contact guard and was independent with wheelchair propulsion for 50 feet. Stairs were not assessed during the initial evaluation.

**Outcome Measures**

The outcome measures chosen for this study were pain intensity, ROM, manual muscle testing (MMT), static sitting and dynamic standing balance, and the FIM. The participant was evaluated at initial evaluation, at one week follow up, and 4 days later at discharge by a student physical therapist.

The Numerical Pain Rating Scale (NPRS) is a self-reported measurement tool consisting of a numerical point scale which ranges from no pain to extreme pain (Kahl, 2005). The scale was set up from 0–10, given in verbal format, and the individual was asked to rate her pain intensity at a particular time. The NPRS scores high on ease of
administration and simplicity for scoring. The test–retest reliability for the NPRS has been demonstrated to be moderate to high, varying from 0.67 to 0.96.\textsuperscript{21} When correlated with the Visual Analogue Scale, the NPRS is determined to have 0.79 to 0.95\textsuperscript{21} convergent validity, which supports its use. The literature reports that a three point change in the NPRS is necessary to demonstrate a true change in pain intensity, and that there are limitations in the responsiveness of a 0–10 scale.\textsuperscript{21}

Active and passive joint ROM of bilateral hip flexion, abduction, knee flexion, and extension was evaluated using a double armed goniometer while the participant lay supine on a mat table. Active ROM was assessed through voluntary movement of the joint by the participant and passive ROM was assessed through movement performed by the examiner without the assistance of the participant. Research shows that goniometric measurements of the knee demonstrate high reliability ($r = .98$, ICCs = .99) and validity ($r = .97$-.98, ICCs = .98-.99).\textsuperscript{22}

MMT was used as a means to test and grade muscle strength based on gravity and manually applied resistance. The participant was graded from zero to five at each muscle group; zero being no observable or palpable muscle contraction and five being full available ROM against gravity with strong manual resistance. Hip flexion, knee extension, knee flexion, ankle dorsiflexion, and ankle plantar flexion were all tested in sitting while hip abduction was tested in supine. The literature shows evidence for good reliability ($r = .80$ -.99, ICCs = .80 to .96) and validity in the use of MMT for individuals with neuromusculoskeletal dysfunction.\textsuperscript{23}

Static sitting and dynamic standing balance were evaluated using a functional grading system. The grades consisted of zero, poor, poor +, fair, fair +, good, good +, and normal.
Zero is equivalent to the individual needing maximal assistance to maintain sitting balance without back support to normal which is equivalent to no deviations seen in postures held statically or dynamically. Static sitting balance was assessed on a mat table with the participant’s feet flat on the floor and her hands resting in her lap. The examiner applied perturbations in all directions with a minimal, moderate or maximal force. Dynamic standing balance was assessed based on the level of guarding needed during ambulation. After a thorough review of the literature no studies were found that discussed the psychometric properties of this balance grading system.

The Functional Independence Measure (FIM) was used as a functional assessment scale to evaluate the participant’s abilities in mobility, locomotion, self-care, communication, and social cognition. The basic idea of the FIM is to determine the amount of assistance an individual will need to perform daily life activities effectively. Individual FIM items range from 1 to 7; a score of 1 is “total assist” which means the individual performs less than 25% of the task, while a score of 7 is categorized as “complete independence.” Scores that fall below 6 require another person or an assistive device for supervision or assistance. The participant was assessed during therapy on her ability to complete transfers, wheelchair propulsion, ambulation, and stairs then she was rated based on the FIM scale. Review of the literature shows that the FIM is sensitive in discriminating levels of disabilities. There is an extensive body of literature supporting the reliability of the FIM and it has demonstrated its usefulness for measuring change during inpatient rehabilitation for mixed impairments and categories of impairments (r = .83 - .95). Its construct validity is supported by the difficulty of items measured in different impairment groups and the comparison between admission and discharge groups.
Evaluation

According to The Guide to Physical Therapist Practice, the physical therapy diagnosis pattern for this participant was 4I: Impaired joint mobility, motor function, muscle performance, and range of motion associated with bony or soft tissue surgery. This conclusion was reach based on the participant’s impairments in body structures and function and activity limitations including decreased ROM, decreased strength and endurance due to inactivity, impaired joint mobility, limited independence in activities of daily living, pain, and swelling. The prognosis described in The Guide to Physical Therapist Practice notes that over the course of 1 to 8 months the participant will demonstrate optimal joint mobility, motor function, muscle performance, and ROM, and the highest level of functioning in home, community, and leisure environments. It is also stated that the participant will be able to achieve the anticipated goals and expected outcomes of the intervention described in the plan of care. Despite the participant’s numerous comorbidities and physical barriers her prognosis was good and she appeared well enough to meet her goals. She was motivated, eager to return home, and had a strong social support system. Possible barriers that might have kept her from meeting her goals included increased fatigue secondary to cancer, general deconditioning throughout, and over reliance on her husband.

The participant’s personal goals included being able to get up and down the stairs and in and out of a chair independently in order to be self sufficient. Short term goals from her initial evaluation included 1. Participant will transfer from supine to/from sit with contact guard in 1 week; 2. Participant will transfer sit to/from stand with minimal assistance in 1 week; 3. Participant will perform stand pivot transfers with a wheeled walker and minimal assistance in 1 week; and 4. Participant will be able to ambulate 100 feet with wheeled
walker and contact guard in 1 week. Long term goals included 1. Participant will be independent with sit to/from supine transfers on the mat table in 3 weeks; 2. Participant will be independent with stand pivot and sit to/from stand transfers with an assistive device in 3 weeks; 3. Participant will be able to ambulate 150’ independently with the least restrictive device in 3 weeks; 4. Participant will be independent with negotiating 4-6” steps with 2 rails in 3 weeks; 5. Participant will be independent with home exercise program in 3 weeks; and 6. Participant will be able to transfer into the car with supervision in 3 weeks.

**Plan of Care**

The participant’s intervention plan included a restorative program focusing on bed mobility, transfer training, gait and endurance training, stair/ uneven surface education, wheelchair management and propulsion, therapeutic exercise, modalities, participant/ family education, discharge planning, and a home exercise program. The participant was seen once a day, 5 days per week, for 35-45 minutes sessions with an anticipated length of stay of 3 weeks.

The participant practiced supine to/from sit transfers a minimum of 4 times and sit to/from stand transfers a minimum of 8 times throughout the therapy session. For the first week she completed this task with moderate to minimal assistance and the second week she completed this task with close to distant supervision. Practicing transfers were needed to help build strength and functional independence. The participant also practiced car transfers at least twice a week. Gait training consisted of ambulating short distance of approximately 60-80 feet, 2-3 times with a wheeled walker and contact guard for the first week and then 80-100 feet 2-3 times with a wheeled walker and contact guard the second week. Gait training was necessary to ensure she would be able to ambulate household distance. Endurance
training was incorporated into the gait training was well as with the Nu Step machine. The participant used the Nu Step for approximately 5 minutes a session to increase left knee ROM as well as endurance. She continued with 5 minutes throughout her course of treatment.

Stair training was included because the participant needed to negotiate 3 steps with bilateral handrails in order to enter her house. She practiced negotiating 4 – 6 inch steps with bilateral handrails twice per week using contact guard for the first week and close supervision for the second week. Wheelchair propulsion consisted of propelling 50-60 feet at least once per session for the first week and 60-75 feet the second week. This task was also incorporated into the therapy session because the participant occasionally used her wheelchair at home prior to hospital admission.

Her therapeutic exercises included seated long arch quads, seated ankle pumps, supine short arch quads, glut sets, heel slides and hip abduction. Each exercise was completed on both lower extremities with 2 sets of 10 repetitions for the first week and then progressed to 2 sets of 15 repetitions for the second week. These exercises were chosen to increase muscle strength in the major muscle groups of the lower extremity. The participant received a cold pack to the anterior aspect of her left knee for 15 minutes after each therapy session to reduce swelling. Her husband was trained in safe car transfers and ambulation and the participant was given a home exercise program including all seated and supine exercises completed in therapy upon discharge.

OUTCOMES

After the first week of restorative subacute rehabilitation, the participant had noticeable improvement in body structures and functions and activity restrictions. Her pain
decreased from an 8/10 at her left lower extremity and low back to a 4/10. Active ROM of bilateral hip flexion, bilateral hip abduction, and right knee flexion all improved since the initial evaluation while the remainder of her bilateral lower extremity ROM remained the same. Lower extremity muscle strength remained unchanged from the initial evaluation. Her static sitting and dynamic standing balance remained as stated in the initial evaluation; good and fair respectively. The participant’s transfers increased from moderate assistance to minimal assistance and she was able to ambulate 100 feet with a wheeled walker indoors with contact guard assistance. She was able to negotiate 4, 6 inch steps with bilateral handrails and contact guard. At this time she was unable to successfully complete a car transfer in the facility’s model passenger seat due to decreased ROM in her left knee. Her FIM scores increased with transfers from a 3 to a 4, with stairs from a 0 to a 2, and wheelchair propulsion and ambulation stayed the same. Refer to Table 2 for specific outcome measurements at initial evaluation, at one week and at discharge.

After the first week of therapy the participant achieved short term goal #2 (transfer sit to/from stand with minimal assistance) and short term goal #3 (stand pivot transfers with a wheeled walker and minimal assistance). At this time the participant did not meet short term goal #1 (transfer from supine to/from sit with contact guard) or short term goal #4 (ambulate 100 feet with wheeled walker and contact). After the first week she still remained a good candidate for physical therapy.

At this point an interdisciplinary meeting was held where it was decided that she would be discharged early in order to return home to continue her chemotherapy. Upon discharge four days later the participant had achieved her own goal of being able to negotiate 4, 6 inches stairs with bilateral handrails and supervision. At this time she achieved long
term goal #2 (independent with stand pivot and sit to/from stand transfers with an assistive device) and long term goal #5 (independent with home exercise program). The other 4 remaining long term goals were not met.

At discharge the participant’s pain was still a 4/10 to the left lower extremity and lower back. The participant’s bilateral lower extremity hip ROM increased with flexion, abduction, and knee flexion. Left lower extremity strength increased with hip flexion, knee flexion and extension, as well as ankle dorsiflexion and plantarflexion, while right lower extremity strength remained the same. Her static sitting balance remained good and her dynamic standing balance increased to good +.

She was independent with sit to/from stand and stand pivot transfers, however she still required minimal assistance with mat mobility. She could only ambulate 100 feet with a wheeled walker with supervision due to fatigue, but was ambulating independently 50 feet or less with a wheeled walker. This improvement seen in her gait improved her standing balance to a good + and her car transfer required minimal assistance in order to get the left lower extremity into the car. She was able to propel her wheelchair 80 feet independently indoors but needed assistance with removing the leg rests for transfers. Her FIM scores increased with transfers but wheelchair propulsion, ambulation, and stairs remained the same. Refer to Table 2 for specific outcome measurements. The participant was discharged from the facility with a home exercise program and was scheduled to receive home physical therapy for progressive gait training, active ROM, strengthening and a home safety evaluation.

DISCUSSION
The purpose of this case report was to describe outcomes following an intervention designed to increase mobility in a 62 year old female with a history of metastatic breast carcinoma and a newly implanted megaprosthesis to the left lower extremity. She participated in a 2 week restorative subacute rehabilitation program which included repetitive bed mobility, transfer training, gait and endurance training, stair/uneven surface education, wheelchair management and propulsion, therapeutic exercise, cryotherapy, participant/family education, discharge planning, and a home exercise program. The participant showed improvements in pain intensity, ROM, strength, balance and overall functional mobility following her rehabilitation program.

Pain intensity improved by 3 points which is beyond the MDC value of 3 and demonstrates a true change. This improvement was most likely due to a decrease in postsurgical inflammation which led to an increase in ROM and functional mobility. Pain was not completely eliminated due to other comorbidities such as bone metastases and a lumbar disc pathology. The participant showed improvement in bilateral LE ROM which we feel was a direct result of her individualized exercise program and a result of the functional activities she was doing outside of physical therapy. The participant’s activities of daily living included dressing, grooming, bathing, and toileting which helped her to maintain and increase her ROM while not in therapy. These activities allowed the participant to work her available ROM through reaching, bending, leaning, and turning.

The participant demonstrated an increase in left LE strength by ½ a muscle grade with hip flexion, knee flexion/extension, and ankle planterflexion/dorsiflexion. This improvement was mostly likely due to the specific mat and seated exercises that were completed on the left LE using ankle weights. Her right LE did not show any improvement.
which is most likely due to the fact that her exercise program did not specifically target this area and it should have. Her increase in strength and balance was most likely due to the large portion of gait training that was completed during her therapy sessions.

The participant also demonstrated marked improvement with sit to stand transfers, stand pivot transfers, short distance ambulation, and stair negotiation. The repetitive nature of the participant’s functional training program helped to make these improvements possible. This report adds to the existing research by Peri et al\textsuperscript{14} that found a repetitive activities of daily living program can contribute to an increase in mobility in older adults. It also adds to the research by McNeely et al\textsuperscript{19} that found aerobic and resistance exercise improves physical functioning in those with cancer.

Although she made marked improvements in functional mobility, she was unable to meet several of her goals at the time of discharge. She was unable to transfer into a car unless someone was with her since she did not have adequate knee range of motion as a result of her surgery as well as increased adipose tissue. She was also unable to achieve independent supine to sit transfers prior to discharge as a result of decreased upper extremity strength, increased adipose tissue, bone metastases, and lumbar disc pathology.

Due to secondary symptoms such as fatigue, we were not able to provide individual sessions of appropriate intensity for her to meet her goals at time of discharge. It is possible that if the treatment had been extended, greater gains could have been made. She was unable to ambulate 150 ft, the necessary amount needed to ambulate household distances to do decreased endurance. She was also unable to independently negotiating 4-6” steps with bilateral handrails due to limitations with dynamic balance and decreased confidence. Due to
the participant’s need to continue with her chemotherapy, she was discharged one week early from the subacute rehabilitation facility and did not reach all of her long term goals.

In retrospect there were a number of limitations to the study. The progression of her therapeutic exercises and activities were appropriate but the overall intensity of the program could have been increased by seeing her twice per day with ample rest time in between. Incorporating further functional exercises such as squats and tandem balance could have helped improve transfers, gait and bilateral lower extremity strength. ROM limitations could also have been addressed with more intensity. This could have been accomplished with the additional help of active assistive mat exercises, so more ROM could have helped her become more functionally independent especially with car transfers and stair negotiation. Since both fractures occurred during car transfers we felt it was important to train the participant and her husband in safe car transfers in order to avoid any further damage to the left lower extremity.

Cause and effect cannot be inferred in a case report. When using a case report (as compared to a randomized control trial) there is no randomization or blinding, no other group to compare to, and generalization cannot occur because there is only one participant.

Over a period of ten days there were only three physical therapy notes that documented her progress; if daily notes had been utilized then additional changes in her progress could have been accounted for. It would have also been beneficial to take girth measurements throughout the participant’s course of treatment in order to determine how much improvement was made in this area.

Additional outcome measures such as the Timed Up and Go, the 30 second Chair Stand Test, gait speed as measured by the 3 Meter Walk Test or a modified 6 Minute Walk
Test 27 to measure aerobic capacity would have been appropriate for this participant and could have been incorporated to strengthen the study. Since exercise has been found to increase quality of life, 19 a quality of life measure like the Short Form (36) Health Survey (SF-36) could have also been beneficial for this participant. 19 The SF-36 examines eight different health concepts including general health, physical functioning, role functioning, bodily pain, mental health, emotional functioning, vitality, and social functioning. 28

As much of the current research discusses the benefits of aerobic conditioning on individuals with cancer it would have been more beneficial if the participant’s rehabilitation program incorporated more aerobic activities. The portion of her program where she was using the Nu Step for the purpose of increasing her ROM could have also been used for aerobic benefit if time and intensity had been increased. It would have also been beneficial to further educate the participant on the importance of exercise in those with cancer in order to ensure that she continues with her home exercise program.

It would be interesting to see if future studies could incorporate manual therapy such as passive range of motion, scar mobilizations, patella mobilizations, or even kinesio tapping techniques to reduce edema and increase ROM in those with megaprosthesis replacement. Further research is needed not only at the subacute level but all so at the outpatient level in order to document long term progress in individuals with a megaprosthesis.
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**AROM** – Active Range of Motion  
**PROM** – Passive Range of Motion  
**MMT** – Manual Muscle Test  
**WFL** – Within Functional Limits
Table 2: Outcomes at Initial Evaluation, 1 Week & Discharge

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<td>WFL R WFL L</td>
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<td>- Ankle PF</td>
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NPRS – Numerical Pain Rating Scale  
AROM – Active Range of Motion  
PROM – Passive Range of Motion  
MMT – Manual Muscle Test  
FIM – Functional Independence Measure  
WFL – Within Functional Limits  
NT – Not Tested  
R – Right  
L – Left
Figure 1 - Anterior view of a distal femoral megaprosthesis

Figure 2 – Lateral view of a distal femoral megaprosthesis
August 12, 2010

Brenna Militello
824 Vermont View Drive
Watervliet, NY 12189

Dear Ms. Militello:

The Institutional Review Board has reviewed your application and has approved your project entitled “The Outcomes Following Functional Interventions on a Patient with a Mega-prosthesis and Metastatic Breast Cancer.” Good luck with your research.

Please refer to your IRB Proposal number whenever corresponding with us whether by mail or in person.

Please let me know if you have any questions.

Sincerely,

Samuel W. Hill, PhD
Chair, IRB

SWH/nan

Cc: Dr. Gabriele Moriello