

A CASE STUDY: PATIENT RESPONSE TO 12-WEEK INDIVIDUALIZED EXERCISE PROGRAM DURING RADIATION AND CHEMOTHERAPY TREATMENTWonders K. Y. Ph.D., FACSM^{*1,2}, Stemly M.¹ and Hale R.³ MD¹Maple Tree Cancer Alliance, Dayton OH 45404.²Wright State University, Dayton OH 45435.³Kettering Medical Center, Kettering OH 45419.***Corresponding Author: Wonders K. Y.**

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ABSTRACT

Introduction: This case study observes the outcomes of a 12-week individualized exercise program on a 44-year old anal/rectal cancer patient's quality-of-life including: body composition, balance, muscular strength, cardiovascular health, muscular endurance, lower-body flexibility and chronic pain. **Case presentation:** The patient experienced treatment with high-beam radiation and 5-flourouracil chemotherapy. The patient was primarily concerned with her ability to manage her hip, lower leg and ball of foot pain all while becoming stronger. **Management and Outcome:** The patient experienced improvements in muscular strength, cardiovascular fitness, muscular endurance, flexibility, pain and self-perceived wellness. **Discussion:** As the patient progressed her hip began to tolerate greater ranges of motion and movements which used to cause her pain/discomfort stopped causing her pain/discomfort.

KEYWORDS: Quality-of-life, Exercise, Cancer, Training, Pain management.**INTRODUCTION**

Of the many symptoms experienced as a result of cancer treatment, pain is experienced by 30% to 60% of survivors.^[4] The cause of this pain is multi-faceted. In particular, physiological damage from radiation treatment often results in vascular necrosis, a condition in which there is death of osteocytes and osteoblasts, primarily effecting the femoral head.^[5] Radiation also induces an acellular matrix, which can cause fibrosis, endothelial proliferation, and microvascular occlusion.^[2]

Together, this increases the risk of pelvic fracture in women receiving pelvic radiation. Women affected by anal and rectal cancers were among those with the highest risk.^[1] While hip joint arthroplasty can reduce pain and improve gait after radiation therapy,^[2] exercise has been linked to enhanced physical performance, flexibility, fitness and quality of life,^[6] and is believed to be an effective interention in women with such morbidities.

Case Presentation

A 44-year old woman who works as an office worker was referred on the basis of leg pain (informally diagnosed as lymphedema), chronic fatigue and muscular weakness. She was diagnosed with anal/rectal cancer and was put on a treatment of 38 rounds of radiation to the abdominal/pelvic regions over 2-months, and a

chemotherapy regimen including mitomycin and 5-Flourouracil.

Her leg pain is isolated to three regions including both hip joints, both calves within the gastrocnemius/soleus and Achille's tendon region, and the balls of both feet at the base of the great toe.

The patient reported "very uncomfortable" low back pain when right hip flexion was performed and "noticeable" low back pain when left hip flexion was performed. Right hip extension resulted in "sharp" right lateral hip pain. Left hip extension resulted in "sharp" left anterior hip pain at acetabulum. Right hip abduction resulted in "noticeable" pain across the anterior aspect of the right groin. Left hip abduction resulted in no pain. Left hip adduction hurt across the anterior aspect of the left groin. Right hip abduction resulted in no pain. When both legs are fully extended in the supine position there was "noticeable" pain in both hamstrings. When seated, there was no pain associated in either the right or the left calves or ankles with ankle dorsiflexion, plantar flexion, inversion or eversion. Circumference measurements were equal among both left and right legs at a site located 5 inches superior of the lateral malleolus of the ankle and, also at a site located 5 inches superior of the superior ridge of the patella.

The patient experiences “crippling” and “debilitating” hip pain when getting in-and-out of the passenger side of the car. She also reports dizziness upon standing, complete physical exhaustion/shut down after tasks such as cleaning or gardening. Her calf pain is chronic, but is most pronounced at the end of the day. She had arthroscopic knee surgery in 1994 and 1996, experienced a prolapsed valve in 2018 and has very low blood pressure, which runs in the family.

Initial postural evaluation revealed a healthy-looking woman with moderate ankle pronation and moderate external rotation of the leg where the toes face laterally away from the body.

Patient demonstrated no balance deficits. Initial skin-caliper body fat testing measured the patient at 31% body fat. Initial circumference measurements differed between the right and left sides by 1.5 inches on a site located 3 inches proximal to the styloid process of the ulna. Initial circumference measurements were the equal at 5 inches superior from the olecranon process, 5 inches superior from the lateral malleolus of the ankle, and 5 inches superior from the superior ridge of the patella.

Initial balance testing measured the patient was able to hold a “side-by-side” foot stance, “tandem” foot stance, tandem “heel-to-toe” foot stance, and single-leg foot stance for 10 seconds each. Right medial hip pain was present in the “side-by-side instep” foot stance balance test.

Initial hand-grip dynamometer testing measured a maximal score of 61 psi for the right (dominant) side and a maximal score of 56 psi for the left side.

Initial cardiovascular testing involving a modified Bruce treadmill protocol measured the patient’s relative VO₂ at 18.1 ml/kg/min. At the terminal stage the patient was light headed, severe calf stiffness and shortness of breath.

Initial muscular endurance testing involving a 60-second squat test measured the patient completing 24 repetitions.

Initial flexibility testing involving a bilateral sit and reach measured the patient’s flexibility at 14.5 inches maximally after the third attempt. The patient experienced left lateral hip pain on the second attempt and bilateral lateral hip pain on the third attempt.

The patient commented about feeling “a little worse than a normal day” 1-day after the initial assessment with particular note of pain on the anterior aspect of the pelvis around the groin.

Clinical Findings

Cancer Treatment Timeline

Breaks in care.

Exercise Intervention

The patient met with a certified exercise oncology instructor on a weekly basis for 1-hour. The program consisted of 12 sessions that form a 12-week phase. The exercise oncology instructor made adjustments as needed to the patient’s exercise prescription and instructed the patient on how often to complete the prescribed exercises to assist with quality-of-life improvement to improve lower body muscular strength and flexibility.

Week 1: 2/26/2019

Exercise prescription completion: There was no exercise prescription to be completed before this week.

Pre-session 3-site pain: The patient began the workout with “constant but non-excruciating” calf pain, heel pain, hip pain and pain at the ball of the left foot.

Additional pre-session comments:

New occurrences:

Workout objectives: The patient’s workout focused on identifying positions that allowed her to stretch without being in pain.

Workout changes: Added “Supine pelvis rotations”*, added “Supine hip stretch”*, added “Wide stance hamstring stretch”*, added “Prone ankle grab”*, added “Straight leg calf stretch”*, added “Bent knee calf stretch”*, added “Lacrosse ball heel/toe roll”* and added “Seated toe pullbacks”*.

Post-session 3-site pain: The patient left the session with no pain in her calf, heel or hips. The only pain left was “non-excruciating” pain in the left ball of the foot.

Additional post-session comments: The session began with a seated “slump test”* for sciatic nerve testing where the patient sat on a bench with hips flexed at 90 degrees, knees bent at 90 degrees, feet flat on the floor under the knees and upright spinal posture. The patient had no pain when she was asked to extend her knee and dorsiflex the ankle. The patient was then asked to round the upper back or thoracic spine and flex the cervical spine by tucking the chin to the chest. Once in this position the patient was asked to repeat the same procedure of extending the knee and dorsiflexing the ankle. She experienced no pain in this position either. The sural or common peroneal nerve was tested for a pain response next. The patient was seated on a bench, hips flexed at 90 degrees, knees bent at 90 degrees, feet flat on the floor and seated with upright posture. The patient was then asked to extend the knee and invert the ankle towards midline. The patient had no pain response. Stretch order made a difference in her pain. Starting with “Supine pelvis rotations”* aggravated the lateral hip instead of stretching her low back. Performing “Supine hip stretch”* before the “Supine pelvis rotations”* allowed her to stretch her low back without aggravating her hip.

Number of stretches: 8

Number of exercises: 0

Week 2: 3/11/2019

Exercise prescription completion: The patient completed her exercise prescription.

Pre-session 3-site pain: No comments related to hip, calf or ball of foot pain.

Additional pre-session comments: The pain which used to reside in the hip, calf and ball of the foot was now described as “soreness” which subsides within 48-72 hours. The patient made us of additional stretching to address post-workout soreness.

New occurrences: The patient had severe soreness in the glutes and sustained a fall while skiing but no other injuries were sustained. The patient stated that much of the soreness and pain subsided as they continued with the exercise prescription for the week earlier.

Workout objectives: Repeat last week’s workout and evaluate for new pains/reinforce proper biomechanical form. Addition of spinal mobility for flexion/extension, and corrective strengthening exercises for the anterior hip, lateral hip, posterior hip and spinal erectors were introduced after repeating last week’s workout.

Workout changes: Added “Cat and Camel”*, “Forward and side neck bend stretch”*, “Supine glute bridge”*, “Fish out of water”* and “Straight single-leg raise”*.

Post-session 3-site pain: Right ball of foot pain was gone but the left ball of foot pain remained. No comments related to pain in hips or the calf.

Additional post-session comments: “Bent knee clamshell”* was attempted in session but was too painful to perform. Hip abduction movements will not be prescribed at the moment because of the sharp pain associated with this movement pattern but toleration for hip abduction will be reassessed later.

Number of stretches: 10

Number of exercises: 3

*Due to the falls while skiing the same workout was performed from the last week and re-evaluated for changes in pain. There was no new occurrence of pain.

Week 3: 3/20/2019

Exercise prescription: The patient completed her workouts at home. She had no pain the previous week associated with the “straight single-leg raise”* but as she went through the home workouts each repetition become more painful, as a result this exercise was removed from her exercise prescription.

Pre-session 3-site pain: No comments related to the hip or calf pain but still experiencing persistent left-sided ball of foot pain.

Additional pre-session comments: She said “I am no longer having pain every time I am getting out of a vehicle” and that when the pain did flare up it was “much more tolerable”.

New occurrences: The patient came into the session with a terrible migraine. The headache was alleviated in 12 minutes through neck stretching and the use of lacrosse ball rolling to the posterior and lateral neck and superior ridge of the scapulas

Workout objectives: Begin the workout the same as the last workout and then assess tolerance for an increase in training volume.

Workout changes: “Straight single-leg raise” was replaced by “chair sit-to-stand with knee extensions” and “Wall push-ups with shoulder blade squeeze” were added to begin upper body strengthening. All other exercises were increased from 2 sets to 3 sets.

Post-session 3-site pain: No changes.

Additional post-session comments: All movements and exercises in session produced no pain despite the increase in training volume.

Number of stretches: 12

Number of exercises: 4

Week 4: 4/5/2019

Exercise prescription completion: The patient completed her exercise prescription every other day between the last week and current session.

Pre-session 3-site pain: “On the muscular side of things I feel much better but where the legs were tight and achy I feel the same although the tightness and achiness is more infrequent now”. She had no comments related to pain in the hip, calf or ball of foot before starting the session.

Additional pre-session comments: The lower leg pain/calf pain is more random and is affecting her ability to sleep well when it flares up.

New occurrences: The patient was having some gastrointestinal cramping problems/discomfort as a result of the MRI contrast dye she consumed earlier in the week.

Workout objectives: Re-assess the patient’s ability to move different body segments according to the joints anatomical function. Increase in lower body training volume and upper body training volume.

Workout changes: Added “Wall mountain climbers”*, added “arm circles”*

Post-session 3-site pain: No comments related to hip pain, calf pain or ball of foot pain.

Additional post-session comments: None

Number of stretches: 13

Number of exercises: 6

Week 5: 4/15/2019

Exercise prescription completion: The patient completed her exercise prescription 3 times (4 times including the last week’s session) but instead spread the exercises over multiple days instead of doing them all within one day.

Pre-session 3-site pain: Leg pain is still present but only at night. No pre-session comments related to hip pain, calf pain, or ball of foot pain.

Additional pre-session comments

New occurrences: The lower leg pain is still the dominant factor impairing her ability to sleep at night.

Workout objectives: Reduce the number of standing exercises to see if this reduces the frequency and severity of night-time lower leg pain. Replace the standing exercises with similar exercises in the supine position.

Workout changes: Remove “Wall mountain climbers”* and remove “Seated ankle kick squats”*. Added “Dead bugs”, added “Supine marching”. Added 2 minutes to “Treadmill warmup”*. More time was also spent stretching the right hamstring and both hip at the end of the session because of stiffness. This week there was no painful low back stretch/discomfort when performing the “Wide stance toe touch”* suggesting improved low back mobility (flexion and rotation).
 Post-session 3-site pain: Her hamstrings and hips felt much better and less tight.

Additional post-session comments: The session began in the same way as the previous session except 2-minutes was added to the treadmill warm-up with the goal of identifying “how long she can walk and still have no symptoms of pain”. “Straight leg band circles” were attempted to progress “Butterfly stretch” but the movement produced a sharp pain in both hips and was stopped. While stretching it was noticed that her right hamstring was significantly tighter than her left and both hips were extremely tight. Upon conclusion of the session she commented “I feel much better”. At week 1 the patient experienced “low back pain/discomfort” in the “Wide stance hamstring stretch” position on both sides but this week had no comments on low back pain/discomfort. The patient also reached further down on her leg while keeping her hips squarely planted on the floor whereas the last time her hips would lift up as she rotated, a signal of the inability of the spine to rotate freely from the pelvis.
 Number of stretches: 13
 Number of exercises: 6

Week 6: 5/13/2019

Exercise prescription completion: The patient missed two-weeks in a row due to emergencies. She completed her exercise prescription 3 times the first week but 0 times the second week.
 Pre-session 3-site pain: She could tell her hips were tighter and said the weekend was “bad” for her hip pain and in general she could tell that everything was tighter. The calf pain would start in a region 4 inches above the heel and then radiate to the rest of the calf.
 Additional pre-session comments: The patient spend more time than usual sitting and driving around.
 New occurrences: None
 Workout objectives: Reduce calf pain in session and adjust training volume through exercise removal and addition. Reasses the ability of the hip joint to tolerate abduction.
 Workout changes: Remove “Dead bugs”* and “Supine marching”*. Added “Supine leg bicycle”*. Added “Knee plank”*, “Exercise ball leg curl”* and “Wall sprinkler”*.
 Post-session 3-site pain: No comments.
 Additional post-session comments: The patient felt the “Supine leg bicycle” primarily in the hip flexors. The patient could tolerate the range-of-motion in the “Clamshell” without any pain this week. The patient

could also tolerate the range-of-motion of the “Straight leg band circles” without any pain this week. Both new movements were added to the exercise prescription to maintain this new range-of-motion but would be performed sub-maximally to prevent total fatigue or overuse. “Clamshells” were prescribed at 1 set of 10 repetitions and “Straight leg band circles” were prescribed at 1 set of 5 reps both clockwise and counterclockwise on each leg. The patient could not perform these motions at all during week 1. Even with the improvement in hip mobility there was still pain when the patient would lay on her side. Ober’s test for iliotibial band tightness was performed and the test came back positive for pain on the right hip. The stretches were transitioned from uniplanar to multiplanar/dynamic stretches that work the joint from different angles to better apply to real life movement patterns.

Number of stretches: 3
 Number of exercises: 8

Week 7: 5/20/2019

Exercise prescription completion: She completed her exercise prescription 2 times during last week on her own.
 Pre-session 3-site pain: No comments about pain in the hip. “Noticeable, but not overly painful” was how she described the pain in her calf.
 Additional pre-session comments: None
 New occurrences: It was revealed that the patient almost never wears comfortable shoes and almost always wears heels or dress shoes.
 Workout objectives: The patient stated that her hip pain is much more manageable and under control but the calf pain is still what causes the majority of her problems. The focus was to identify strategies to reduce/eliminate the lower calf pain before the workout.
 Workout changes: The patient was had the sciatic, sural and peroneal nerves tested with tension based nerve flossing to identify painful/inflamed nerves. She was also physically palpated for “point tenderness” possible indicating posterior tibial tendonitis or plantar fasciitis. Pressure based ball rolling was done to the posterior lower leg and ball of her foot. Addition of “Fire hydrants”* to exercise prescription.
 Post-session 3-site pain: The patient said “the rolling helped a bit but did not totally resolve the pain”. She had no comments related to her hip pain but did say that the ball of her foot still hurt.
 Additional post-session comments: The patient was able to tolerate 1 set of two different hip abduction based exercises which she had previously been unable to perform. The patient was also able to perform “Forward side bend lunge” this week with no pain whereas on week 2 this stretch produced bilateral low back pain. The patient was concerned the pain in her toe was a stress fracture because she wears 2-3 inch heels to work. The patient had no redness, swelling, or warmth in comparison to the other side though.
 Number of stretches: 4
 Number of exercises: 9

Week 8: 6/3/2019

Exercise prescription completion: She completed her exercise prescription 1 time during the last week on her own.

Pre-session pain 3-site: The patient said "My lower leg pain was good this week" and described that her hip pain was even better than her lower leg pain. The ball of the foot pain was still bothersome but not terrible.

Additional pre-session comments: None

New occurrences: The patient commented on how much better the back of her ankle and knee felt throughout the week after our ball rolling session last week.

Workout objectives: Re-assess the patient's ability to move her body body segments according to the anatomical function of that joint. Modify the exercises to incorporate the patient's improved range-of-motion.

Workout changes: "Glute bridge kick ups"*, "Exercise ball bird dogs"*, "Exercise ball sit ups"*, "Exercise ball cobra lift"*, "Exercise ball hip extension"*, "Roll outs"*, "Clamshell"* and "Supine leg bicycle"* became the new strength exercises to be performed but the stretches all stayed the same.

Post-session 3-site pain: "The knee and the back of the ankle felt much better at the end of the session".

Additional post-session comments: The "Motor skill warmup" consisted of high knees, heel lifts and side stepping. The patient tolerated standing side stepping motions which were "fatiguing but not painful" whereas on Week 6 the patient tried a side stepping motion but experienced hip pain when leading with the right leg. The patient also had a great deal of fatigue in the hamstrings after performing the "Heel kicks"*. The patient completed "Supine leg bicycle" with no hip flexor fatigue this week whereas in week 8 this movement was fatiguing. All other exercises had no pain in the session. The patient is completing more movement patterns now with no comments on pain. The patient was told to complete her exercise prescription on Wednesday and Friday.

Number of stretches: 4

Number of exercises: 9

Week 9: 6/10/2019

Exercise prescription completion: The patient did not complete the new exercise prescription. But did say that she was more active than usual and whenever she felt the onset of pain that she remembered to do her ball rolling exercises which helped.

Pre-session 3-site pain: There was 1-day the past week that she experienced hip pain when reaching to get something from the back seat of her car while she was seated in the front of the car. This pain was described as "not as bad as previously but still noticeable".

Additional pre-session comments: The patient demonstrated very good self-care habits by stretching when she felt the onset of pain or to relieve pain as she went through last week.

New occurrences: None

Workout objectives: Split workouts into a "Workout A"* and "Workout B"*. Increase training volume of

exercises done by increasing the repetitions performed. The patient was instructed to do one workout on Wednesday and one workout on Friday.

Workout changes: Added "Straight leg deadlift"*, "Conventional deadlift"*, "Kettlebell swing"* and "Wall-sit"* to "Workout A"*. "Glute bridge kick ups"*, "Exercise ball bird dogs"*, "Exercise ball sit ups"*, "Exercise ball cobra lift"*, "Exercise ball hip extension"*, "Roll outs"*, "Fire hydrant"*, "Clamshell"* and "Supine leg bicycle"* were added to "Workout B". Added "Supine hip stretch"* into stretches.

Post-session 3-site pain: No comments related to pain in the hip, calf or ball of the foot.

Additional post-session comments: There was popping in the right hip on the "Supine leg bicycle".

Number of stretches: 5

Number of exercises: 13

Week 10: 6/17/2019

Exercise prescription completion: The patient completed her exercise prescription.

Pre-session 3-site pain: Her whole body was extremely sore. In particular she noted that her calves felt "heavy and weak".

Additional pre-session comments: None

New occurrences: She spent the weekend deep cleaning/scrubbing her house and it left her feeling very shaky and weak afterwards. She said "I feel much stronger now, but I am frustrated because of how this has set me back". The patient was told "it's been 1-year now, you should be better now" by people at work at this had a negative effect on her attitude and view of her health.

Workout objectives: Reduce/alleviate soreness. Comfort the patient by discussing progress notes and help her refocus on taking control of her health.

Workout changes: In addition to stretching, additional suggestions for her reduction of soreness was told to increase her fluid intake, practice deep breathing exercises or try taking a warm bath. The patient was talked to about the uniqueness of her case (she was hospitalized for 14-days at one point for radiation burns during treatment, 11-days for sepsis at one point during her treatment, her systolic blood pressure dropped to 40 and she lost consciousness a couple times with no sight or hearing, the kinds of physiological damage within muscle that occurs as a result of being exposed to chemotherapy and radiation at the same time and helped her focus on using her difficult battle with cancer/cancer recovery as a model example to help others with cancer be inspired to not give up and instill hope that things can get better. The patient was instructed to not perform "Workout A" nor "Workout B" until she was feeling better. She was instructed to continue stretching.

Post-session 3-site pain: No comments

Additional post-session comments: This session was taken as a time to talk through the patient's progress and also stretch. No workout was done today due to her level of overexertion. One of the stretches performed was

“Child’s pose”* and caused a regional anterior hip pain while performing the stretch.

Number of stretches: 5

Number of exercises: 13 (although she was instructed to skip these exercises this week).

Week 11: 6/24/2019

Exercise prescription completion: The patient did not complete the exercise prescription.

Pre-session 3-site pain: No comments related to hip, calf or ball of foot pain.

Additional pre-session comments: The patient did rest more and increase her intake of water as discussed last week. The patient did not feel like herself on Monday or Tuesday (“I felt like a zombie but I didn’t realize I was in this zombie state until after I had snapped out of it”).

New occurrences: None

Workout objectives: Re-test the last workout completed in session to look for changes in pain or weakness.

Workout changes: Increase the intensity of exercises in “Workout A”* through increasing weight or duration. Substitutions to exercises in “Workout B”*: “Cobra lift”* was replaced with “Multiplane arm bird dog”*, “Clamshell”* was replaced by “Straight leg hip abduction”*.

Post-session 3-site pain: No comments related to hip, calf or ball of foot pain.

Additional post-session comments: There was no new pain/discomfort with any of the exercises performed in the session even with a higher load being utilized on “Workout A” exercises. The “Straight leg hip abduction”* was very painful for her to perform at the beginning of the program. Last week there was “non-painful popping” in the “Supine leg bicycle”* and there was none this week. The patient held her “Knee plank”* and “Wall sit”* for 30% longer than the first time she performed it 2-weeks ago and stated “I could go further” but was stopped to avoid overexertion. The patient commented at the end of the workout “I look and feel stronger”.

Number of stretches: 5

Number of exercises: 13

Week 12: 7/1/2019

Exercise prescription completion: The patient completed her exercise prescription.

Pre-session 3-site pain: No comments related to hip, calf or ball of foot pain.

Additional pre-session comments: The pain which used to reside in the hip, calf and ball of the foot was now described as “soreness” which subsides within 48-72 hours. The patient made us of additional stretching to address post-workout soreness.

New occurrences: None

Workout objectives: Repeat last week’s workout and evaluate for new pains/reinforce proper biomechanical form.

Workout changes: None.

Post-session 3-site pain: No comments related to pain in the hip, calf or ball of foot.

Additional post-session comments: All movements and exercises in session produced no pain. All variables of the workout were maintained to make sure the patient was adequately recovered for the next session.

Number of stretches: 5

Number of exercises: 13

End of 12-week re-assessment: 7/8/2019

Pre-evaluation comments: The patient had to “power walk” 30 minutes down the road from her office in heels within 1-hour of our session.

Weight: 135.4 lbs

BMI: 21.2

3-site skin-caliper based body fat analysis: 31%

Circumference measurements: Right wrist 8 inches. Left wrist 8 inches. Right upper arm 12 inches. Left upper arm 12 inches. Right lower leg 10 inches. Left lower leg 10.5 inches. Right upper leg 17.5 inches. Left upper leg 18 inches.

Muscular strength: 74 psi on the right side (21.31% increase). 69 psi on the left side (23.21% increase).

Cardiovascular fitness: 19.7 ml/kg/O₂ (8.84% increase).

Muscular endurance: 33 repetitions (37.5% increase).

Flexibility: 18.5 inches (27.59% increase).

Self-perceived wellness: 5/10 (100% increase).

Outcomes

The patient performed much better on her re-assessment. The patient also had significantly fewer instances of pain during the re-assessment. She had no pain while standing for the “Tandem stance” in the balance test. She reported less dizziness and did not get dizzy after the treadmill test. The patient stopped at 3.5 mph and a 5 degree incline the first assessment because of “shortness of breath” but lasted until 3.6 mph and 6 degrees of incline on the reassessment and stopped because of tight calves and not shortness of breath. The patient experienced bilateral hip pain on the initial flexibility test and experienced no bilateral pain at the same relative flexibility on the re-assessment but did experience unilateral hip pain when pushing to to her maximal sit and reach length.

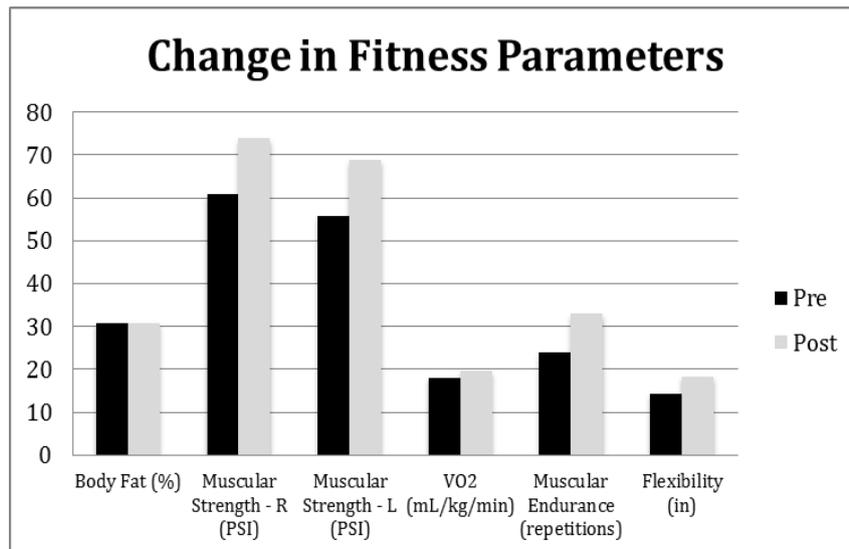


Figure 1: Change in Fitness Parameters. Values are pre- and post- exercise intervention. Body fat expressed in percentage, muscular strength in psi, cardiovascular endurance in ml/kg/min, muscular endurance in repetitions, and flexibility in inches.

DISCUSSION

This case serves as an example to the effectiveness of exercise on the severity of symptoms that a cancer patient may experience during radiation to the pelvic area. In the present case, the patient was exposed to both high-beam radiation and 5-Fluorouracil chemotherapy. Her foremost complaints after cancer treatment were extreme muscular weakness, severe chronic fatigue, and “excruciating and debilitating pain” primarily centralized to 3-regions: both hips, both lower legs and the balls of both feet.

The patient participated in a 12-week individualized exercise program where each session was tailored to the patient’s overall goals, as well as to the symptoms that were present at the start of each session. The patient had chronic pain in the hips, lower legs, calves and balls of feet and by the end of the 12-week exercise program this was reduced to “infrequent and tolerable”, the lower leg and calf pain was reduced to “infrequent and mostly at nights” and the ball of the foot pain was eliminated in the right but still present in the left. Upon conclusion of the 12-week exercise program the patient went on a vacation where she kayaked and ziplined, most importantly she was able to complete both and enjoy her time with her family.

Due to lack of information and medical records it is not always clear cut as to what structures have been affected by chemotherapy and to what extent they have been affected. However, the exercise oncology instructor noted that with increased exercise dose, the patient’s mobility increased pain diminished. As time progressed, the patient was able to tolerate more difficult exercises that made use of her own bodyweight or free weights. Exercise modification played a significant role in her ability to reduce her joint pain. All exercises were prescribed in a manner that would not allow the patient

to over-exert herself into extreme fatigue, pain, or muscle soreness. If the patient experienced pain with any movement then then the pain was made note of and that exercise or movement pattern was revisited later on into the program as exercise tolerance improved.

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