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The Effects of Low-impact Exercise in Postmenopausal Women with Osteoporosis

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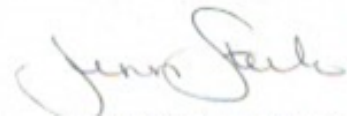
The Effects of Low-impact Exercises in Postmenopausal Women with Osteoporosis

Department Nursing

Degree Master of Science

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Abstract

A case of a 67-year-old postmenopausal woman presenting for follow-up care after a right hip fracture will be presented. The scenario brings up the question, can low-impact exercise be beneficial to a patient in this population? It may be easier for them to sustain. A literature review was compiled on low impact exercise in postmenopausal women already diagnosed with osteoporosis. Medications used to treat osteoporosis have an impact on bone health, however, increase in quality of life, independence, balance, and/or pain management is not always achieved with medications alone. Exercise regimens, whether high or low-impact can help improve areas where medication cannot necessarily improve. It is important to consider recommending low-impact exercise such as Pilates, Yoga, walking, Tai Chi, or home exercises for postmenopausal women to help prevent deteriorating BMD, improve pain, quality of life, and function. These exercises do not require high-intensity and can be adapted if needed for any injury or loss of function from aging or surgery. These can come with minimal or no cost to the patient, therefore, a great return on investment. It is crucial to counsel patients on the facts of the benefits from low-impact exercise and to be sure to encourage it to be a lifestyle modification, and not a short-term change.

Keywords: Osteoporosis, exercise, low-impact exercise, menopause, postmenopausal, bone density.

The Effects of Low-impact Exercise in Postmenopausal Women with Osteoporosis

Many concerns arise for the overall health of women as they age, particularly after menopause which cause them to seek medical care. Women go through many biological changes as they age. Menopause is defined by Cleveland Clinic (2017) as an end to a woman's reproductive years, or 12 months of no menstrual cycles. The ovaries no longer release eggs or produce as much estrogen. Because of a "lower level of estrogen, postmenopausal women are at increased risk for a number of health conditions, such as osteoporosis and heart disease," (Cleveland Clinic, 2017, para. 4). Osteoporosis is a disease where bones become weak and are more apt to break than usual, at times without injury. Osteoporosis is known as a "silent disease" because women can be affected by it and unfortunately not know until a fracture occurs (Pinkerton, Thomas, & Dalkin, 2013). Most commonly affected bones include the bones of the wrist, spine, and hips. Women are at a higher risk for osteoporosis than men (National Institutes of Health, 2014).

An overwhelming amount of information and studies are available for high-impact exercise or strength training to help prevent and treat osteoporosis. "Low-impact exercise refers to activities that are joint-friendly," says Jessica Matthews, an exercise physiologist at the American Council on Exercise (Stanten, 2014, para. 2). Matthews goes on to discuss because one foot stays on the ground at any given time, "it puts minimal stress on joints such as the ankles, knees, and hips. Low-impact exercise doesn't involve jumping or running. Walking is a good example of low-impact," (Stanten, 2014, para. 2). Cycling, swimming, Yoga, Pilates, walking, Tia Chai, and stationary biking can be examples of low-impact exercises.

A case will be presented with a postmenopausal woman following up after a hip fracture. She has many risk factors for osteoporosis which will be discussed in greater detail throughout

the project. Due to the commonality of the scenario presenting in primary care, the case will be presented and current literature and recommendations will be reviewed. Given many post-menopausal women are over the age of 50, is it realistic for this population to complete high-impact exercises, such as running, or strength training? This raises the question, what are the effects of low-impact exercise in post-menopausal women with osteoporosis? Could low-impact exercise be as beneficial to women in this particular age group as strength training or high-impact training?

Case Report

A 67-year-old female presents to clinic for a two-month follow up after a right hip fracture and replacement. The patient is new to the clinic where she is being evaluated, therefore, a complete medical history is unavailable to review. The patient fell at home in the shower, without a cause and reports she did not slip or trip. The fall seemed to be “for no reason at all.” She denies dizziness or lightheadedness at the time of the incident. She does not have a history of falls prior to this incident, nor has she had any since. At the present, she is back at home by herself, but she does have help from one of her daughters. When asked about her incision, she denies any pain to her hip and reports that she “recovered well.” She reports the wound healing well and denies fever, redness, or drainage from incision site. Currently, she does not use a cane or walker to get around. She did not complete any physical therapy since she has been out of the hospital.

Past medical history for this patient includes a history of hypertension and a history of right breast cancer. Her medication list includes Lisinopril 10 mg by mouth every day and Arimidex one mg by mouth every day. She does take Tylenol occasionally as needed for pain. She does not have any allergies to medications.

The patient is a retired widow and has three grown children. She smokes one and a half packs of cigarettes per day for 50 years and is not interested in quitting when asked. She uses alcohol rarely and does not exercise. The woman denies any intake of calcium or milk, nor does she eat any other yogurt or cheese to replace calcium.

Physical Exam and Treatment Plan

On exam, the woman is calm and in no acute distress. She participates in the exam without difficulty and answers questions appropriately. The patient is her own historian and is a reliable source. She is alert and oriented. The woman has no obvious abrasions, rashes, or bruising.

The cardiac exam is unremarkable with a regular rate and rhythm; no murmur, gallop or rub; S1 and S2 present. Breath sounds are clear to auscultation bilaterally, without wheezes, crackles, or rales; regular effort, rate, and rhythm noted. The patient has a normal gait and range of motion.

Given the lack of history available to review, the patient is questioned about screening tests, such as a dual-energy x-ray absorptiometry (DXA) scan, in which she denies having in the past. She has had a mammogram in October 2016, which she reports as “negative.” It is recommended to start with a DXA scan to screen this patient for osteoporosis, as she is postmenopausal and has had a recent fall with fracture. Current recommendations include assessing risk factors for fracture in all adults, especially postmenopausal women (or women over 65 years of age), and in any individual who experiences a fragility or low-trauma fracture (Kleerkoper, 2015).

The patient’s DXA scan was completed and showed bone density consistent with osteoporosis, with a femoral neck bone mineral density (BMD) T-score of -2. The radiology

report for the DXA scan can be found under Appendix A. Current recommendation is to start with pharmacologic therapy for postmenopausal women with a history of fragility fracture or with osteoporosis based upon BMD measurement (T-score ≤ -2.5), which is consistent with this case. Oral bisphosphonates are recommended first-line therapy for postmenopausal women with osteoporosis (Rosen & Drezner, 2017). Creatinine is recommended to be evaluated before starting bisphosphonates to evaluate kidney function, as oral bisphosphonates are excreted through the kidney (Rosen, 2017). This patient's creatinine was within normal limits at 0.8mg/dL, therefore, Alendronate 70 mg by mouth, once weekly is started. Other labs to consider testing is calcium and 25-hydroxyvitamin D (25[OH]D) (Rosen, 2017).

A concern to be addressed for this patient is an inadequate intake of calcium in her diet. Rosen (2016) recommends a daily dose of 1200 mg of calcium combined between diet and supplement and 800 international units (IU) of vitamin D daily for postmenopausal women with osteoporosis. Rosen & Drezner (2017) recommend women with inadequate dietary intake take supplemental calcium between 500 to 1000 mg/day, in divided doses at mealtime.

Smoking cessation was recommended as well. Smoking puts women at increased risk for osteoporosis because it accelerates bone loss, reduces the amount of calcium absorption in the bones, lowers estrogen levels, and is toxic to the bone-forming cells (Rosen & Drezner, 2017). Therefore, smoking cessation could be immensely beneficial to this patient.

Increase in exercise has also been recommended to the patient. Thirty minutes of exercise, at least three times per week, help prevent worsening of osteoporosis (Rosen & Drezner, 2017). Exercise helps to build bone mass and strengthen muscles, all of which would be helpful to a patient with osteoporosis.

Follow up recommendations given to the patient included a recheck in 2 months to see how she is doing overall since she is establishing and could benefit from a complete physical and discussion about further health maintenance and screenings and another discussion about smoking cessation. A repeat DXA scan is recommended to be repeated in 2 years based on her T-score. With a T-score between -2.00 and -2.49, or increased risk factors that may facilitate ongoing bone loss, DXA scan should be repeated in 2 years. However, a T-score of -1.50 to -1.99 and no increased risk factors, a DXA scan can be repeated in three to five years (Rosen & Drezner, 2017).

Pathophysiology.

To properly treat the disease, it is important to understand the disease process. Osteoporosis occurs when bone mass is reduced or impaired. There are a number of causes of osteoporosis, such as menopausal reduction of estrogen, decreased calcium and vitamin D intake, age greater than 65 years, long term steroid or immunosuppression therapies can all be risk factors for osteoporosis (Rosen, 2014). The case presented for this project had multiple common risk factors. It is important to note, there are other causes of osteoporosis that are not mentioned in this project. Rosen (2014) states “bone loss as a result of aging/and or estrogen deficiency is the predominant pathophysiologic disorder of primary osteoporosis” (para. 3). This pathophysiologic mechanism is likely the cause of the osteoporosis of the patient discussed.

Bone mass measurement defines mineral content per area of bone. “Bone density by DXA is a very strong predictor of bone strength and accounts for about 80% of the variability in the breaking strength of a single femur. Thus, a very low bone mass can be linked to increased skeletal fragility with a great degree of confidence,” (Rosen, 2014, “Factors that Affect Bone Quantity and Quality,” para. 2). Two different processes can affect bone mass; first, the build-up

of bone mass in adolescence and, second, the maintenance of bone mass in adulthood. Changes in bone mass occur during the remodeling cycle. Changes can occur where bone “resorption exceeds formation resulting in a net loss of bone. However, it is also apparent that some individuals have impaired peak bone acquisition,” (Rosen, 2014, “Bone Remodeling and its Relationship to Bone Quantity,” para. 2). This patient likely falls into the resorption exceeding formation.

For the most part, “estrogen deprivation remains one of the most common and critical elements in shifting resorption rates to a higher set point” (Rosen, 2014, “Bone Remodeling and its Relationship to Bone Quantity,” para. 4). Estrogen plays an important role in preserving bone mass, as it signals cells in the bones to stop breaking down (Cleveland Clinic, 2017). “Women lose an average of 25 percent of their bone mass from the time of menopause to age 60, due in large part to the loss of estrogen. Over time, this loss of bone can lead to bone fractures,” (Cleveland Clinic, 2017, “What are the Long-term Health Risks Associated with Menopause,” para. 2). “Many osteoporotic patients suffer fractures with very minimal trauma, and this feature is pathognomic of the skeletal fragility which accompanies low bone mass,” (Rosen, 2014, “Factors that Affect Bone Quantity and Quality,” para. 1).

Literature Review.

Improving quality of life and preventing injury during menopause is crucial. Women are living longer and spending more years in a menopausal state. It is estimated women will spend one-third of their life after menopause (Grindler & Santoro, 2015). The case presented is a very common presentation of osteoporosis for women who have not been screened. Most women do not know they have osteoporosis until they have a fracture resulting from no injury or from a very slight trauma, therefore the mechanism does not match the severity of injury. In this

situation, the patient had fallen in the shower without slipping or tripping. She had not had a screening DXA scan, and she also is being treated with Arimidex for breast cancer, which also increases the risk of osteoporosis. Given the significance and frequency of this type of concern in primary care, it is important to screen patients prior to a fracture. Once diagnosed with osteoporosis, health care providers can recommend nonpharmacological interventions to augment therapy and improve symptoms.

When considering the recommendations given to this patient, the question still comes to mind of how capable she is to do strength training or high impact exercise at the age of 67 and eight weeks' status-post right hip fracture and repair. Can low-impact exercise be beneficial to a patient in this population? It may be easier for them to complete or comply. Therefore, a literature review was compiled on low impact exercise in postmenopausal women already diagnosed with osteoporosis. A search of the CINAHL database was conducted. A vast number of articles were available on exercise and osteoporosis. Articles were narrowed to the last five years and additionally, utilizing low-impact exercise such as walking, Yoga, Pilates, and Tai Chi. Ten articles met the criteria, thus were utilized for critical review and analysis.

A study by Angin, Erden and Filiz (2015) was completed to identify impacts of clinical Pilates programs on quality of life, BMD, walking distance, and pain in postmenopausal women with osteoporosis found an improvement in many areas when compared to a control group. The study included only postmenopausal women over the age of 40. The groups were split in two, the Pilates group and the control group. The Pilates Group completed a 24 week Pilates program, whereas the control group were not subjected to any program at all. The Pilates group reported significant improvement in pain and quality of life compared to the control and could increase walking distance after participating in the program. BMD was significantly increased in

the Pilates group as well. This study shows significant positive effects in which would be beneficial to this patient as recommendations for treatment in addition to medication management.

A study performed to evaluate effects of Pilates on pain, functional status, quality of life found similar results. The study was a one-year randomized, prospective, controlled and single-blind trial. Sixty postmenopausal women between the ages of 45-65 years were split into two groups, one into a Pilates group and the other to do home exercises to consist of thoracic extension exercises. After one year, significant positive improvements in quality of life and functional status, as well as a decrease in pain and risk for falls were shown in the Pilates group. A significant positive improvement in pain and risk for falls was noted in the home exercise program (Küçükçakır, Altan, & Korkmaz, 2012). The article shows the positive impacts on both types of exercise, however, Pilates does have an even greater impact. Both a home exercise program or Pilates would be beneficial to patients with postmenopausal osteoporosis. For the purpose of comparison to this case, recommending an exercise regimen to help prevent BMD from decreasing, reducing the risk for falls, and improving her quality of life can be in either a home exercise program or group fitness. Taking this study into consideration, it is not necessary to recommend group physical fitness away from the home, or for one to pay for such class if resources are not available.

Yoga is another type of low-impact exercise. Smith and Boser (2013) compiled a literature review to determine the effects of Yoga on osteoporosis and vertebral fractures. Other studies have focused a great deal on the femur BMD measurements or have found little to no effect on the vertebral areas. “Moderate, weight-bearing activities that strengthen the muscles supporting the spinal column, promote balance, improve posture, and enhance quality of life

appear to be of greatest benefit. Ample evidence supports the importance of varied spinal movement for preserving the health and strength of the vertebral bodies” (Smith & Boser, 2013, p. 18). “Strengthening the back extensors may provide long-term protection against vertebral fractures, independent of bone mineral density” (Smith & Boser, 2013, p. 18). Evidence showing strengthening lumbar muscles can help prevent fractures and improve balance in patients is beneficial for this case, as other reviewed evidence has focused on femur fractures or shown little evidence for improvement in the lumbar spine.

Another study by Fishman (2009) studied the effects of Yoga on osteoporosis in postmenopausal women. The study had 117 patients who were taught Yoga and committed to daily, or almost-daily routines for two years. The study had many people who were lost to follow-up, therefore the compliance was low overall. The results, however, of those who completed the study, showed patients who performed eight to ten minutes of Yoga daily had an increase in BMD. The authors are currently conducting a second study to verify results with a goal of improved compliance. The two aforementioned articles give more reasons to suggest adding in exercises such as Yoga, given the improvement in small amounts of regular practices, could be something the presented patient could comply with once taught. Yoga may be done at home and not require travel to comply.

Black and Rosen reviewed current recommendations and guidelines to come up with further clinical recommendations for postmenopausal osteoporosis. The authors looked at ways to improve outcomes including pharmacological measures such as bisphosphonates or estrogen, and other modifiable measures such as exercise, calcium and vitamin D intake, smoking cessation, and decrease in alcohol intake. Other low-impact exercise programs, such as Yoga or Tai Chi, are found to improve balance and muscle tone, resulting in decreased fall risk for

women with osteoporosis (Black & Rosen, 2016). The overall treatment recommendations given for treatment included increased physical activity, avoidance of alcohol, decreased alcohol intake, daily calcium intake of 1000 to 1500 milligrams, vitamin D daily intake of 800-1000 milligrams, and first line bisphosphonates for osteoporosis (Black & Rosen, 2016). This article reinforces all recommendations to be given to the patient presented in the case.

Beck et al. (2010) completed a cross-sectional cohort study looking at the association between exercise and BMD of the femur in postmenopausal women. They used data from DXA scans from 6032 postmenopausal women with osteoporosis who exercised. The study concluded walking has a positive effect on bone health, such as increased bone strength and resistance to fracture (Beck et al., 2010). This study shows more evidence to support increased activity will be beneficial to this patient, or others like her, even with a daily walking routine.

Ma, Wu, and He (2013) completed a meta-analysis and systematic review of postmenopausal women who walked for 40 to 60 minutes per session, three to four times per week, ranging from three months to two years. Ma, Wu, and He (2013) found walking as monotherapy has no significant effects on BMD at the lumbar spine, at the radius, or for the whole body. However, they found significant and positive effects on femoral neck BMD are evident with walking, particularly brisk walking, for more than 6 months in duration. When considering this article for the patient presented, it is important to encourage exercise, such as walking, but to keep in mind it is something for the patient to incorporate into their lifestyle and not a short-term relief.

A 16-year study has observed the long-term effects of exercise in postmenopausal women participating in a multipurpose exercise program with low and high-impact exercise regimens involved. The study shows decrease in low back pain, decreased risk of coronary heart disease,

and decreased fracture incidences (Kemmler, Kohl, & von Stengel, 2017). Given a 16-year compliance rate of this study shows long-term exercise programs, as long as they are adjusted to the ability and functional level of the patient, are a good option for promoting health in this population. This article can be related to the case study to support the positive effects of exercise, and shows the importance of encouraging the patient to make a lifestyle change of completing regular exercise.

Roush (2011) provided an overview and recommendations for osteoporosis in postmenopausal women. Recommendations given by Roush (2011) include adequate calcium and vitamin D intake, weight-bearing exercise, decrease alcohol intake, smoking cessation, fall prevention, and pharmacological interventions such as bisphosphonates or estrogen. Roush (2011) notes women who participate in regular exercise programs have a significantly decreased fall risk, however, the strict compliance to regular exercise is required or positive effects may be lost with cessation of program. Furthermore, it is found the effects of counseling have a significant effect on those participating as those who were counseled walked significantly more than those who did not receive counseling (Roush, 2011). Although this study does not suggest specifically low-impact exercise, it does recommend exercise and reinforces the remaining recommendations given to the patient in the case. Additionally, this article reinforces the importance of providers counseling patients on the benefits of regular exercise.

A narrative review completed by Grindler and Santoro (2015) considered the relationship and effects of exercise and menopause. The results mirrored the previous studies. Grindler and Santoro categorized exercise into aerobic, muscle strengthening, flexibility, and balance. The authors found regular exercise such as walking, Pilates, or swimming has beneficial effects such as improved quality of life, mobility, increased independent functioning., and decreased risk of

fall related injury. The study notes that walking alone has no significant effect on the lumbar spine or radius, but significant improvement on femoral neck BMD as long as a minimum of 6 months of therapy are completed. It is important to note the authors state higher-impact exercises have an even greater impact than low-impact, and low-impact has a greater impact than being sedentary. Therefore, any regular exercise, high or low-impact can greatly improve patient outcomes if a patient is not exercising.

Impact on Practice.

Each one of the articles reviewed supports recommendations given to the patient in the case presented for this project. After reviewing all the literature gathered here, the following recommendations can be taken when treating postmenopausal women with osteoporosis:

- Modifiable risk factors, such as regular exercise, adequate calcium (1200 mg) and vitamin D (800 IU) daily intake, smoking cessation, and limited alcohol intake can all have a positive impact on BMD, reduced risk of fracture, pain, function, and quality of life for this population.
- It is imperative to counsel patients about the importance of exercise so they are more apt to be compliant. Patients may be more willing to comply or consider exercising if they are informed of the positive impact it can make.
- Although it is widely recommended to encourage weight-bearing exercise for improvement in BMD, walking, Yoga, Pilates, Tai Chi, or at home exercises can all be ways to improve it as well. These are easier for patients in this population to complete and some of them can be done in their own home versus traveling to group exercises and paying memberships to fitness centers.

- Vast amount of information on high-impact, further studies on low-impact exercises could be beneficial.

Conclusions.

Medications used to treat osteoporosis have an impact on bone health, however, increase in quality of life, independence, balance, and/or pain management is not always achieved with medications alone. Exercise regimens, whether high or low-impact, can help improve areas where medication cannot necessarily improve. Given the information presented after the case, it is important to consider recommending low-impact exercise such as Pilates, Yoga, walking, Tai Chi, or home exercises for postmenopausal women to help prevent deteriorating BMD, improve pain, quality of life, and function. These exercises do not require high-intensity and can be adapted if needed for any injury or loss of function from aging or surgery. Most importantly, these can come with minimal or no cost to the patient, therefore, a great return on investment. It is crucial to counsel patients on the facts of the benefits from low-impact exercise and to be sure to encourage it to be a lifestyle modification, and not a short-term change. Ultimately, any exercise regimen is better than a sedentary lifestyle, therefore a specific population may find benefit from low impact exercises.

References

- Angin, E., Erden, Z., & Can, F. (2015). The effects of clinical pilates exercises on bone mineral density, physical performance, and quality of life of women with postmenopausal osteoporosis. *Journal of Back and Musculoskeletal Rehabilitation*, 28, 849-858.
- Balk, J., & Bernardo, L. M. (2011). Using Yoga to promote bone health and reduce fracture risk in the geriatric population. *Topics in Geriatric Rehabilitation*, 27(2), 116-123.
- Beck, T. J., Kohlmeier, L. A., Petit, M. A., Wu, G., Leboff, M. S., Cauley, J. A., ... Chen, Z. (2011). Confounders in the association between exercise and femur bone in postmenopausal women. *Medicine & Science in Sports & Exercise*, 43(1), 80-89.
doi:10.1249/mss.0b013e3181e57bab
- Black, D.M., & Rosen, C.J. (2016). Postmenopausal osteoporosis. *The New England Journal of Medicine*, 374(3), 254-262.
- Cleveland Clinic. (2017). Menopause, Perimenopause, and Postmenopause. Retrieved from Cleveland Clinic: <http://my.clevelandclinic.org/health/articles/what-is-perimenopause-menopause-postmenopause>
- Fishman, L. (2009). Yoga for osteoporosis: A pilot study. *Topics in Geriatric Rehabilitation*, 25(3), 244-250.
- Grindler, N. M., & Santoro, N. F. (2015). Menopause and exercise. *Menopause: The Journal of The North American Menopause Society*, 22(12), 1351-1358.
- Kemmler, W., Kohl, M., & von Stengel, S. (2015). Exercise and fractures in postmenopausal women. Final results of the controlled Erlangen Fitness and Osteoporosis Prevention Study (EFOPS). *Menopause: The Journal of The North American Menopause Society*, 24(1), 45-51.

Kleerkoper, M. (2015). Screening for Osteoporosis. Retrieved from UptoDate:

https://www.uptodate.com/contents/screening-for-osteoporosis?source=search_result&search=dexa%20scan%20screening&selectedTitle=1~132

Küçükçakır, N., Altan, L., & Korkmaz, N. (2013). Effects of Pilates exercises on pain, functional status and quality of life in women with postmenopausal osteoporosis. *Journal of Bodywork and Movement Therapies*, 17(2), 204-211. doi:10.1016/j.jbmt.2012.07.003

Ma, D., Wu, L., & He, Z. (2013). Effects of walking on the preservation of bone mineral density in perimenopausal and postmenopausal women: a systematic review and meta-analysis. *Menopause: The Journal of The North American Menopause Society*, 20(11), 1216-1226.

National Institutes of Health. (2014). *What Is Osteoporosis?* Retrieved from National Institutes of Health Osteoporosis and Related Bone Diseases Resource Center:

https://www.niams.nih.gov/health_info/bone/osteoporosis/osteoporosis_ff.asp

Pinkerton, J. V., Thomas, S., & Dalkin, A. C. (2013). Osteoporosis treatment and prevention for postmenopausal women: Current and future therapeutic. *Clinical Obstetrics and Gynecology*, 56(4), 711-721.

Rosen, C. J. (2014). The epidemiology and pathogenesis of osteoporosis. Retrieved from

<https://www.ncbi.nlm.nih.gov/books/NBK279134/>

Rosen, H. N. (2016). Calcium and Vitamin D Supplementation in Osteoporosis. Retrieved from UptoDate: https://www.uptodate.com/contents/calcium-and-vitamin-d-supplementation-in-osteoporosis?source=see_link

Rosen, H. N. (2017). The use of bisphosphonates in postmenopausal women with osteoporosis.

Retrieved from UptoDate: https://www.uptodate.com/contents/the-use-of-bisphosphonates-in-postmenopausal-women-with-osteoporosis?source=see_link

Rosen, H. N., & Drezner, M. K. (2017). Overview of the management of osteoporosis in postmenopausal women. Retrieved from UptoDate:

https://www.uptodate.com/contents/overview-of-the-management-of-osteoporosis-in-postmenopausal-women?source=see_link

Roush, K. (2011). Prevention and treatment of osteoporosis in postmenopausal women: A review. *American Journal of Nursing*, 111(8), 26-35.

Smith, E. N., & Boser, A. (2013). Yoga, vertebral fractures, and osteoporosis: Research and recommendations. *International Journal of Yoga Therapy*, 23(1), 17-23.

Stanten, M. (2014, February 17). Low Impact Exercise High Impact on Fitness? Retrieved from Sanofi Diabetes: <http://diabetes.sanofi.us/low-impact-exercise/>

Appendix A

Bone Densitometry Scan

History: This is a 67-year-old post-menopausal Caucasian female.

Lumbar Spine: The total BMD for L1 to L4 is 0.594g/cm. The BMD is 67% of the young adult reference population and 69% of the age matched population. The T-score is -4.1.

WHO Classification: Osteoporosis.

Lumbar Spine: There has been an interval decrease in lumbar spine BMD of 1.7% when compared to baseline with an interval increase of 2.9% when compared to baseline study.

Hip: There has been an interval increase in hip BMD of 0.2% when compared to the baseline with an interval decrease of 1.0% when compared to baseline study. The T-score is -2.0.

Conclusion:

1. Bone density consistent with osteoporosis
2. Fracture Risk is high

Recommendations:

1. Adequate Vitamin D and calcium

Follow up DXA scan in 2 years to evaluate for change or response to treatment.