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Outpatient Physical Therapy Management of a Patient with Left Hip Femoroacetabular Impingement: A Case Study

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Outpatient Physical Therapy Management of a Patient with Left Hip Femoroacetabular Impingement: A Case Study

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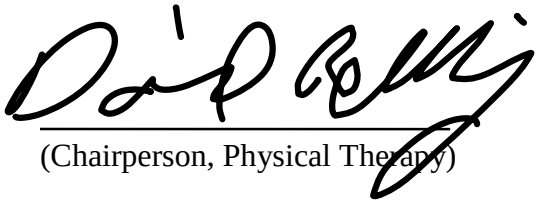
This Scholarly Project, submitted by Mark Geerdes in partial fulfillment of the requirements for the Degree of Doctor of Physical Therapy from the University of North Dakota, has been read by the Advisor and Chairperson of Physical Therapy under whom the work has been done and is hereby approved.

(Graduate School Advisor)



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Signature Mark Geerdes

Date 9/24/2020

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ABSTRACT

Background and Purpose: Femoroacetabular impingement (FAI) syndrome is a motion related clinical disorder of the hip in which there is premature contact between the acetabulum and the proximal femur. This case study evaluates the effectiveness of physical therapy as a first line treatment for FAI and discusses the patient outcomes based on the chosen interventions. The results can be used to better understand the most appropriate interventions for conservative FAI treatment. **Case Description:** The patient was a 15-year-old male student athlete who presented to physical therapy with left anterior and lateral hip pain. **Interventions:** The rehabilitation program provided to the patient consisted of patient education, core strengthening, application of McKenzie hip flexor stretching, hip musculature strengthening, postural balance exercises, neuromuscular re-education, functional lower limb strengthening as well as a personalized home exercise program. **Outcomes:** Following treatment the patient demonstrated increased left hip ROM, and strength as well as 0/10 left hip pain with all ADLs. **Discussion:** The patient responded well to the chosen interventions. However, further research into the most effective conservative care for the treatment of FAI is still necessary and is currently being carried out.

CHAPTER I

Background and Purpose

Femoroacetabular impingement (FAI) syndrome is a motion related clinical disorder of the hip in which there is premature contact between the acetabulum and the proximal femur. When this premature contact occurs patients generally exhibit motion or position-related pain in the hip or groin, as well as restricted motion and pain with hip flexion and internal rotation. Patients may also describe clicking, locking, or stiffness in the hip joint.[1] If left untreated, FAI can lead to cartilage and labral damage as well as osteoarthritis due to the abnormal contact occurring at the joint.[2]

There are three common morphologic abnormalities that may occur with FAI: cam, pincer, and mixed. Cam morphology describes a “flattening or convexity of the femoral head and neck junction and is more common in men.”[3] Pincer morphology describes "overcoverage of the femoral head by the acetabulum in which the acetabular rim is extended beyond the typical amount, either in one focal area or more generally across the acetabular rim and is more common in women.”[3] Both types have been shown to damage the articular cartilage. An estimated 85% of patients with FAI have mixed morphology, meaning both cam and pincer morphologies are present.[2] It is important to note that these morphologies are thought to be fairly common (around 30% of the general population), including individuals without hip symptoms.[4] Since both morphologies can be present in asymptomatic individuals it is theorized that other factors may also play a role in the development of FAI such as weakness of the deep hip muscles. It is proposed

that by strengthening the hip musculature, loading of the labrum can be reduced leading to downregulation of nociceptive neurotransmitters in the labrum.[5]

The clinical presentation of FAI is most often anterior or anterolateral hip pain that refers to the groin and may occasionally radiate down to the thigh. This hip pain is generally aggravated by activities requiring hip flexion and internal rotation such as sitting, driving, and squatting. If there is significant intra-articular damage, then clicking or catching of the hip may also be present. The two motions most often limited with FAI are hip flexion and internal rotation. Other clinical tests that may be used to help diagnose FAI include the FADIR and FABER tests. Imaging such as plain radiographs and MRI may also be utilized, especially if the patient's symptoms are more severe or if they are not responding to conservative treatment.

The etiology of FAI is likely multifactorial and is currently still being researched, however, certain factors have been proposed. These include pediatric hip diseases, high-impact athletic activities during growth, and genetic factors. Slipped capital femoral epiphysis (SCFE) has also been proposed as a risk factor and in some cases surgical overcorrection of hip dysplasia may lead to a pincer type deformity.[6] More recently there are reports that adolescents who participate in high impact sports such as soccer, basketball, and ice hockey while their bones are still maturing may have a higher prevalence of FAI. Agricola et al. studied elite soccer players, mean age 14.4 years, for 2 years and observed an increased prevalence of a cam deformity in the athletes. The cam deformity was defined as an increase in the alpha angle and was likely due to the high shear forces during hip joint development. The increase in severity or prevalence of the cam deformity was not seen after full closure of the proximal femoral growth plate. A

similar trend was observed in high level ice hockey and basketball players. This evidence suggests that an alteration of athletic activities during skeletal growth may prevent formation of cam deformities.[7]

There is also believed to be a genetic component to FAI. Pollard et al. found a relative risk greater than 2 for having a cam or pincer deformity in siblings of patients with cam or pincer-type FAI.[8] Baker-Lepain reported that "allele variants in wnt/Beta catenin signaling antagonists, a cell signaling pathway that directs the development of both bones and joints, are associated with the shape of the proximal femur and also later in life with hip OA."[9] These studies suggest genetics may play an important role in the development of FAI, however more research is needed in this area.

In a randomized controlled trial performed by Palmer et al. they compared arthroscopic hip surgery with physical therapy and activity modification for improving patient reported outcome measures in patients with symptomatic FAI. The trial included 222 participants between 18 to 60 years of age with confirmed FAI using radiography and magnetic resonance imaging. Participants were randomized 1:1 to receive arthroscopic hip surgery (n=112), or a program of physical therapy and activity modification (n=110). A maximum of eight physiotherapy sessions were delivered over five months. The primary outcome measure was the hip outcome score activities of daily living subscale (HOS ADL). At eight months post-randomization the mean HOS ADL was 10.0 points higher (6.4 to 13.6) in the arthroscopic hip surgery group compared with the physical therapy group ($P<0.001$).[10]

Based on the data collected, Palmer et al. concluded that patients with symptomatic FAI referred to secondary or tertiary care achieve superior outcomes with

arthroscopic hip surgery than with physiotherapy and activity modification. However, it should be noted that patients were only included if their FAI symptoms were more severe, and they were only allowed eight physical therapy sessions over 5 months. It should also be clarified that Palmer et al. still recommended physical therapy as a first line treatment due to lower cost and reduced potential for complications.

The American Physical Therapy Association (APTA) currently recommends patient education on joint protection strategies, avoidance of symptom-provoking activities, manual therapy for capsular restrictions, therapeutic exercise including stretching and strengthening, cardio-respiratory endurance exercises, and neuromuscular re-education that focuses on multi-joint patterns to improve movement coordination.[11] However, there is a paucity of quality randomized controlled studies to support treatment interventions for FAI at this time.

The purpose of this case study is to describe and investigate the treatment of a 15-year-old male with symptoms consistent with FAI to help delineate the most effective treatment for individuals with FAI. Since FAI is increasingly being recognized as a source of hip pain, especially in young adults[12] it is important that physical therapists understand the most effective interventions to use for this diagnosis. This case study aims to contribute to the literature so that physical therapists may develop an effective FAI protocol in the future. The interventions analyzed in this case study include: core strengthening, hip flexor stretching (McKenzie Principle), postural balance exercises, hip musculature strengthening to decrease loading of the labrum, aerobic exercise, and hamstring/abdominal strengthening to promote a posterior pelvic tilt. Providing effective

physical therapy for the treatment of FAI will lead to increased function and quality of life for patients while also decreasing the cost of care.

CHAPTER II

CASE DESCRIPTION

A 15-year-old male student athlete who presented to physical therapy with left anterior and lateral hip pain. The left hip pain started approximately five months prior during the lacrosse season and progressively worsened since. He did not recall a specific injury that caused his pain but rather a gradual onset of symptoms. The patient reported no previous history of injury to his back, hip, knee, or ankles prior to this episode. His main difficulties included negotiating stairs, lifting, bending, and sprinting. He had pain when sleeping on his left side, however he was able to fall back to sleep upon repositioning.

Past medical history for this patient included Wolff-Parkinson-White (WPW) syndrome caused by an extra electrical pathway between the atria and ventricles resulting in a rapid heartbeat. The WPW syndrome was treated medically using radiofrequency catheter ablation therapy years before the FAI symptoms. If performed correctly, radiofrequency ablation should permanently correct heart-rhythm issues in the majority of individuals with WPW syndrome.[13]

Medications the patient was taking included nonsteroidal anti-inflammatory drugs (NSAIDs) for pain management. No imaging was performed prior to treatment and the patient reported good health overall. The patient reported an active lifestyle and appeared to be in good general health without any behavioral risk factors such as smoking or

drinking. He did not require any assistance to complete activities of daily living, however his left hip pain was affecting his participation in school, ability to complete chores at home, as well as recreational activities with friends.

The patient reported hobbies and recreational activities of fishing, lacrosse, football, and basketball. Although he was not currently employed, he did report that he was required to help with daily chores around the house which involved heavy lifting and bending. Transportation and housing were provided by the patient's parents. He resided with his mother, father and sister in a two-story house with his room being on the second level. This was particularly difficult for the patient since stairs required hip flexion that seemed to aggravate his left hip pain. No assistive devices or braces were utilized by the patient and he indicated no previous treatments for his left hip pain.

Goals for the patient and his family were to decrease his left hip pain in order to allow him to complete his activities of daily living with no pain and enable him to fully participate in physical activities at school. The patient also stated he wanted to return to extracurricular sports and negotiate stairs without left hip pain. Due to the patient's stable health condition and willingness to participate in therapy a thorough examination and evaluation were performed.

Examination

The examination performed was based on the McKenzie Method of Mechanical Diagnosis and Therapy. The McKenzie Method is a system of musculoskeletal care which emphasizes patient empowerment and self-treatment. This system of diagnosis and patient management has been shown to be effective for a variety of musculoskeletal

conditions of the spine and extremities.[14] The McKenzie Method focuses on how patients respond to repeated movements in particular directions to determine directional preferences for movement patterns as well as differentiating between dysfunctions and derangements of the spine and extremities.

He described his pain on a scale from 0-10 (0 = no pain and 10 = worst pain ever experienced) as a constant ache 1/10 in his anterior left hip at rest, with the pain increasing to a 5/10 with sprinting or stairs, and 8/10 when playing sports. Table 1 below describes the patient's response to various positions and how his symptoms changed throughout the day.

Table 1. Patient response of symptoms during various positions throughout the day.

Response to:	Symptoms: Same, Better, Worse
Bending	Worse
Sitting	Same
Rising	Same
First Few Steps	Same
Standing	Worse
Walking	Worse
Stairs	Worse
AM	Same
PM	Same
Stationary	Same
On the Move	Worse
Sleeping	Worse when he sleeps on his left side

It was noted upon initial observation that the patient demonstrated poor seated posture with rounded shoulders and a forward head. Lumbar active range of motion (ROM) was found to be within normal limits, as well as active bilateral knee and ankle ROM and strength. There were no neurological or sensory deficits noted upon palpation and sensory testing. The patient's active and passive hip ROM were measured using a goniometer and can be found in Table 2.

The patient demonstrated decreased left hip active range of motion into flexion, while internal rotation resulted in end range pain. There was weakness bilaterally for hip abduction, internal rotation, and flexion with the left hip being weaker than the right. The pain increased with movement and was only relieved when the patient was at rest.

Table 2. Initial Hip Range of Motion for Right and Left Lower Extremities (degrees)

Hip Motion	Left (Involved)	Right
Flexion	85 (AROM) pain 110 (PROM) pain	115 (AROM) 120 (PROM)
Extension	18 (AROM) pain	18 (AROM)
Abduction	42 (AROM)	44 (AROM)
Internal Rotation	25 (AROM) pain 30 (PROM) pain	35 (AROM) 40 (PROM)
External Rotation	43 (AROM)	44 (AROM)

Hip ROM and strength were tested utilizing manual muscle testing methods described in "*Cram sessions in goniometry and manual muscle testing.*"[15] The results of the patient's hip strength manual muscle testing can be found in Table 3.

Table 3. Manual Muscle Test Results for Hip Motions at Initial Evaluation

Hip Motion	Left	Right
Flexion	3/5 pain	4/5
Extension	4/5 pain	4/5
Abduction	3/5 pain	4/5
Internal Rotation	4/5 pain	5/5
External Rotation	4/5	5/5

Special tests performed to aid in the potential diagnosis of femoroacetabular impingement included the FADIR and FABER tests. The FADIR test was positive on the left with increased pain and a pinching sensation in the anterior left hip. The FADIR test has a sensitivity of 99% and a specificity of 5%.[16] The FABER test was also positive on the left with the knee remaining above the opposite leg in the testing position with increased tightness noted in the anterior hip and groin. The FABER test has a sensitivity of 82% and a positive predictive value of 0.46 (95% CI).[17]

Evaluation, Diagnosis, and Prognosis

Based on the subjective and objective information gathered it was determined that the patient had symptoms consistent with femoroacetabular impingement of the left hip. These symptoms included limited left hip ROM, specifically hip flexion, and internal rotation in addition to increased left anterior hip pain with movement. FABER and FADIR tests were also positive for this patient's left hip. FAI is also more common in young male athletes and the gradual onset of symptoms during repetitive microtrauma while playing lacrosse may have further provided evidence that the patient had left hip

FAI. The lumbar spine was screened and determined to have normal AROM and the location of pain being in the patient's anterior hip. Pathology of the knee and ankle were also ruled out since they do not generally refer to pain to the anterior hip and there were no limitations observed at these joints.

A problem list was created after identifying difficulties the patient was experiencing due to his FAI (see Table 4). Using the *Guide to Physical Therapy Practice*, the patient was placed in the Practice Pattern of 4D: Impaired Joint Mobility, Motor Function, Muscle Performance, and Range of Motion Associated With Connective Tissue Dysfunction.[18] The ICD-10 code for femoroacetabular impingement is M25.859 719.95.

Table 4. Listing of patient reported problems for review

Problems:
• Pain • Decreased L hip ROM • Decreased L hip strength • Difficulty negotiating stairs • Trouble carrying heavy objects, bending, and sprinting. • Unable to participate in physical activities at school • Activities of daily living and repetitive chores tend to aggravate his left hip pain • Anteriorly tilted pelvis • Poor seated posture- rounded shoulders and forward head

Goals for this patient included increased left hip ROM, increased strength, and decreased left hip pain to allow the patient to return to his prior level of function. The SMART goals written for this patient include:

1. Following PT intervention, the patient will demonstrate pain-free left hip flexion of 120° to restore normal gait pattern when ascending stairs within 6 weeks time.

2. Following PT intervention, the patient will demonstrate 5/5 bilateral hip strength for all motions with manual muscle testing in order to fully participate in physical education classes at school within 6 weeks time.

The patient was deemed appropriate for physical therapy treatment following a thorough examination and evaluation. The patient's prognosis was good to excellent due to his active lifestyle, familial support, as well as his motivation to decrease pain and return to sports and recreational activities with friends.

CHAPTER III

INTERVENTIONS

The patient was seen twice a week for 45-minute sessions in outpatient physical therapy over a period of six weeks. His rehabilitation program consisted of patient education, core strengthening, hip flexor stretching (McKenzie Principle), hip musculature strengthening, postural balance exercises, neuromuscular re-education, functional lower limb strengthening as well as a personalized home exercise program.

Therapy sessions were carried out in the late afternoon to accommodate the patient's school schedule as well as his parents' work hours. Initial treatment included the following abdominal and hip strengthening exercises: pelvic tilts in supine with verbal and tactile cueing to achieve proper posterior pelvic rotation, and left hip abduction in side-lying position. The first week of therapy the patient was instructed to perform a home exercise program consisting of alternating single leg bridges, and side-lying hip abduction, 2 sets of 15 reps per exercise to be completed 2 times per day.

The second and third week of therapy the patient progressed with repeated hip extension in half kneeling to stretch the hip flexors to help promote a posterior pelvic tilt. Sidesteps with TheraBand above the knees and single leg step downs with a 4" step were also added to strengthen the bilateral hip musculature. At the end of the third week active left hip flexion improved to 105° with decreased pain and active left hip internal rotation increased to 30°. The patient no longer had left hip pain at rest, but did report 4/10 left hip pain with running and squatting.

During weeks 4-6, an emphasis was placed on functional strengthening of hip and abdominal musculature in weight bearing. Following a five minute warm-up on the upright stationary bike the following exercises were added to the patient's treatment sessions: repeated hip extension in half kneeling, bridging with alternating leg lifts, lumbar/hip extensions using an exercise ball, side crunches on an exercise ball, wall squats, box jumps, and lunges. At home the patient was instructed to perform repeated hip extension in half kneeling, bridging with alternating leg lifts, and sidesteps with a TheraBand above his ankles.

The promotion of a posterior pelvic tilt, a key treatment for FAI, was incorporated throughout all interventions. Stretching of the hip flexors (McKenzie Principle), and hip musculature strengthening provided necessary range of motion and strength to decrease loading of the labrum. Core strengthening improved necessary stabilizing forces while postural balance, and aerobic exercises provided dynamic opportunities to practice posterior pelvic positioning. Both hamstring and abdominal strengthening are thought to encourage correct pelvic alignment. The emphasis towards posterior pelvic tilting is thought to lead to more space between the acetabulum and proximal femur thereby reducing the limitation occurring from the premature contact between these two structures. A case study published in the *Journal of Physical Therapy Science* also found that strengthening of the rectus abdominis, hamstring, and gluteal musculature lead to a greater posterior pelvic tilt.[19]

Hip-specific and functional lower limb strengthening, core stability and postural balance exercises are recommended by Casertelli et al. They found that improving the dynamic stability of the hip leads to decreased loading of the labrum which in turn

downregulates nociceptive neurotransmitters. Strengthening may also help decrease the generalized inflammation in the hip joint that is common with FAI.[5]

Wall et al developed a conservative care protocol based on a systematic review of the literature and a Delphi study group. This protocol included four main components: patient education, patient assessment, help with pain relief, and an exercise-based hip program.[4] The patient education component included relative rest and lifestyle/ADL/sport modifications to try to avoid FAI such as avoidance of deep hip flexion, adduction and internal rotation The exercise program recommends beginning with muscle control of the pelvis, hip, glutes, and abdominals and progressing to non-vigorous stretching of the hip external rotators, and flexors. As the patient progresses, they suggest functional strengthening of the glutes, external rotators, abdominals and lower limb in general.[4]

The interventions that were carried out in therapy corresponded well to the current literature available on the conservative treatment of FAI. It was evident the patient responded well to the interventions performed as the patient's hip ROM, strength and function increased while pain decreased over the six-week period of physical therapy intervention.

CHAPTER IV

OUTCOMES

The outcomes for the patient were excellent due to the utilization of evidence based interventions as well as the patient's age, activity level, motivation, and family support. Objective and subjective outcome measures were utilized to measure the effectiveness of physical therapy. These measurements included hip strength, ROM, pain level, exercise endurance, and Lower Extremity Functional Scale (LEFS).

Following treatment the patient demonstrated increased left hip ROM, and strength as well as 0/10 left hip pain with all ADLs. He was also able to fully participate in sports and recreational activities pain-free. Improvements made in left hip strength and ROM can be found in Table 5 and Table 6. Following physical therapy, the patient's Lower Extremity Functional Scale score increased from a 44/80 at initial evaluation to a 76/80 at discharge. The minimum clinically important difference for the LEFS is 9 points meaning clinicians can be confident that they produced a meaningful functional change.[20] Therefore, it can be inferred that the physical therapy provided substantially improved the patient's function.

The physical therapy goals that were met by discharge included: pain-free left hip flexion of 120° in order to restore normal gait pattern when ascending stairs, and 5/5 bilateral hip strength for all motions with manual muscle testing in order to fully participate in physical education classes. All physical therapy goals were met by discharge at 6-weeks time. Based on the patient's exercise compliance, age, and

motivation it is reasonable to predict maintenance of his pain-free status and improvements in daily functioning. The patient was provided a thorough home exercise program to continue on his own and was instructed to call or message his physical therapist with any further questions regarding his condition. Overall the patient expressed satisfaction with the physical therapy interventions he was provided.

Table 5. Discharge Hip Range of Motion for Right and Left Lower Extremities (degrees)

Hip Motion	Left (Involved)	Right
Flexion	120 (AROM) 120 (PROM)	120 (AROM) 125 (PROM)
Extension	19 (AROM)	20 (AROM)
Abduction	44 (AROM)	45 (AROM)
Internal Rotation	35 (AROM) 40 (PROM)	35 (AROM) 40 (PROM)
External Rotation	44 (AROM)	44 (AROM)

Table 6. Manual Muscle Test Results for Hip Motions at Discharge

	Left	Right
Flexion	5/5	5/5
Extension	5/5	5/5
Abduction	5/5	5/5
Internal Rotation	5/5	5/5
External Rotation	5/5	5/5

CHAPTER V

DISCUSSION

During the patient's physical therapy treatment he achieved significant gains in ROM, muscle strength and function while decreasing his left hip pain. Barring any future injuries, it is reasonable to expect the patient to fully participate in all activities of daily living including sports and recreational activities pain-free, without limitations. It can be inferred from the information gathered in this case study that core strengthening, hip flexor stretching, postural balance exercises, hip musculature strengthening, aerobic exercise, and hamstring/abdominal strengthening were effective for the treatment of FAI in a 15-year old male student athlete.

The interventions for strengthening carried out in this case study are thought to decrease loading of the labrum leading to downregulation of nociceptive neurotransmitters in the labrum.[5] In addition, the interventions are theorized to promote a position of posterior pelvic tilt that should result in more space between the acetabulum and proximal femur thereby reducing the limitations occurring from the premature contact between these two structures.[19] Patient education was a vital component of treatment in order to ensure the patient understood the biomechanical rationale behind the exercises he was being asked to perform.

A randomized control trial by Palmer et al. found that arthroscopic hip surgery produced superior outcomes compared to physical therapy and activity modifications for

the treatment of FAI. The primary outcome measure was the hip outcome score activities of daily living subscale (HOS ADL) at eight months post-randomization.[10] Although they found that surgical interventions led to better outcomes there are some important limitations of the study that should be discussed. Patients in the physical therapy group were only provided eight therapy sessions over a period of five months and the experience or qualifications of the physical therapists were not clearly described. The trial also focused on patients with more severe FAI symptoms rather than those with minimal to moderate symptoms that physical therapists are more likely to treat in the clinic. There is also the potential for a placebo effect for individuals in the surgical group since blinding was not possible. The study did go on to recommend physical therapy as a first line treatment due to decreased costs and reduced potential for complications. If the patient's hip FAI does not improve with conservative management, they then recommend hip arthroscopic surgery for superior outcomes. This trial emphasized the importance of developing effective treatment intervention protocols for hip FAI to help patients manage their FAI before they become more severe and lead to surgery and increased medical costs for patients.

A systematic review by Mallets et al. demonstrated that physical therapy consisting of patient education, activity modifications, manual therapy and strengthening is effective in decreasing pain and improving function. They also found that physical therapy interventions were shown to have a greater impact on a patient's symptoms and function than intra-articular injection alone.[21] The authors did point out that there is currently a limited number of high quality articles on this topic and further research into the most effective interventions is still necessary.

Due to the increasing prevalence of FAI and the number of patients undergoing arthroscopic hip surgery, it's vital that we understand which interventions are best for the treatment of FAI. The protocol for non-operative care for patients with FAI developed by Wall et al. offers guidance to clinicians and researchers in an area with a paucity of high-quality research. The aim of their future research is to provide a standard of conservative care in which arthroscopic surgery can be compared.[4]

This case study seeks to provide further evidence into the effectiveness of physical therapy as a first line treatment for FAI. In addition, the case study attempts to explain the physiological and biomechanical reasoning behind the interventions performed. Further research into the most effective conservative care is still necessary and is currently being performed.

Reflective Practice

Reflecting on the initial examination and evaluation I believe all pertinent subjective information related to the patient history was gathered. One examination procedure that could have been potentially included in the examination is the hip scour test to test for a labral tear. The patient likely could have progressed to more advanced functional activities earlier in his therapy however the aim was to avoid aggravating the patient's symptoms and encouraging exercise compliance with simple exercises that could be easily incorporated into his daily routine.

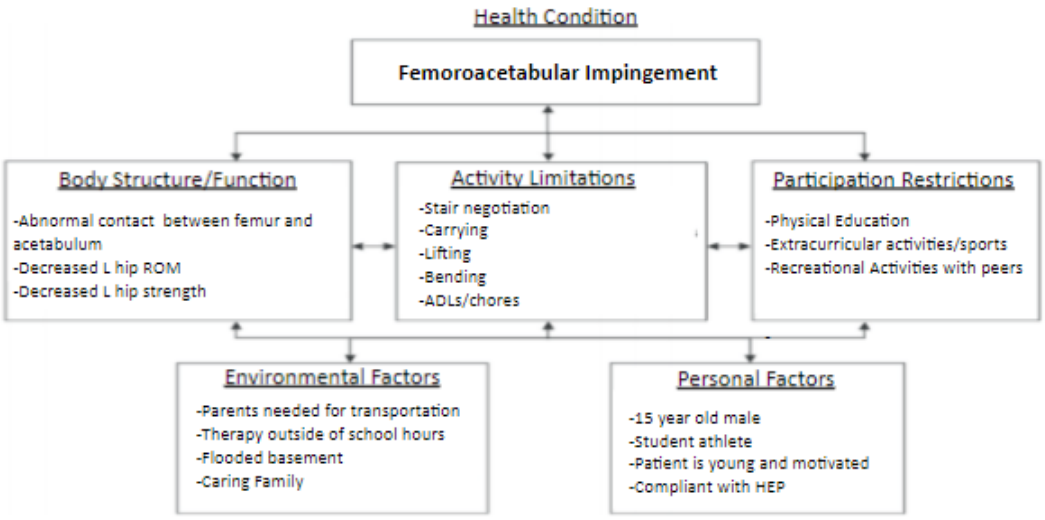
Despite the paucity of evidence on the most effective interventions for the treatment of FAI, the treatment interventions chosen yielded excellent outcomes and were backed by the most current evidence-based literature on the subject. Current studies are

underway to help further elucidate the best treatment options to improve patient outcomes. A referral to other disciplines was not necessary in this case evident by the patient's improved function.

The episode of care included 12 treatment session of 30-45 minutes over a period of 6-weeks. The total cost for this episode of care was estimated around $901, meaning the average cost per session was approximately $75. After insurance, the total cost to the patient was calculated to be $180. Based on the outcomes and dramatic increase in function I believe the cost was more than reasonable. I could potentially have reduced costs to the patient by discharging at an earlier date however, the patient still required significant cueing for proper exercise performance and his exercise needed to be progressed further. In the future I plan on continually reflecting upon the quality of care I provide patients and make sure I stay informed on the most current evidence-based literature.

APPENDIX

Appendix 1. ICF Model for Case Study Patient



REFERENCES

1. The Warwick Agreement on femoroacetabular impingement syndrome (FAI syndrome): an international consensus statement | *British Journal of Sports Medicine* https://bjsm.bmj.com/content/50/19/1169 (accessed 6.25.20).

2. Chaudhry, H., Ayeni, O.R., 2014. The Etiology of Femoroacetabular Impingement. *Sports Health* 6, 157–161. https://doi.org/10.1177/1941738114521576

3. Raveendran, R., Stiller, J.L., Alvarez, C., Renner, J.B., Schwartz, T.A., Arden, N.K., Jordan, J.M., Nelson, A.E., 2018. Population-based prevalence of multiple radiographically-defined hip morphologies: The Johnston County Osteoarthritis Project. *Osteoarthritis Cartilage* 26, 54–61. https://doi.org/10.1016/j.joca.2017.10.002

4. Wall, P.D., Dickenson, E.J., Robinson, D., Hughes, I., Realpe, A., Hobson, R., Griffin, D.R., Foster, N.E., 2016. Personalised Hip Therapy: development of a non-operative protocol to treat femoroacetabular impingement syndrome in the FASHIoN randomised controlled trial. *British Journal of Sports Medicine* 50, 1217–1223. https://doi.org/10.1136/bjsports-2016-096368

5. Casartelli NC, Maffiuletti NA, Bizzini M, Kelly BT, Naal FD, Leunig M. The management of symptomatic femoroacetabular impingement: what is the rationale for non-surgical treatment? *British Journal of Sports Medicine*. 2016 May;50(9):511-2.

6. Ziebarth, K., Balakumar, J., Domayer, S., Kim, Y.J., Millis, M.B., 2011. Bernese Periacetabular Osteotomy in Males: Is There an Increased Risk of Femoroacetabular Impingement (FAI) After Bernese Periacetabular Osteotomy? *Clinical Orthopedic Related Research* 469, 447–453. https://doi.org/10.1007/s11999-010-1544-9

7. Agricola, R., Waarsing, J.H., Arden, N.K., Carr, A.J., Bierma-Zeinstra, S.M.A., Thomas, G.E., Weinans, H., Glyn-Jones, S., 2013. Cam impingement of the hip—a risk factor for hip osteoarthritis. *Nature Reviews Rheumatology* 9, 630–634. https://doi.org/10.1038/nrrheum.2013.114

8. Pollard, T.C.B., Villar, R.N., Norton, M.R., Fern, E.D., Williams, M.R., Simpson, D.J., Murray, D.W., Carr, A.J., 2010. Femoroacetabular impingement and

classification of the cam deformity: the reference interval in normal hips. *Acta Orthopaedica* 81, 134–141. https://doi.org/10.3109/17453671003619011

9. Baker-Lepain, J.C., Lynch, J.A., Parimi, N., McCulloch, C.E., Nevitt, M.C., Corr, M., Lane, N.E., 2012. Variant alleles of the Wnt antagonist FRZB are determinants of hip shape and modify the relationship between hip shape and osteoarthritis. *Arthritis Rheumatology* 64, 1457–1465. https://doi.org/10.1002/art.34526

10. Palmer, A.J.R., Gupta, V.A., Fernquest, S., Rombach, I., Dutton, S.J., Mansour, R., Wood, S., Khanduja, V., Pollard, T.C.B., McCaskie, A.W., Barker, K.L., Andrade, T.J.M.D., Carr, A.J., Beard, D.J., Glyn-Jones, S., 2019. Arthroscopic hip surgery compared with physiotherapy and activity modification for the treatment of symptomatic femoroacetabular impingement: multicentre randomised controlled trial. *British Medical Journal* 364. https://doi.org/10.1136/bmj.l185

11. Enseki, K.R., Kohlrieser, D., 2014. Rehabilitation Following Hip Arthroscopy: An Evolving Process. *International Journal of Sports Physical Therapy* 9, 765–773.

12. Pun, S., Kumar, D., Lane, N.E., 2015. Femoroacetabular Impingement. *Arthritis Rheumatology* 67, 17–27. https://doi.org/10.1002/art.38887

13. Wolff-Parkinson-White (WPW) syndrome - Symptoms and causes Mayo Clinic. https://www.mayoclinic.org/diseases-conditions/wolff-parkinson -white-syndrome/s ymptoms-causes/syc-20354626 (accessed 6.25.20).

14. Namnaqani, F.I., Mashabi, A.S., Yaseen, K.M., Alshehri, M.A., 2019. The effectiveness of McKenzie method compared to manual therapy for treating chronic low back pain: a systematic review. *Journal of Musculoskeletal Neuronal Interactions* 19, 492–499.

15. Ost LV. *Cram session in goniometry and manual muscle testing*. Slack Incorporated; 2013.

16. Reiman, M.P., Goode, A.P., Cook, C.E., Hölmich, P., Thorborg, K., 2015. Diagnostic accuracy of clinical tests for the diagnosis of hip femoroacetabular impingement/labral tear: a systematic review with meta-analysis. *British Journal of Sports Medicine* 49, 811. https://doi.org/10.1136/bjsports-2014-094302

17. Maslowski, E., Sullivan, W., Forster Harwood, J., Gonzalez, P., Kaufman, M., Vidal, A., Akuthota, V., 2010. The diagnostic validity of hip provocation maneuvers to detect intra-articular hip pathology. *Pub Med* R 2, 174–181. https://doi.org/10.1016/j.pmrj. 2010.01.014

18. Guide to Physical Therapist Practice. 3rd ed. *Physical Therapy*. 2015: http://guidetoptpractice. apta.or g/content/1/SEC1.body (accessed 6.25.20)

19. Yoo, W., 2014. Effect of the Individual Strengthening Exercises for Posterior Pelvic Tilt Muscles on Back Pain, Pelvic Angle, and Lumbar ROM of a LBP Patient with Excessive Lordosis: A Case Study. *Journal of Physical Therapy Science* 26, 319–320. https://doi.org/10.1589/jpts.26.319

20. Mehta, S.P., Fulton, A., Quach, C., Thistle, M., Toledo, C., Evans, N.A., 2016. Measurement Properties of the Lower Extremity Functional Scale: A Systematic Review. *Journal of Orthopedic Sports Physical Therapy* 46, 200–216. https://doi.org/10.2519/jospt.2016.6165

21. Mallets, E., Turner, A., Durbin, J., Bader, A., Murray, L., 2019. Short-Term Outcomes Of Conservative Treatment For Femoroacetabular Impingement: A Systematic Review And Meta-Analysis. *International Journal of Sports Physical Therapy* 14, 514–524.