University Football Player with Hoffa's Fat Pad Syndrome: A Disablement Model Case Study

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ABSTRACT

A 23-year-old university football player presented with acute onset anterior knee pain with no distinct mechanism of injury. The pain began soon after the start of fall football camp and prevented the patient from participating in team activities, including weights and practices. Along with pain, the patient experienced edema, decreased knee flexion range of motion, and an antalgic gait. The findings of the evaluation of this patient were consistent with Hoffa's fat pad syndrome, an inflammatory and impingement condition of the infrapatellar fat pad that is often a rare diagnosis of exclusion. Conservative treatment was used for this patient, which included rest, therapeutic rehabilitation exercises, cold modalities, and manual therapies. The patient adhered well to the treatment plan and was attentive and committed to his progress. Within two weeks, the patient was partially participating in team weights, and after a month, the patient was fully participating in practice again. Hoffa's fat pad syndrome is frequently overlooked and not treated properly, although this case and other research have shown that it responds well to conservative treatment. Understanding the role and involvement of the infrapatellar fat pad in anterior knee pain and knee biomechanics can be beneficial in recognizing conditions that affect the fat pad and implementing proper intervention programs that yield positive patient outcomes. Hoffa's fat pad syndrome is a manageable and treatable pathology that should be considered more in differential diagnoses of anterior knee pain.
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INTRODUCTION

Hoffa's fat pad syndrome, a condition of the infrapatellar fat pad of the knee, is a rare diagnosis of anterior knee pain but a rather common occurrence.[1,2] This pathology is often misdiagnosed and is more often used as a diagnosis of exclusion.[1] The infrapatellar fat pad (IFP) is highly vascularized and innervated, contributing to its likelihood of being a source of anterior knee pain, although not often recognized in clinical examination.[3,4] Branches of the femoral, common peroneal, and saphenous nerves supply the IFP. Hoffa's fat pad is an intracapsular structure that fills the anterior compartment of the knee and is bordered by the patella, patellar tendon, proximal tibia, and knee joint synovium.[3,4] The exact function and role of the IFP are unknown and poorly understood. Still, studies suggest that it plays a role in knee biomechanics and reduces friction between the patella, patellar tendon, and deep structures.[1,3,4]

Injury to Hoffa's fat pad, leading to fat pad syndrome, can occur through direct or indirect traumas and chronic microtrauma from repetitive stressors.[3] These mechanisms can lead to inflammation or enlargement of the infrapatellar fat pad and cause impingement in the patellofemoral joint.[2] Patients with an IFP pathology often present with burning or aching infrapatellar anterior knee pain aggravated by physical activity and lessened with rest.[3,4] Through inspection, the fat pad may appear enlarged or have a firm consistency upon palpation.[1,2] Conservative treatment is recommended in the acute stages of Hoffa's fat pad syndrome, commonly rehabilitation-based care.[2-4] Other conservative treatments include taping or bracing, local corticosteroid injections, or avoiding the aggravating sport or activity.[2-4]

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PATIENT INFORMATION

Patient

The patient is a 23-year-old African American male, an in-state student-athlete from a Southeastern United States town. He participates on a NCAA Division II University football team as a defensive end. The patient consistently engaged in practices and team weights during fall football camp when he reported to the athletic training facility with insidious onset anterior knee pain, tenderness, and swelling along the front of his left knee. Before attending the University, the patient underwent left anterior cruciate ligament (ACL) reconstruction and meniscus tear surgery. In addition, he has had imaging done for his heart, which resulted in a heart murmur diagnosis, but he has no cardiovascular complications in his family history. The patient has no history of sickle cell trait. The injury occurred on August 11th, 2021, two weeks after beginning football camp. The patient returned to weights about a week after beginning treatment and returned to full sport participation about a month after treatment.

Differential Diagnosis and Evaluation

Examination of the patient showed obvious swelling along the anterior knee, no bony abnormalities, and palpable tenderness along the patellar tendon. Functionally, the patient experienced a decreased active range of motion with knee flexion due to pain but no changes in knee extension. When compared bilaterally, internal rotation, external rotation, flexion, extension, adduction, and hip abduction were all within normal limits. Similarly, the patient had decreased passive range of motion with knee flexion due to pain, no change in knee extension, and internal rotation, external rotation, adduction, abduction, and hip extension were all within normal limits when compared bilaterally. For the resistive range of motion, the patient had some discomfort with knee flexion, and hip external rotation caused some discomfort. Hip internal rotation, adduction, abduction, extension, and knee extension were all within normal limits when compared bilaterally. Manual muscle tests for the patient were rated 5/5 for flexion, extension, internal rotation, external rotation, adduction, and abduction. Selective tissue tests done included Thessaly's, McMurray's, Lachman's, Anterior Drawer, Posterior Drawer, Valgus Stress, Varus Stress, Lellis, Apley's Compression and Distraction, Bouncehome, Dial, Slocum, Bump, Compression, Ballotable, and Hoffa's test. Only Ballotable and Hoffa's tests yielded a positive result, with McMurray's causing some discomfort on the medial meniscus and Valgus Stress causing some pain along the patellar tendon. Differential diagnoses for this patient were Hoffa's fat pad syndrome, medial meniscus injury, patellar tendonitis (jumper's knee), and potential chondromalacia of patellar cartilage. The plan was to refer for MRI/imaging if the pain persisted and begin conservative treatment.

Body Structure and Function

This case involves moderate impairment of the musculoskeletal system, specifically of the left lower extremity or left knee. The patient reported no acute injury mechanism, just sudden pain, extreme tenderness, and swelling along the front of his left knee. The patient said there was some numbness along his patellar tendon scar and tingling along the surface but said that it has been going on since he was one month cleared post-surgical for his ACL and meniscus tears. The patient explained that before this happened, he got scraping, an ace wrap, ice, and took Ibuprofen for it, and it helped, but now it is not working. The patient reported his pain at a 7/10 on the Numeric Pain Rating Scale at the onset of pain and a 2/10 at rest for evaluation. The patient score from the 2000 IKDC Subjective Knee Evaluation Form patient-reported outcome was 15, indicating a low knee functionality. The IKDC Subjective Knee Evaluation was designed to assess symptoms and function in activities of daily living for individuals with various knee pathologies.[5]

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Activity and Participation

The symptoms of the patient's injury impacted his participation in team activities and social activities in different ways. The patient described activity limitations when he said he could not bend his left knee as much. He also said he walks with a limp due to pain, tried to rest it, and did no activity for the day. The patient exemplified participation restrictions when he could not participate in team weights or practice due to the injury. However, while injured, the patient could still go to work and complete his job as a forklift driver. He was also able to participate in school and Greek life events. The patient reported no other hindrances besides sport-related activity and participation. However, patient responses on the Short Form-36 (SF-36) patient-reported outcome indicated a physical functioning score of 25%, emotional well-being at 36%, social functioning at 50%, and general health at 50%. The Short Form-36 is a multi-item questionnaire designed to assess eight concepts of overall health for patients. These include limitations in physical activity, social activity, normal daily roles, general mental health, bodily pain, vitality, and general health perceptions.[6]

Environmental and Personal Factors

The patient was most concerned about his football participation and ability to remain on the team. Coaches were threatening to cut athletes while the athlete was injured. This made it difficult for him to follow the treatment and rehabilitation plan because it required him to be removed from practices and weights. Still, he understood that he would return faster and better if he followed the clinician's protocol instead of trying to push through the disability. The patient has a strong family background, familial support, and good health insurance and transportation, so he could attend all treatment and rehabilitation sessions and was willing to be sent to the physician's office for imaging if conservative treatment proved unsuccessful. The area of life most affected by the patient's disability was sport and team participation. This was crucial to the patient because of the coaches' cutting players from the team and the fear that his attendance in the athletic training facility would be seen as a weakness and avoidance of the team. This contributed to the low emotional well-being score and the low social functioning score on the SF-36.

INTERVENTIONS

The patient was removed from all activity until pain decreased and he could transition back into weights. The patient received compression with a neoprene style knee sleeve, compression, ice and ultrasound modalities, and performed rehabilitation exercises daily for his knee to increase strength and stability. Therapeutic exercises included progressive quadriceps and hip-focused exercises for stability and appropriate vastus medialis oblique activation. Examples include heel slides, quad sets, 4-way hips, single-leg balance, mini squats, lunges, single-leg Russian deadlifts, and star excursions. Referral was to be done if the patient showed no signs of improvement with treatment or the condition worsened. The patient responded well to conservative treatment, and a referral was unnecessary.

OUTCOMES

Body Structure and Function

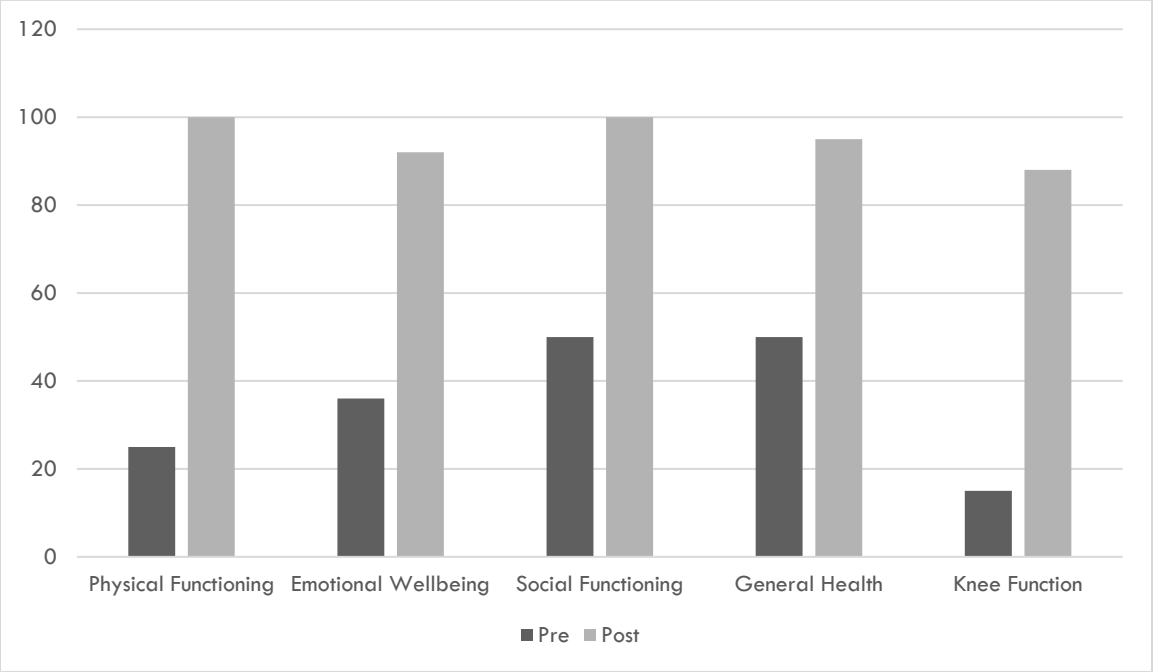
The patient came in for a follow-up evaluation after returning to weights with little to no impairment. The patient reported no pain with knee flexion. The patient also had a full range of motion, with knee flexion within normal limits when compared bilaterally. The patient still reported some tenderness with palpation along the patellar tendon and tibial tuberosity. Upon re-evaluation, Valgus Stress, Bouncehome, McMurray's for medial meniscus, and patellar mobilizations yielded positive test results. Varus Stress, Ballotable, and

Clark's Sign yielded negative test results. The patient's score on the 2000 IKDC Subjective Knee Evaluation patient-reported outcome increased to 88, indicating greater knee functionality after treatment interventions.

Activity and Participation

The patient could resume participation in weights after one full week of rehab and treatment. He performed modified lower extremity movements and progressed to no modification and full participation in team weights. The patient then began a graduated return to play football, beginning with non-contact drills at practice. The patient continued work as a forklift driver without issues and was fully participating in class, school, and Greek life extracurricular activities. Percentages on the Short Form-36 patient-reported outcome increased to 100% for physical functioning, 92% for emotional well-being, 100% for social functioning, and 95% for general health, suggesting that increasing team participation and cohesion was incredibly beneficial for the patient's overall sense of well-being. Comparisons of pre-to-post objective findings for function and quality of life are presented in **Table 1.**

Table 1. Pre-to-post Objective Findings



Physical functioning, emotional well-being, social functioning, and general health were measured in SF-36 and presented in percentages (0-100%). Knee function was measured using the IKDC Subjective Knee Evaluation and presented as a score of function with 0=low function to 100=high function.

Environmental and Personal Factors

The patient was consistent with treatment, coming in each day for either therapeutic exercises or treatment. The patient progressed well through rehabilitation and tolerated all prescribed treatments well. The patient did experience some anxiety and pressure from the coaches while rehabilitating his knee because the coaches were making cuts during this part of the season, and the patient's position on the team was at risk. Although the sports medicine clinicians assured the coaches that the patient was adhering well to rehabilitation, putting in good work, and progressing, the patient was still concerned that he would be let

go. Figure 1 below outlines the factors involved in this case that affected the patient and their outcomes based on the ICF disablement model.[7]

DISCUSSION

This case study is unique because it involves a rarely diagnosed but often occurring pathology. Often a diagnosis of exclusion, Hoffa's fat pad syndrome is frequently overlooked and not treated correctly. Individuals who experience patellar maltracking are predisposed to Hoffa's fat pad syndrome. However, there has been research done about the role and effect of the infrapatellar fat pad in knee function and anterior knee pain. One such study, which is of particular interest to this case study, examined the volume of the infrapatellar fat pad 6 to 12 months post anterior cruciate ligament reconstruction surgery. Results described an increase in the volume of the infrapatellar fat pad between 6 and 12 months in the reconstructed limb, but the volume remained less than that of the fat pad in the uninjured limb at 12 months. Additionally, greater increases in infrapatellar fat pad volume between 6 and 12 months post-reconstruction were related to better knee function at six months as measured by the IKDC.[8] Considering the limb-specific medical history of the patient in this case study, he may have been experiencing poor knee function, anterior knee pain, and Hoffa's fat pad syndrome due to post-surgical effects on his infrapatellar fat pad. Hoffa's fat pad syndrome was diagnosed by the clinicians in this case study due to the activity limitations and body functions affected in the patient. A study examining the effect of infrapatellar fat pad edema on knee biomechanics and kinematics and its relation to anterior knee pain reported findings of increased infrapatellar fat pad pressure, with the highest increase in pressure occurring around 113 degrees of flexion.[9] These findings are consistent with Hoffa's syndrome and anterior knee pain that decreases flexion due to pain and is exacerbated by chronic mechanical impingement of the fat pad in knee flexion and extension.

This case study presented with strengths and limitations. For example, the conservative treatment chosen to treat the diagnosis of Hoffa's fat pad syndrome proved successful and provided quick results for the patient. This was a strength in the approach to this specific case. Another benefit of this treatment approach was that it could be beneficial but, most importantly, would not be harmful to any of the differential diagnoses presented in the case. Therefore, the patient was not physically at risk by participating in the treatment and rehabilitation protocol designed by the clinicians. The patient was also committed to his rehabilitation and had the necessary means to attend treatment sessions and any appointments that may have been arranged. The patient was easily educated about his condition and communicated well with the clinicians, which encouraged favorable outcomes in this case. On the other hand, the lack of imaging provided in the case because the referral was not initially indicated could be considered a limitation when examining the diagnosis made in this case. The diagnosis was made primarily based on clinical findings and physical evaluation, as well as subjective reported symptoms. Although Hoffa's fat pad syndrome does not present significant findings with common imaging techniques and is usually considered when nothing else remarkable is present on radiographic images, MRIs will occasionally reveal structural abnormalities of the infrapatellar fat pad. However, these findings are commonly benign or do not relate to a present pathology. This makes diagnosis by imaging difficult. In this specific case study, it may have been beneficial if there were abnormalities present in the infrapatellar fat pad of the post-surgical knee compared to the uninjured limb, which could then be compared to the evaluation findings and activity limitations. Another limitation of this study was that the previous ACL and meniscus tear, reconstruction surgery, and post-surgical rehabilitation were completed prior to the patient matriculating to the University. Thus, it was difficult for the clinicians to reflect on the previous maintenance, treatment, and rehabilitation of the patient's knee in the diagnosis or treatment of his new pathology.

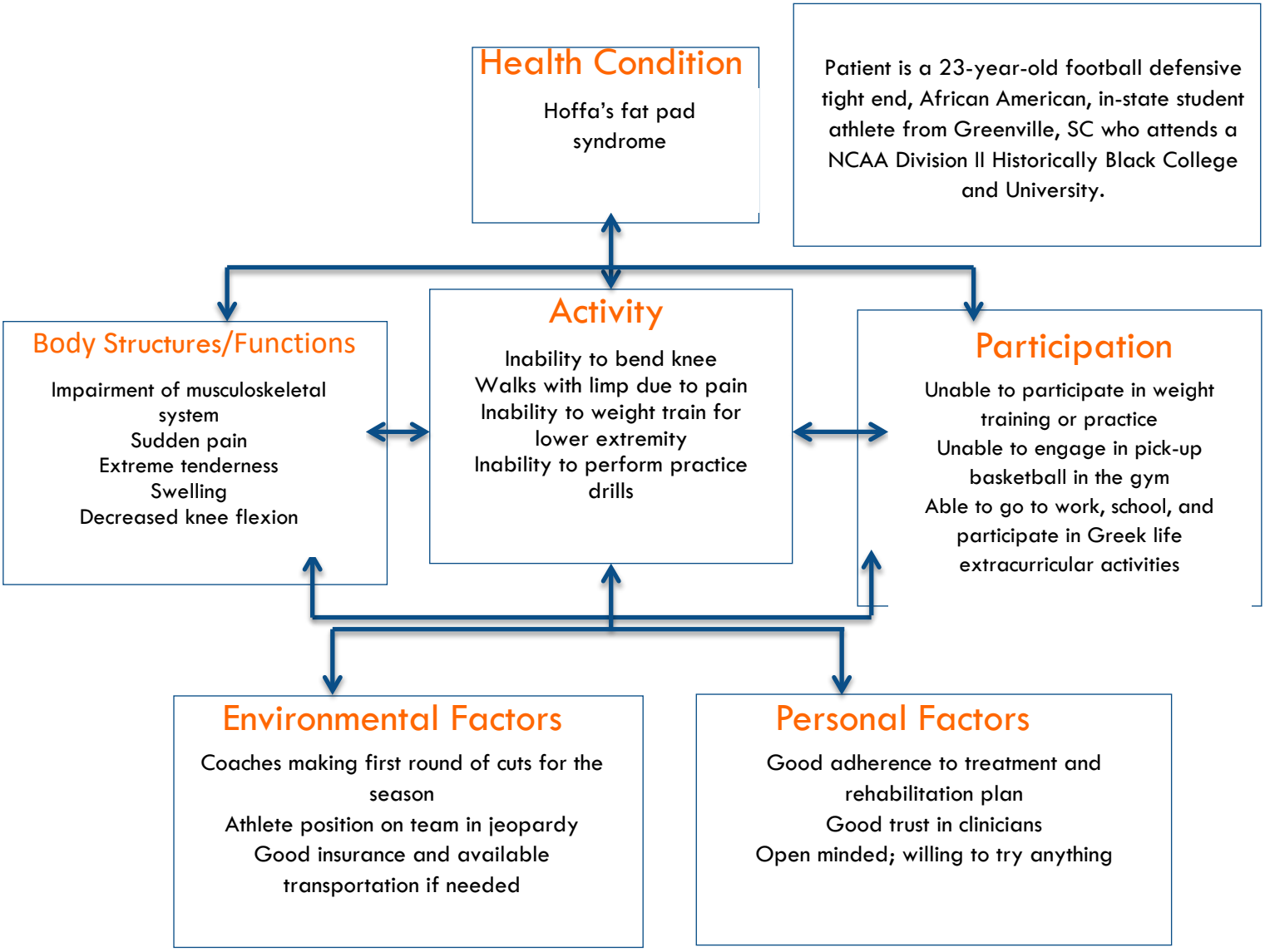


Figure 1: ICF Disablement Model for Case Study Patient[7]

Further research with the ability to follow patients longitudinally after an ACL tear or reconstruction could offer more insight into uncommonly diagnosed complications experienced after surgery. Additionally, future research examining the change in the size and quality of the infrapatellar fat pad over time in sporting populations could be beneficial to better understanding and managing this uncommon diagnosis.

The patient returned to partial participation within two weeks and full participation within a month; however, he continued to face the threat of being cut from the team. The clinicians chose an aggressive conservative treatment approach because of this threat, so the patient would not have to wait for appointments, imaging arrangements, and follow-ups before re-engaging in team activity. Since the patient showed promise during the initial stages of rehabilitation, the clinicians for this case decided not to refer the patient for imaging and potentially slow his progress. The patient's goal was to return to activity as soon as possible so he could

continue to fight for his spot on the University football team. The clinician's goal was to ensure the patient returned to sport safely and was supported physically, mentally, and emotionally throughout the process.

CLINICAL BOTTOM LINE

Hoffa's fat pad syndrome is a commonly missed diagnosis but a manageable and treatable pathology by athletic trainers. It should be considered more often in cases of anterior knee pain and especially in cases of patients who have a history of ACL reconstruction. Because anterior knee pain can be present in many different conditions, it is important for clinicians to have a good understanding of the activity limitations and specific movements that are restricted for the patient. This can help narrow differential diagnoses and focus treatment plans appropriately. Additionally, conservative treatment for this condition demonstrates favorable patient outcomes and is not harmful to differential diagnoses of anterior knee pain. Therefore, conservative treatment can be implemented in similar cases to achieve good clinical outcomes. It is important that the management of Hoffa's fat pad syndrome is accompanied by good patient education about maintenance rehabilitation and understanding the chronic or traumatic stressors that may exacerbate the infrapatellar fat pad in the future.

PATIENT PERSPECTIVE

When reviewing the case with the patient, he said that he "felt like my knee was the problem limiting my skills" on the football team. He detailed that he believed his injury was "more hurting the team than helping it" or that if his "knee doesn't get better, I might get cut from the team." This led to feelings of anxiety, frustration, and fear. He confided in the sports medicine staff that "even though I am trying everything, I am still failing" and that "I am letting people down and not doing what I said I would do for my teammates and coaches." However, instead of allowing his diminishing mental state to discourage his recovery, the patient said it "encouraged me to stay focused on treatments and try different things" and to "go harder on sets and do more sets a day." The patient shared that his overall goal was "to stop having knee pain when doing rigorous activity in any sense," including pick-up basketball in the University gym. He claimed that he felt the most change and recovery from the rehabilitation exercises and the cold/compression modality treatment. The patient said, "after a week or two, I could feel the difference" from the intervention. The patient shared that he had great support from the athletic trainers, who were like a "family away from home," and that he could comfortably confide in the sports medicine staff, which helped his adherence to the intervention program. Once the patient was able to reintegrate into activity, beginning with team weights, he revealed that "I was very happy and able to focus on something other than my knee injury. I felt like part of the team again and was able to start getting stronger and build my knee up." Overall, the patient was pleased with the evaluation, intervention program, and outcomes, as he was able to play the rest of the season as a defensive tight end on the University football team.

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