Rehabilitation of an ACL injury in a 29 year old male with closed kinetic chain exercises: A case study

Abstract

Objective: This paper will examine a rehabilitation program for a healthy 29 year old male who sustained an incomplete tear of the left ACL.

Results: Following a 9 week treatment plan focusing on active rehabilitation, utilizing closed kinetic chain and proprioceptive exercises a reported 95% resolution of the primary complaint of knee pain and subjective instability was reported with the patient resuming pre injury activity levels.

Discussion: Conservative care, specifically rehabilitation is a mainstay treatment for ACL injuries. There is little consensus as to the type and duration of exercise for an ACL injury. It was found that closed chain kinetic exercises with a focus on increasing both strength and endurance in the quadriceps and hamstring musculature as well as increasing proprioception, was effective in treating this isolated, incomplete ACL injury.

Key words/MeSH terms: Anterior cruciate ligament, rehabilitation, sports injury, knee

Introduction

Knee injuries among the most common types of injuries seen in practice, with approximately 33% of people reporting a previous history of knee injury. Knee injuries can be seen in both contact and non contact sports and both acute and chronic overuse injuries are commonly treated with conservative care. Acute injuries can occur with acceleration, deceleration, pivoting, jumping and of course traumatic impact. Chronic overuse injuries are more commonly attributed to overuse injuries and are often the result of poor biomechanics and previous history of injury to the knee.[1] It has been demonstrated in the literature that the tibiofemoral shear force produced by the knee is more posteriorly located during muscle activity and the magnitude of the posterior shear force increases with increased knee flexion during closed kinetic chain exercises, whereas the magnitude of the resultant shear forces produced on the knee is maximal during open kinetic chain exercises. Therefore the type of exercise that are prescribed to patients with knee injuries is an important consideration when rehabilitating a knee injury.[1] Closed kinetic chain exercises are often utilized as more functional exercises that can help protect the knee, specifically the anterior cruciate ligament (ACL), from excessive strain while restoring lower extremity muscle strength.[2] Rehabilitation programs are therefore designed with the following goals post knee injury, to increase muscular strength, re-establish joint mobility and neuromuscular control and to enable patients to return to pre injury activity levels.[2]

Case Report

A 29 year old healthy male presented to the clinic with a primary complaint of left knee pain. The patient reported injuring his left knee approximately 5 weeks previously, while playing soccer. The patient believed that the injury occurred when pivoting on his left leg to get out of

the way of another player in order to avoid a collision. Immediately following the mechanism of injury, the patient reported that there was no pain, however, as he continued playing, his knee pain progressively increased. Following the game the patient began to experience difficulty with weight bearing on the affected leg and by that night the patient was unable to sleep due to left knee pain. The patient presented to his medical doctor the following day and was told the injury could not be properly diagnosed. No imaging was done to his affected knee. The patient denied any prior history of left knee injuries. Although the patient has experienced an improvement of approximately 65% since the time of the initial injury, he has not played soccer since incurring the trauma. The area of pain was described as "deep within the joint" and localized to the posterior aspect of the knee.

During physical examination of the affected knee, it was found that the patient was unable to fully flex knee to get into the duck waddle position due to pain and was therefore unable to take any steps. During range of motion of the left knee, flexion reproduced the chief complaint at end range actively, with passive overpressure into deep flexion exacerbating the patient's pain. Resisted muscle testing of the left hamstring was positive for the chief complaint of knee pain and was graded 4/5 with associated give way weakness due to pain. Active extension of the knee was full and pain free, however, the patient verbally reported pain with passive over pressure at end range and laxity was noted compared to the right knee with associated muscular guarding. Left quadriceps resisted testing was graded 5/5 and was unremarkable for pain. Laxity was noted in the left knee during anterior drawer compared to right knee with muscular guarding and a pain response noted for the chief complaint. Unremarkable tests included Slocums (with both the foot interanally and externally rotated) and Varus and Valgus stress tests. Palpation of the knee was unremarkable for joint line tenderness and overlying the lateral and medial collateral ligaments, distal quadriceps tendon and bicep femoris, semi-tendinosis and semi-membranosus. The patient reported increased pain and discomfort following the physical examination.

Based upon the history and physical assessment a suspected left ACL 1st degree sprain with associated joint effusion was diagnosed. A two part treatment plan was initiated, a passive component at each appointment including acupuncture (SP 9, ST 35, 36, Extra 2, overlying high point of the VMO) was performed on the left knee with the application of ice directly following for 10 minutes to help decrease the suspected joint effusion and address the primary complaint of knee pain and an active rehabilitation component, beginning with isometric exercises and progressing to closed chain exercises in order to address the muscular strength and conditioning of the affected musculature as well as proprioceptive retraining of the injured mechanoreceptors within and around the left knee. The patient was instructed to ice at home following exercise and to control pain (icing protocols: 10 minutes on, 10 minutes off, 10 minutes off).

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The patient was instructed to perform the strength and conditioning exercises every other day, with as many repetitions as possible with good form and to cease and desist if the chief complaint of left knee was reproduced with any exercise. With the exception of 1 leg balancing, prioprioceptive exercises were performed when the patient presented for his appointments as he did not have access to a BOSU ball, wobble board or other labile surface. Paperwork including pictorial representations and written instructions of each exercise were provided to the patient at each appointment when new exercises were prescribed. New exercises were reviewed at the subsequent appointment following their initial prescription in order to ensure that they were being done with the proper form.

The rehabilitation exercises initially prescribed included seated isometric terminal knee extension at 180 degrees and isometric flexion at approximately 90 degrees, two leg pelvic bridging and wall sits. More advanced exercises including bridging on an exercise ball and straight legged dead lifts while holding 20lbs, hamstring curls on an exercise ball and balancing on the dome and flat surface of a BOSU ball with both 2 feet and 1 leg standing on the affected left leg, while catching and throwing a ball to a partner, were prescribed accordingly as the patient advanced through the rehabilitation program. Additional proprioceptive exercises included 1 legged standing on a labile surface (balance discs and balance pods) and 1 leg and 2 leg standing on a wobble board were prescribed once the patient's subjective instability allowed him to perform them with good form.

When the patient reported feeling approximately 95% improved, he was discharged from an active treatment plan and was advised to maintain the rehabilitation plan in order to maintain the strength and conditioning of stabilizing musculature of his knee.

Discussion

The knee is comprised of three compartments that have a common synovial cavity. Of the three, the medial and lateral tibiofemoral compartments are involved with weight bearing, where are the patellofemoral compartment, containing the patella is involved in increase the mechanical advantage of the quadriceps muscle.[1] The bony anatomy of the knee includes the femur, tibia fibula and the patella, which are held together by the ligaments, muscles and joint capsule. The primary motion of the knee is flexion and extension of the tibofemoral joint typically ranging from 135 degrees of flexion and 0 to -10 degrees of extension, however there is also an axial rotation component to the knee with approximately 10 degrees of internal and 10 degrees of external rotation. ACL injuries are a common injury seen in a sporting environment.[4] Although the incidence of injury is higher in contact sports, non contact sports that put increased acceleration-deceleration forces, lateral 'cutting' motions and pivoting through the knee also have a high level of ACL injury. Although the ACL can be injured in combination with other structures, specifically the MCL and the medial meniscus (known as the 'terrible triad'), isolated ACL injuries are not uncommon.[1] Compared to other ligament injuries in the knee, ACL injuries often require surgical repair and the prognosis is worse than when they are injured in

isolation.[3] People with an ACL deficient knee often experience chronic knee instability, decreased activity levels, poor knee-related quality of life in the short term and over time ACL deficiency is associated with and increased risk of osteoarthritis.[3,4] It has been well documented that the poor healing potential of the ACL may be due to an inhibitory effect of the intra-articular environment, such as lack of cytokine stimulation and poor hematoma formation. As well, it would appear the cruciate ligaments have an inherent inability to produce a significant response to facilitate healing.[5]

Conclusion

Although there is a plethora of information about the evaluation and treatment of the knee, with respect to ligament injuries, in clinical journals, textbooks and online to name a few sources, a common trend is tissue specific diagnosing in order to provide the right type of treatment for the right injury. Given the mechanism of injury, the signs and symptoms that the patient presented with, the author is confident in saying that in this instance, closed chain kinetic exercises with a focus on increasing both strength and conditioning of the hamstring and quadriceps musculature as well as increasing proprioception, was effective in treating this isolated, incomplete ACL injury.

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