CLINICAL COMMENTARY

FUNCTIONAL REHABILITATION AFTER MEDIAL MENISCUS REPAIR IN A HIGH SCHOOL FOOTBALL QUARTERBACK: A CASE REPORT

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ABSTRACT

Background. Rehabilitation guidelines and functional progression of isolated medial meniscus repair is not well documented in the literature. Due to the importance of the knee menisci, surgical repair of these structures has been very common. Physical therapists need to be aware of the imposed precautions and proper progression of patients post meniscus repair surgery.

Objectives. The objective of this case study is to describe rehabilitation guidelines, functional progression, and functional outcomes for a high school football player status post medial meniscus repair.

Case Description. The rehabilitation approach started with an early protection phase, followed by progressive neuromuscular training, then aggressive functional rehabilitation utilizing functional tests and measures to gauge return to play. Data collected for this case included joint range of motion, joint effusion, neuromuscular facilitation, isokinetic strength, and functional test scores.

Outcomes. This patient was able to return to full level of participation in 140 days (20 weeks), and was without re-injury 10 months after surgery.

Discussion. The rehabilitation approach of meniscus repair described in this case study may provide guidelines in clinical decision making for a safe return to competitive athletics.

Key Words. knee, meniscus, repair

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INTRODUCTION

The menisci of the knee are essential for proper knee function. They act in shock absorption, load transmission, stress reduction, joint stability, joint nutrition, and joint lubrication.[1,2] The menisci also have been found to have a significant role in neuromuscular control of the knee, providing proprioceptive information regarding joint awareness such as position, direction, velocity, acceleration, and deceleration.[3-5] Therefore, injury to the menisci resulting in partial or complete meniscectomy can lead to mechanical dysfunction, including decreased joint stability, increased joint degeneration, or neuromuscular deficits.[4,6-8] Meniscectomy results in 50% reduction of contact area between the femur and tibia, increasing the contact pressure on articular cartilage, and reducing the shock absorption capacity of the knee by 20%.[9]

Due to the importance of the menisci to the knee joint, from both a mechanical and neuromuscular standpoint, surgeons have focused more attention to preserving the integrity of the meniscus through repair procedures.[10] Procedures to repair meniscus include inside-out, outside-in, open, and all inside repairs.[1] The fixations vary from suture repairs to biodegradable devices. Inside-out fixation involves passing sutures arthroscopically from inside the knee, with the suture knots being tied outside the joint. Outside-in fixation involves passing the sutures from outside the knee joint, and tying the sutures arthroscopically inside the joint. Open repairs involve suture fixation with an open incision. All inside repairs vary from suture fixation passed with a suture hook, to commercial biodegradable fixation devices such as meniscus arrows.[1,11] These procedures have been applied to menisci in both the vascular and avascular zones, with an 80-90% success rate reported.[1,11,12]

Very little evidence exists in the current literature on rehabilitation following meniscus repair. No investigation has reported into the healing timeframes, strength capacity, or the effects of weight bearing or rotational stresses to a healing, repaired meniscus. Currently, both conservative and aggressive approaches exist for rehabilitation of meniscus repairs. The traditional conservative approach calls for partial weight bearing for the first 4-6 weeks with a post-operative brace locked in full extension and passive ROM limited from 0 - 90 degrees for the first 4 weeks.[13,14] These early restrictions in the conservative approach are likely due to the reported 50% of compressive loads in the knee passing through the menisci when the knee is in full extension. In 90 degrees of flexion, 85% of the load passes through the menisci.[9] Activation of the hamstring muscles are also limited due to the evidence that knee flexion results in displacement of posterior horn meniscal tears.9 Thus, the conservative approach limits end range of flexion range of motion (ROM), does not allow resistive hamstring exercises, and avoids closed kinetic chain positions such as squatting or lunging beyond 30-40 degrees of knee flexion. This approach aims to protect the shear forces on the repair for up to 4 months, with return to sports delayed for 4 to 6 months.[13, 14]

In the accelerated approach to rehabilitation of meniscus repairs, authors have reported return to play after as little as 10 weeks.[15,16] This approach integrates unlimited flexion ROM, hamstring muscle contraction, and weight bearing in the early stages of rehabilitation.[15] These two different approaches provide some insight into the current rehabilitation of meniscus repair. One promotes the necessity for protection of the repair,[13,14] while the other approach is less restrictive.[15]

Some authors have attempted to outline return to play guidelines.[9,15,17] Shelbourne et al[15] addresses some predetermined goals to gauge return to play, including full ROM, 75% quadriceps strength, completion of a running program, and completion of functional, sport-specific exercise.9 Brotzman and Wilk[9] calls for return to full activity between 11-15 weeks upon full, pain-free ROM, satisfactory clinical examination, and satisfactory isokinetic test results for strength. In addition to these approaches, neuromuscular rehabilitation and training has most recently been addressed as a key component of rehabilitation from meniscus injuries.[3,17] These studies address sport-specific neuromuscular control as the point of emphasis for rehabilitation and progression to return to activity.

The purpose of this case report is to integrate the approaches of early conservative treatment, neuromuscular and proprioceptive training, and functional progression into recommended guidelines for rehabilitation status post meniscus repair. This case will also present functional testing as useful clinical outcome measures of rehabilitation from meniscus repair.

CASE DESCRIPTION

The patient was a 17-year-old football quarterback in his junior year of high school. The patient initially injured his right knee in a pivoting mechanism of injury during the middle of his football season. He reported experiencing medial knee pain, swelling, and popping the right knee.

The team orthopedic surgeon evaluated him, and he was without definitive signs for meniscal pathology. According to the physician's office notes and his athletic training staff, his symptoms subsided and he was able to continue the season without major findings such as popping, buckling, pain, or swelling. After the season, the patient experienced a sharp pain and recurrence of previous symptoms while participating in the discus throw in track practice.

He was evaluated by his team orthopedic surgeon 3 days later. According to the physician's office notes, he presented with moderate joint effusion, lack of terminal 15 degrees of flexion, and a positive McMurray's sign. After clinical examination by the physician the patient had an MRI. According to the physician's office report, the MRI findings were consistent with a medial meniscus tear. The patient opted for arthroscopic surgery of the right knee one week later so he could have full recovery in time for his senior year football season.

The patient underwent surgery on 3/10/06. According to the operative report, a large tear was noted in the vascular portion of the medial meniscus, coursing from the posterior horn to the anterior horn and body. The meniscus repair was performed using six bio-absorbable staples. Per his orthopedic surgeon, the patient was placed in a post-operative knee brace (TROM, Donjoy, Vista, California) locked in full extension. He was instructed in ambulation non-weight bearing on the right lower extremity using standard axillary crutches. Additionally, he was instructed to progress to weight bearing as tolerated by week 2 and full weight bearing with the locked brace and crutches on week 3 (21 days post-op). He was also instructed by his orthopedic surgeon not to flex his knee beyond 90 degrees until week 3. Physical therapy was to begin exactly 3 weeks post surgery.

INITIAL PHYSICAL THERAPY EXAMINATION

Initial Presentation

The patient presented to physical therapy 3 weeks and 3 days (24 days) post arthroscopic medial meniscus repair. The history of his current injury was as noted previously. He presented with a mildly antalgic gait, with decreased toe off and stance phase of gait. He was ambulating full weight bearing without an assistive device and wearing a post-operative knee brace locked in full extension. The patient had minimal joint effusion, which measured at +0.5 centimeters with a circumferential measure at the joint line. The knee was minimally warm to touch. Three portal incisions existed, one at the lateral joint line, one at the medial joint line, and one at the far medial joint line, just anterior to the medial collateral ligament. The portal incisions were closed, with minimal redness, and without evidence of drainage or abnormal tenderness. The patient did have an additional far lateral portal incision, which he reported was due to the complexity of the meniscus tear. Palpation for condition revealed swelling at the joint line and superior pouch, and involuntary muscle tone of the distal hamstring musculature involving the distal biceps femoris and distal semimembranosis / semitendinosis.

Functional Status

The patient was limited in all activities of daily living that involved flexion of the right knee or excess weight bearing on the right lower extremity. These restrictions included, but were not limited to, rising from or lowering to squat positions, and stair ambulation. The patient avoided unilateral stance daily activities due to pain and feelings of instability.

Systems Review

The patient appeared to be a healthy, athletic 17-year-old male. At the time of evaluation the patient was 6'4" and 180 lbs. He had no significant medical history or family medical history. Patient denied having previous injuries or surgeries. At the time of the initial evaluation he had no gross warmth to touch in the lower extremity or gross sensory deficits in the lower extremities.

Range of Motion

The patient's classical, active ROM was 0-100 degrees in a pain-free manner, versus 0-130 degrees on the left knee. Range of motion was taken measured with a goniometer and taken via heel slide in a long sitting position. Patient presented with a mild decrease in mobility of the patella.

Pain

The patient reported 3/10 on a numerical pain intensity scale. The scale was defined as 0/10 for no pain and 10/10 as the worst pain.

Muscle Strength

The patient had a fair quad set / facilitation, versus excellent on the left lower extremity. A surface EMG biofeedback unit (CARE EMG, CARE Rehab, McLean, Virginia) with electrodes placed over the vastus medialis oblique muscle and 10 cm proximally to the superior border of the patella on the rectus femoris muscle during active quad sets resulted in an average output of 54.9 microvolts on the right, versus 117.6 microvolts on the left. The resultant

deficit of 56% was recorded. The accuracy of this unit is reported as 4% of the microvolt reading.[18] Strength of the quadriceps and hamstring muscles using a manual muscle test measured at 4-/5 on the right versus 5/5 on the left. Muscle testing was performed in a sitting position, resistance was applied in a pain free manner, and measures were taken as a global measure of hamstrings and quadriceps muscles contraction due to patient's postoperative status.

Assessment

This patient's primary impairment was an acutely repaired right knee medial meniscus secondary to sports related trauma. Physical therapy evaluation revealed decreased ROM, decreased strength, decreased functional mobility such as general ambulatory status and squatting activities of daily living, swelling, pain, and decreased ability to perform desired athletic activities. These findings were the patient's secondary impairments. Due to the operative procedure, this patient was also not permitted to squat, climb, pivot, ambulate stairs, or run until instructed due to the excess forces placed upon his meniscus.[9,13,14] These limitations were placed upon the patient by his orthopedic surgeon due to the meniscus repair procedure itself and the size of the tear. Taking into account his prior level of function, age, pain levels, and examination findings, his rehab potential was deemed as excellent.

Plan of Care Design

The rehabilitation program was divided into four phases. The program integrated aspects of the previously discussed treatment approaches,[9,13,15-17] including conservative treatment, neuromuscular and proprioceptive training, and dynamic functional rehabilitation to include agility drills and lower extremity functional capacity testing. Physical therapy interventions were initiated during the end of the first phase of his rehabilitation.

PHASE 1 (post-op weeks 0 to 4)

Goals

In Phase 1, the knee was in the early protection phase. The goals of this phase were to obtain 0-90 degrees of active ROM, decrease inflammation, restore normal patellofemoral joint mobility, and protect the repair. This phase lasted until post-op week 4 (28 days), when the patient was allowed to increase ROM as tolerated based on pain level and wean from crutches for ambulation to full weight bearing as tolerated with the brace locked in full extension.

Intervention

The patient wore a brace locked in full extension during all activities. He utilized bilateral axillary crutched in a non-weight bearing fashion. During Phase I, he progressed to weight bearing as tolerated and eventually full weight bearing without crutches by the time he presented for his initial PT evaluation. The patient was initially instructed in quadriceps facilitation exercises via a quad set with a surface EMG biofeedback unit (CARE EMG, CARE Rehab, McLean, Virginia)[18] during quad sets, straight leg raises, and multi-angle quadriceps isometrics in sessions supervised by the physical therapist. The patient was also instructed to perform quad sets, active assisted ROM heel slides, straight leg raises, hamstring stretches, grade II-III patella mobilizations inferior and superior, and calf stretching followed by icing as part of a home exercise program. All activities were to be performed 3 times per day, every day. This patient also performed weight shifting and single leg stance while wearing a brace locked in extension for proprioceptive input, and stationary cycling without resistance for ROM in supervised physical therapy during the end of this phase. These exercises were performed to facilitate quadriceps muscle activation, reduce the tonic contraction of the hamstring muscle, improve ROM, improve joint proprioceptive awareness, and reduce swelling. In addition to this, the patient performed gross hip strengthening via straight leg raises, lower abdominal and core strengthening, and cardiovascular training with the upper body ergometer. The patient was closely monitored for any increase in pain and swelling.

Outcomes

The patient attended physical therapy sessions three times per week during the last week of Phase I. By the end of Phase I the patient was able to perform full revolutions on a stationary bike without discomfort or tightness and tolerate unilateral stance without pain but with intermittent upper extremity support. The patient was able to perform a quad set with fair muscle tone. The surface EMG revealed an average workload of 91.0 microvolts on the right quadriceps muscle, which resulted in a 22% deficit in quad facilitation.

PHASE 2 (post-op weeks 5-9)

Goals

Phase 2 was from post-op weeks 5 through 9. In this phase, the goals were to achieve full ROM, normalize gait, and improve strength and neuromuscular control for daily activities. The patient was to perform unsupported squat-

ting to 60 degrees of knee flexion without pain or compensation by post-op week 6 and unsupported squatting to 90 degrees of knee flexion by post-op week 9. By week 10, the patient was to restore full, pain-free ROM, with good quadriceps tone, strength, and motor control to initiate interval-jogging program without pain or compensation.

Intervention

In the early portion of this phase, emphasis was placed on proprioceptive activities, normalizing ROM, improving quadriceps and hamstring muscles strength, and limited arc closed chain strengthening, allowing no more than 90 degrees of flexion. As the patient progressed to the Phase 2 of rehabilitation, he continued to respond with increased ROM, quad facilitation, motor control, and tolerance to open and closed chain strengthening. The patient was able to perform closed chain exercises within the restrictions of no greater than 90 degrees of flexion. He performed supported partial squats without pain and progressed to unsupported squatting and step-up activities. Motor control improved as he was able to perform box step ups, box step downs, and box side stepping with decreased dyskinesis and improved balance. Proprioceptive exercises were initiated with supported bilateral rocker board activities, progressing to unsupported exercises, followed by unilateral stance. The unilateral stance exercises were progressed to unstable surfaces when he was able to perform static stance on level surfaces without need for upper extremity assist, loss of balance, or pain. Toward the end of Phase 2 oscillatory and impulse stabilization exercises were introduced and performed on level ground then un-level ground.[3, 8, 17] During this phase, the patient performed open and closed chain strengthening exercises, gradual ROM exercises, and motor control / proprioceptive exercises all within the imposed less than 90 degrees of knee flexion limitations until he reached the final weeks of this phase.

Once the patient was confident with unilateral weight acceptance, demonstrated good unilateral neuromuscular control, and displayed no deficit on surface EMG[18] during quad facilitation exercises, he was permitted to begin light throwing while in standing position. At this time his throwing was limited to minimal level of exertion, short distances, and a fairly static, step-and-throw technique to a static target to avoid any rotation stress to his knee. The patient was a right-handed quarterback. Thus, his involved lower extremity was used as his push-off leg when throwing. He was again cautioned to discontinue throwing if he experienced pain or swelling in the right knee.

As this patient entered the late stages of Phase 2, he went through a significant transitional period in his rehabilitation. He began closed kinetic chain exercises with increasing resistance, but still within the 90-degree limitation due to the size of his repair. He also initiated isokinetic exercise on the Biodex19 at 180 deg/sec and 300 deg/sec. These speeds were selected for exercise based on the planned testing in later phases. He was able to achieve full knee flexion during week 9. It was at this time the patient began performing functional deep squatting with no knee flexion limitation, with no added resistance beyond that of his body weight, and within pain free ROM. With this patient's goal of initiating running by week 10, he began straight plane, low-level agility (ladder) exercises to improve motor control at a faster cadence. Once he demonstrated ability to perform these agility drills without compensations or discomfort, he was allowed to practice straight drop back footwork, as well as step-and throw drills with the high school football team training staff.

Outcomes

The patient continued to receive physical therapy three times a week for 5 weeks while in Phase 2 (15 total visits). By week 6, the patient no longer had ROM limitations during closed chain strengthening. Therefore, functional exercises were initiated and full ROM during these activities was expected by the end of phase 2. At week 6, the patient achieved symmetrical values for his average output (microvolts) during a standard quad set exercise. He also had symmetrical circumferential measures at his tibiofemoral joint line, and presented with full, symmetrical ROM. At post-op week 8, the patient performed an isokinetic strength evaluation at 180 degrees per second and 300 degrees per second. He displayed peak torque strength deficits of 26.9% and 20.1% in his quadriceps muscle, and 6.4% and 5.9% in his hamstrings muscles, respectively*(Table 1)*.

Table 1. Week 8 Isokinetic Test Results

	Week 8 180 degrees/sec	Week 8 Deficit% (180)	Week 8 300 degrees/sec	Week 8 Deficit% (300)
Quad Peak Torque (ft-lbs)	109.1	26.9%	97.6	20.1%
Quad Peak Torque/Body Weight (%)	59.0%	-	52.8%	–
Quad Total Work (ft lbs)	1212.1	18.4%	1040.9	25.1%
Hamstring Peak Torque/Body Weight %	50.2%	-	44.1%	-
Hamstring Total Work (ft.lbs)	930.8	4.2%	906.9	8.3%

PHASE 3 (post-op weeks 10-16)

Goals

Phase 3 of rehabilitation focused on progression of functional activities and the goals were to transition this patient back to football related activities. At 12 weeks, the goals were to perform full, pain-free functional deep squat and closed chain pivoting activities without complaints of pain. By post-op week 16, the patient should be able to run on a treadmill and grass, tolerate progression of pivoting and cutting, and advance throwing with incorporated agility drills to safely advance to sport specific demands.

Intervention

Once the patient displayed full knee extension, good quad strength (as displayed by the week 8 isokinetic test results), good quad tone, and good neuromuscular control during low-level, straight plane agility exercises such as agility ladder drills and skipping, the patient was allowed to begin jogging. The patient began jogging with an interval program on a treadmill at post-op week 10. This began with 30-second intervals, followed by 30-second rest periods, with a running speed of 6 mph at 0% incline for 10 repetitions. The interval program was repeated each visit, and times were increased to 60 second running, with speeds eventually increased to 9mph by the end of phase 3. The incline was also progressed up to 5% by the end of Phase 3. The speeds and incline were increased as the patient's strength and fitness improved, adjusting to provide a moderate level of perceived exertion.

As the patient entered Phase 3, he continued with higher level neuromuscular training including oscillatory and impulse techniques for isometric stabilization, open and closed chain strengthening with and without added loads, treadmill jogging, and isokinetic strength training. Neuromuscular training was progressed with oscillations from the upper extremities using tubing, first in a straight plane then diagonal plane of motion. Impulse stabilization was provided with the use of a plyoback while in a unilateral stance. Again, progression occurred with diagonal patterns of throwing, then progression to uneven surfaces. Loads were added to closed chain exercises utilizing weighted vests, varying from 15 to 45 pounds. This activity was performed to add stress to his lower extremities, challenge his neuromuscular control during his lunging and squatting activities, and provide higher demand strength training as the patient was planning on extensive strength training with his football team upon release from rehabilitation. He began with the 15 lb weight, performing bilateral squatting to a box height allowing 90 degrees of knee flexion to maintain low stress at the knee, then progressed to squatting without support of a box. Although the patient was allowed to perform a full, deep squat without resistance, he was not permitted to perform a squat with added loads as it is postulated that this would be excess stress to this patient's knee. Unilateral step-ups were performed with the added loads up to 45 lbs and at a 14-inch box height.

At 12 weeks post-operatively, the patient began pivoting exercises. This exercise was done utilizing a vector board, in which the patient performed drop-step, or diagonal squats, and lunges at 45 degree, 60 degree, and then 90-degree angles. He progressed by adding loads to these closed chain exercises. Crossover footwork drills and pivoting agility cone exercises completed the progression. These exercises emphasized high demand neuromuscular control and placed progressively higher demands on the meniscus.

At football practice, the patient was permitted to increase his distance and exertional levels for throwing. He was also allowed to perform drop backs from his quarterback position, as well as drop backs to a 45 degree angle in either direction. He was also permitted to perform straight plane jogging and only agility ladder drills which he was performing in his rehabilitation program.

Functional rehabilitation activities progressed through higher-level activities including ladder drills, 5-dot drills, plyometrics, and cone drills involving cutting at 16 weeks. The patient also increased speeds of his 40-60 yard running on grass, including some sprinting at week 16. Sprinting was also performed and progressed on the treadmill. He was able to progress treadmill running to 12mph at a 15% incline for 20 second intervals as he completed Phase 3.

Outcomes

The patient was treated 2-3 times per week for seven weeks while in Phase 3 (18 total visits). At the end of Phase 3, the patient was able to perform all agility ladder drills, in-door cone drills, and 5-dot plyometric drills without discomfort, pain, or compensation. The patient was also able to perform jogging and light sprinting up to 12mph with varying inclines up to 15% without discomfort, pain, or compensation. At post-op week 14, the patient performed an isokinetic strength evaluation at 180 degrees per second and 300 degrees per second. He displayed peak torque strength deficits of 6.3% and 8.2% in his quadriceps, and 4.4% and 2.9% in his hamstrings, respectively*(Table 2)*.

Table 2. Week 14 Isokinetic Test Results

	Week 14 180 degrees/sec	Week 14 Deficit% (180)	Week 14 300 degrees/sec	Week 14 Deficit% (300)
Quad Peak Torque (ft-lbs)	136.6	6.3%	112.4	8.2%
Quad Peak Torque/Body Weight (%)	73.8%	-	60.8%	-
Quad Total Work (ft lbs)	1307.4	16.5%	1143.9	15.6%
Hamstring Peak Torque/Body Weight %	51.7%	-	46.3%	-
Hamstring Total Work (ft.lbs)	809.8	21.9%	739.6	12.9%

PHASE 4 (post-op weeks 17-20)

Goals

Phase 4 focused on aggressive sport specific training. The goals were to normalize running and sprinting, normalize lower extremity strength, and perform sport specific athletic demands without pain or compensation.

Intervention

This phase encompassed weeks 17 through 20. Upon completion of functional tests to assess strength, agility, and endurance, the patient entered into Phase 4, which was return to sport participation. The athlete fulfilled this phase through demonstrating the ability to perform all athletic demands of his specific sport prior to returning to unrestricted competition.

As the patient entered and progressed through this phase of his rehabilitation, he began more sport specific cutting and pivoting. The patient began performing roll-out activities at football practice and running drills that emphasized cutting and change of direction. He was unrestricted in exertional levels for throwing. The patient also began functional testing, which included the Lower Extremity Functional Test (LEFT),[20] the T-test,[21] and 300-yard shuttle.[22] The LEFT test assesses multiple lower extremity movement patterns,[20] the T-test is an anaerobic test for agility,[21] and the 300-yard shuttle is an anaerobic capacity test.[22] The patient initially performed these tests at 50% effort level at week 16, then 75% effort at week 17, and finally at maximum effort upon final physical therapy visits at weeks 20-21. This progression in effort was instructed so the patient could become familiar with the tests. It was postulated that familiarization with the tests would assist in gaining an accurate assessment of his functional capacity when permitted to perform the test at 100% effort.

Outcomes

The patient was treated two times per week for the four weeks of Phase 4 (8 total visits). As the patient progressed with his functional rehabilitation, higher demanding agility exercises, and sport specific exercises, he was able to complete all functional testing without discomfort and within acceptable criteria for discharge from physical therapy. He scored 1 minute, 40 seconds on the LEFT test.[20] The patient scored 65.8 seconds on the 300-yard shuttle, which places him 4.8 seconds slower than previously tested Division-I football players at his position.[22] Lastly, the patient scored 10.55 seconds on the T-test, which places him .55 seconds slower than previously reported competitive college male athletes.[21] Upon his final physical therapy visit, he also scored III out of III on each the lower extremity components of the Functional Movement Screen,[23] including the deep squat, hurdle step, and in-line lunge. Since the patient was in the off-season of his particular sport and recovering from significant knee surgery, he was quite pleased with these results on his functional tests.

At post-op week 18, the patient performed an isokinetic strength evaluation at 180 degrees per second and 300 degrees per second. He displayed peak torque strength deficits of 2.0% and 7.1% in his quadriceps, and 11.4% and 3.2% in his hamstrings, respectively*(Table 3)*.

Table 3. Week 18 Isokinetic Test Results

	Week 18 180 degrees/sec	Week 18 Deficit% (180)	Week 18 300 degrees/sec	Week 18 Deficit% (300)
Quad Peak Torque (ft-lbs)	152.1	2.0%	127.4	7.1%
Quad Peak Torque/Body Weight (%)	82.8%	-	68.9%	-
Quad Total Work (ft lbs)	1660.4	11.6%	1369.2	14.7%
Hamstring Peak Torque/Body Weight %	48.5%	-	45.5%	-
Hamstring Total Work (ft.lbs)	1051.8	11.1%	846.1	0.7%

This patient returned to full, unrestricted football practice upon being discharged from physical therapy 140 days after meniscus repair surgery. As of 10-months post medial meniscus repair, he has been without re-injury. He played the fall 2006 football season without complication and is currently playing Division I football as a quarterback.

DISCUSSION

Due to both the neuromuscular and mechanical functions of the menisci of the knee, injury to these structures can be quite detrimental. With improved understanding of these essential roles, surgeons have made a more focused effort on the restoration of knee anatomy by repairing a torn meniscus when feasible.[10] Efforts have been made to guide

the rehabilitation from meniscus repair surgery, but no definitive consensus exists on the most effective approach to rehabilitation. Advocates exist for both conservative[13,14] and aggressive rehabilitation.[15, 16]

The rehabilitation guidelines in this case follow early conservative, progressive neuromuscular training, and aggressive functional progression. This patient was limited in weight bearing and closed kinetic chain positions early in his rehabilitation, which correlates with conservative guidelines.[13, 14] However, the patient was also allowed to perform resistive hamstring muscle exercises as soon as week-4, versus week-6 in conservative protocols.[13,14] Additionally, no previous studies have strongly advocated neuromuscular training.[3,8,17] This patient performed extensive neuromuscular training and reactive neuromuscular training early in rehabilitation as soon as weight bearing was permitted and within his restrictions of motion and pain. As this patient was allowed greater angles of knee flexion during closed chain activities, exercises were designed to progressively strengthen, retrain neuromuscular control, and functionally stress the knee and meniscus in the newly allowed range. It is postulated this approach bridged the gap between early protection and progressive neuromuscular training to the aggressive, stressful stages of functional progression and sport specific activities. Conservative approaches outline early restrictions lasting for up to 6 weeks, with some calling for no pivoting activities or deep squatting beyond 125 degrees of flexion for 4 to 6 months.[11] Simply avoiding these types of activities for this duration does not prepare the patient for resuming the activities that involve deep squatting or pivoting, especially in an athletic population. The approach presented in this case outlines progressive neuromuscular training and clinical decision-making process to adequately prepare the patient for returning to these activities.

The individual needs of the patient need to be taken into consideration when addressing return to sport. Many authors have called for the examination of the sport specific demands of the individual when considering the timeframe for safe return,[15,17] similar to this rehabilitation program. Studies suggest the type of repair may impact the outcomes of surgery, with vertical suture fixation being favorable over horizontal suture fixation and commercial biodegradable devices.[1,11] Additionally, other factors suggest a higher failure rate, such as avascularity of tear location,[11] complexity and type of tear,[1,11] and compounding injuries such as ACL deficiency.[12]

The patient in this case had favorable conditions for a successful outcome. Although he had a large tear, the tear was in the vascular zone and was a simple longitudinal tear. No other compounding factors existed, and he had a high level of fitness with no previous injuries, and he was of a young age. He was compliant with his early postoperative restrictions; he managed the early swelling, consistently worked on regaining his ROM and quadriceps muscle activation, and was aware of all of his precautions with respect to pain and reactive swelling throughout rehabilitation. The mixed approach was appropriate for this patient due to the rather large meniscus tear and the activity level of this patient. Due to the size of the tear, he needed to be conservative in the early phase of rehab to ensure adequate healing of the repair. Taking into account his activity level and the demands that this patient would be placing on himself in future athletic activities, this patient needed aggressive functional rehabilitation. The approach taken for this patient integrated an early phase conservative approach, progressive neuromuscular and proprioceptive training, and late phase dynamic functional rehabilitation to return to unrestricted athletic activity.

CONCLUSION

This case report outlined rehabilitation guidelines, functional training, and functional outcomes in the rehabilitation of a high school athlete with medial meniscus repair. This patient achieved a successful outcome, returning to competitive football in 140 days (20-weeks) post medial meniscus repair. The guidelines discussed in this case report, as well as criterion-based functional progression, displayed a safe return to competitive athletics, with no reinjury 10-months after surgery. Further studies are needed to accurately examine the healing rates of a repaired meniscus, correlating rehabilitation considerations so that our patients may have an optimal outcome in rehabilitation from meniscus repair.

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