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Nonsurgical Management of an Anterior Cruciate Ligament-Deficient Knee in a Women's Soccer Player: A Validation Clinical Case Report

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Background: A collegiate women's soccer player sustained an isolated anterior cruciate ligament (ACL) tear and expressed a desire to continue her season without surgical intervention.

Design: Case report.

Intervention(s): Using the results of a randomized controlled trial and published clinical guidelines, the clinicians classified the patient as an ACL-deficient coper. The patient completed her soccer season without incident, consistent with the findings of the established clinical guidelines. However, 6 months later, she sustained a meniscal tear, which was not unexpected given that 22% of ACL-deficient copers in the randomized controlled trial incurred a meniscal tear within 24 months of ACL injury.

Conclusion: The external evidence was helpful in making informed clinical decisions regarding patient care.

Key Words: clinical guidelines, copers, patient values

Level 1: Validation Clinical Contribution to the Available Sources of Evidence (CASE) Report.

For more information, see the following:

- King MA, Medina McKeon JM, McKeon PO. Clinical case study as a clinical communication tool. *J Athl Train*. 2016;51(7):509–510. doi: 10.4085/1062-6050-51.9.06.
- Medina McKeon JM, King MA, McKeon PO. Clinical contributions to the available sources of evidence (CASE) reports: executive summary. *J Athl Train*. 2016;51(7):581–585. doi: 10.4085/1062-6050-51.9.07.

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More than 200 000 anterior cruciate ligament (ACL) injuries occur yearly in the United States, with most patients choosing to have surgery.[1] It is reported that those who have sustained an ACL injury have a far greater risk of developing osteoarthritis (OA) than the unaffected population.[2] This is thought to be due to a combination of intra-articular pathogenic processes at the time of injury and alterations in postinjury loading patterns.[3] Once the effusion is resolved and range of motion (ROM) is restored, surgery is often recommended to patients with the goals of improving quality of life, returning to the previous level of activity, restoring joint stability and knee function, and preventing further damage to the knee's articular cartilage and menisci. Several studies[4,5] have indicated that undergoing ACL reconstruction (ACLR) does not prevent patients from developing OA later in life, and rates of OA were similar between groups that had surgery and those that opted to forgo it. This raises the possibility that not all patients need to undergo surgery immediately[6,7]; if some can cope with an ACL-deficient (ACLD) knee, they can potentially save on health care costs and reduce the time spent recovering from surgery.[5]

Researchers have found that outcomes between those who opted for ACLR and those who rehabilitated an ACLD knee were not different. In a randomized controlled trial,[6] 121 young active adults 18 to 35 years of age were treated with structured rehabilitation plus early ACLR versus structured rehabilitation with the option of delayed ACLR if needed.[6] Patients completed self-reported questionnaires and were evaluated for knee laxity at rest, and the authors noted changes from baseline to 2 years. At the 2-year follow-up, no substantial differences were present between the groups in patient-reported score or return to preinjury level.[6] Overall, the early ACLR group demonstrated better knee stability on clinical examination. In the group initially treated nonoperatively, 40% had discomfort and underwent a delayed operation, whereas the other 60% did not have ACLR. At the 2-year end point, both subgroups achieved the same results as the primary ACLR group with regard to pain, function, and activity level.[6] The nonoperatively treated group had a greater frequency of adverse meniscal events at follow-up than the ACLR group, but the authors suggested that meniscal tears were managed more aggressively in those with ACLR and more likely to be left untreated in the nonoperative group, which could have been a cause for the increase in eventual surgery.[6] This high-quality study was rated as level 2 evidence according to the Oxford Centre for Evidence-Based Medicine, and it was

rated 7 of 10 on the Physiotherapy Evidence Database (PEDro) scale. Three points were lost due to a lack of blinding in the study.

An algorithm from the University of Delaware group[7] has been developed and evaluated to help clinicians determine which patients present with indicators that make them candidates for a nonsurgical return to activity. The investigators implemented this algorithm with 345 highly active patients to determine whether ACLD patients could be classified as *copers*, which would indicate they were candidates for nonoperative management. After the initial impairments (eg, swelling, ROM deficits) were resolved, the patients underwent screening that included unilateral hop testing, self-reported questionnaires, and recording the number of giving-way episodes since the injury. Patients who could complete testing without experiencing shifting in their knee or reporting symptoms and could demonstrate sufficient scores on all outcome measures might be able to stabilize their ACLD knee. Patients classified as copers would then begin a nonsurgical rehabilitation that included a 10-session perturbation rehabilitation protocol.[7] Over a 10-year period, Hurd et al[7] prospectively classified their population as 42% (n = 146) copers and 58% (n = 199) noncopers. Of the copers, 72% (63/88) returned to preinjury activities and 57% (36/63) eventually opted for surgery, whereas 40% (25/63) of copers who had not undergone surgery were still participating in high-level activities 1 year later.[7] The authors concluded that this protocol could be used by clinicians to help determine the likelihood that a patient could avoid ACLR and return to his or her previous level of activity. A checklist for critical appraisal of guidelines[8] met the requirements for appropriate internal and external validity with a score of 9 of 11.

Therefore, the purpose of this case study was to describe our process of using the best available evidence to determine the indicators for a successful return to play without surgery. We aimed to learn if this screening tool could be used to return an ACLD women's soccer player to sport without surgical intervention.

CASE PRESENTATION

Patient

A 21-year-old National Collegiate Athletic Association Division III collegiate women's soccer player reported a giving-way sensation and feeling a pop in her left knee during a cutting maneuver while playing in a game. She was assisted off the field by the athletic trainer (AT), and on examination, her knee demonstrated positive Lachman and anterior drawer tests, consistent with an ACL rupture. She was referred to the team physician and magnetic resonance imaging was ordered. One day postinjury, she presented with normal full–weight-bearing gait, minimal effusion, and almost full ROM with a complaint of slight stiffness at end-range flexion and extension. In a follow-up appointment, the team physician confirmed an ACL rupture via magnetic resonance imaging. The physician and patient discussed the possibility of nonsurgical management with the goal of her returning to collegiate soccer. The patient cited personal values that included a previous history of ACLR on her right knee 3 years before and familiarity with the rehabilitation process. She expressed a desire to return to sport as soon as possible as well as anxiety over her ability to complete an internship scheduled for the next academic semester if she opted for surgery. She also had concerns about her ability to complete the duties and tasks required after undergoing ACLR and the need to undergo rehabilitation away from home while navigating a new city.

Intervention

In consultation with the team physician, the AT performed a literature search to identify articles that reported outcomes and helped identify a model that outlined a nonsurgical approach to return to play. The AT reviewed the Frobell et al[6] study and used the algorithm reported by Hurd et al and the University of Delaware group[7] (Table) to screen the patient for a potential nonsurgical return to soccer. Because the patient did not have any exclusionary injuries (eg, grade II or greater posterior cruciate ligament, medial collateral ligament, or lateral collateral ligament laxity; articular cartilage tear; repairable meniscal tear) that would make her a better candidate for surgery, she was evaluated to see if she met the criteria to begin the screening process: no or minimal knee-joint effusion, full and symmetric active knee range of motion (AROM), $\geq$70% quadriceps strength bilaterally, and the ability to hop on the injured leg without pain while in a functional derotation brace.[7] On examination, the patient demonstrated no noticeable joint effusion and full knee AROM confirmed by goniometric measurements, whereas isokinetic testing demonstrated $\geq$70% of both quadriceps and hamstrings strength. The patient was able to hop without pain, though a derotation brace was not used at this point due to budgetary constraints. Given that the patient met the criteria, she was cleared to begin the screening, which consisted of functional hop testing, patient-reported questionnaires, and recording of giving-way episodes that occurred with activities of daily living (ADLs). The hop test consisted of 4 patterns (hop for distance, crossover hop for distance, straight triple hop for distance, timed hop over a 6-m distance). The timed hop test is believed to pose the most significant neuromuscular challenge for the patient and requires an index of $\geq$80% for successful performance.[7] Our patient completed all the tests satisfactorily and scored 85% on the timed hop. Because the patient met the requirements for hop performance, we administered 2 patient-reported questionnaires. The Knee Outcome Survey–Activities of Daily Living (KOS-ADLS) and the global rating of knee function scales were used.[9] The KOS-ADLS has patients rate their symptoms during basic activities on a 0 to 5 scale, with higher scores indicating less difficulty performing tasks and fewer symptoms. Our patient had a KOS-ADLS score of 90%, thereby meeting the threshold of $\geq$80% to be classified as a potential coper. For the global rating of knee function, patients are asked to report their perception of overall knee function, including during athletic participation. A score of 0 represents *total disability*, and a score of 100 represents *full knee function before the injury*.[10] When given these criteria, the patient rated herself at 80%, with her only complaint being difficulty kneeling on the affected knee.

Table. Screening the Patient With Anterior Cruciate Ligament Deficiency

Coper/Noncoper Determination Process	Item	Result
Inclusion criteria (Frobell et al[6,11])	Complete anterior cruciate ligament rupture	Yes
	Highly active	Yes
	International Knee Documentation Committee level I, II; Tegner Activity Scale score = 5–9[a]	Yes
Exclusion criteria (Hurd et al[7])	Concomitant injury	No
	>Joint effusion present	No
	Less than full active range of motion	No
	≤70% Quadriceps strength	No
	Unable to single-leg hop	No
Screening examination to classify	Hop test index score ≥80%	85%
	Questionnaires	
	Knee Outcome Survey–Activities of Daily Living score ≥80%	90%
	Global rating of knee function ≥60%	80%
	Reported knee giving-way episodes ≤1	None
Classification	Coper or noncoper?	Coper

[a] 1 = *least strenuous*, 10 = *high-demand knee activity at the professional level*.

The last screening criterion was giving-way episodes of the knee during ADLs. A patient who reports any episodes is advised to opt for ACLR due to the higher likelihood of giving way when sport-specific demands are introduced. The patient was given a description of a giving-way episode (ie, shifting or buckling of the tibia) and reported that none had occurred.

Our patient met all requirements to be classified as a potential coper. Therefore, the decision was made for her to attempt to return to soccer without ACLR.

The rehabilitation progression occurred over a 3-week period in which stretching to maintain full flexion and extension was introduced, as well as strengthening of the quadriceps, hamstrings, and proximal hip. For balance training, the Delaware group[7] recommended 10 perturbation sessions using a rocker and rollerboard; we chose to use a BOSU balance trainer (Ashland, OH) with the curved side down. The patient started in a double-legged stance and progressed to a single leg with external perturbations applied to the BOSU. The goal was to teach the patient to respond appropriately to external forces and progress to more difficult sport-specific positioning and stronger perturbations from different angles. Forces were started in the anterior-posterior direction, progressed to medial-lateral, and eventually included diagonal and rotary forces. The patient was given cues to help maintain proper positioning and reaction without locking the knee or losing core stability. A wobbly balance disc was also used during a single-legged stance with perturbations applied to the patient's upper body.

To provide increased protection when live activity with the potential for contact was introduced, the patient was fitted with an off-the-shelf functional ACL brace at 2 weeks postinjury. She began sport-specific drills that included using the agility ladder and progressed to cutting and change of direction. Using a soccer ball, the patient worked on dribbling, striking, receiving passes, and accelerating. She was cleared to begin practice drills at 3 weeks postinjury, though contact with opposing players on her team was minimized. The patient continued to perform therapeutic exercises throughout the return to the full-participation phase, focusing on strengthening and neuromuscular control for the remainder of the competitive season.

Comparative Outcome

At 4 weeks postinjury, she played 10 minutes in a regular-season game without difficulty and began to start in games. She was able to complete the season, including multiple postseason games, without any giving-way episodes and maintained full function. Our patient returned to her preinjury level of activity, similarly to the 72% of classified copers in the Hurd et al[7] study.

Six months later, she was playing in a recreational soccer game, rotated on her knee, and injured her medial meniscus, which was not unexpected considering the 22% incidence of adverse meniscal events reported by Frobell et al.[6] At this point, the patient consulted with her AT, team physician, and orthopaedic surgeon and opted to have an ACLR and meniscal repair.

DISCUSSION

Recommendations for ACL management should involve all aspects of evidence-based practice. The best available evidence, clinician expertise, and patient values should be evaluated and applied to each unique patient. Typically, patients presenting with ACLD knees are referred to surgeons for reconstruction with the goal of protecting overall long-term joint health. The current evidence regarding the protective effect of ACLR against OA is extremely limited, with no substantial differences between groups that opted for ACLR versus nonsurgical rehabilitation.[11–16] At the 2- and 5-year follow-ups of a randomized controlled trial, the ACLR patients had better knee stability on static testing; across groups, the patient-reported outcomes were usually similar, though some demonstrated lower knee-stability scores in those managed nonsurgically.[6,11] Currently no consensus exists regarding the use of ACLR to achieve better long-term patient outcomes.

The prevalence of OA was slightly higher in the ACLR versus the ACLD group.[5] We found it interesting that when a meniscectomy was also performed, the OA rate was reduced in the ACLR group.[5] This may indicate that those presenting with an ACL rupture and a meniscal lesion should be referred for ACLR and not given consideration for returning to sport without repair, which was a recommendation of the Delaware group's algorithm.[7]

In the short term, many patients opt for ACLR with the goal of returning to sport, but a recent systematic review[17] showed that only 55% were able to return to their previous level of competitive sport and the likelihood for males was 1.5 times higher than for females. Among females who were able to return to soccer, the reported reinjury rates were as high as 28%.[18] In our case, the patient had a previous ACL tear and reconstruction on the contralateral knee and was familiar with the rehabilitation and return-to-sport process. The patient indicated that during her first soccer season after surgery, she experienced apprehension, fatigue, instability, and soreness in her knee. On the basis of her previous experience with ACLR and knowing the postsurgical risks of returning to sport and the potential for reinjury, the patient preferred to pursue nonsurgical rehabilitation if possible.

The clinician in this case had expertise in rehabilitation with a return to collegiate soccer after ACLR but none with a patient attempting a nonsurgical return. The algorithm from the Delaware group[7] was helpful in specifying criteria that the patient had to achieve in order to continue the progression versus being referred for surgery. This made the expectations and indicators for success clear to the patient, AT, and physician throughout the entire decision-making progress. Despite the different models available to guide clinicians through the screening process for an ACLD athlete to return to sport, the evidence regarding the best indicators for success is still limited. Authors of a systematic review[19] sought to delineate patient-related factors that might help to identify the need for surgical reconstruction after nonoperative treatment of ACL injury. They found strong evidence that sex was not a good predictor and moderate evidence that knee-joint laxity was also not a predictor; the rest of the characteristics were not strong enough to permit a conclusion to be drawn.[19]

At this point, clinicians are still limited in the ability to identify patient-related factors that can predict success for a nonoperative return to sport. Clinicians are unable to guarantee that future injury will not occur with either course of treatment. As noted in a recent editorial,[20] we may need to better define what *successful return to sport* means (eg, being symptom free, defining the time without reinjury, long-term prognosis). The use of other patient-reported outcomes during the decision-making process through the return to play might allow clinicians to make more informed decisions.

Our patient reported she was pleased with her rehabilitation because the soccer team had one of its most successful seasons in some time and she was able to excel in her internship. This is important to note given that these strong patient values were the impetus for her deciding not to undergo ACLR at the time of the initial injury. The patient chose to undergo reconstruction on completion of her collegiate soccer season and internship after sustaining a meniscal injury. After surgery, she made a return to full activity without restrictions.

The patient's values and preferences strongly favored a nonsurgical return to sport, and despite the clinician's having more expertise with rehabilitation after ACLR, the best available evidence did not make a strong case for either treatment option. Whereas the validity of symmetry scores in individuals with a history of bilateral ACL injury has recently been called into question,[21] the clinical guidelines were effective in guiding our decisions. Future research is needed to determine whether more specific guidelines are required for patients presenting with a history of bilateral ACL injury. Consequently, this patient's outcome was consistent with that of the 20% in the Frobell et al[6] study who elected for ACLR 1 year postinjury, and her outcome serves to validate the probability of this occurring (1 of 5 may undergo eventual ACLR). The patient's return to play and subsequent meniscal injury were in keeping with what has been reported in the external evidence.

CLINICAL BOTTOM LINE

No consensus exists as to the best treatment recommendation for patients presenting with an ACLD knee, and it remains difficult to recommend 1 treatment strategy unless meniscal injury is present. The decision and timing need to be tailored to the patient's characteristics, preferences, and values. Using the best available external evidence, in this case the randomized controlled trial and established clinical guidelines, clinicians can help patients make informed decisions and prognosticate potential outcomes. The use of the Delaware group algorithm and screening tool[7] may assist in objectively identifying patients who demonstrate the qualities of copers. When the patient is carefully screened and monitored by a clinician, an individualized approach to ACLD knee-injury management may allow for a potential return to sport without surgery.

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