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Surgical Reconstruction vs. Conservative Rehabilitation of Isolated Posterior Cruciate Ligament Injury: Relevance to Long-term Function and Return to Sport

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Abstract

Background: While isolated posterior cruciate ligament (PCL) injuries are fairly common amongst athletes, there is still no established rule as to how to best treat such an injury, and indeed there is much controversy on whether such and injury should be treated surgically or conservatively with physical therapy.

Case Description: The patient who was the inspiration for this research was a young male athlete who presented with knee pain and instability after a fall during a soccer game. He wished to proceed conservatively as long as such a course of treatment would afford the ability to return to sport without sacrificing the future function of his knee.

Discussion: Studies of both conservative and surgical treatment of isolated PCL injury describe good results, although most sources seem to suggest that passive stability of a knee is more greatly improved with surgical intervention as compared to conservative treatment. However, there has been shown to be no significant relationship between PCL laxity and satisfaction with or subjective function of the knee.

Conclusion: Considering the financial burden of orthopaedic surgeries and the generally good outcomes of conservative treatment, even for return to the highest levels of competitive sports, most isolated PCL injuries should be treated conservatively at least at the outset of treatment – surgical intervention should be considered if nonsurgical treatment is ineffective or does not provide the desired result.
Background and Purpose
The impetus for this analysis of literature was an athletic male patient in his mid-twenties who presented to a rural outpatient clinic with knee pain, inability to run, and subjective reports of excessive movement in the left knee that began after a sliding fall on a flexed knee during a soccer game. Objectively on examination, there was increased posterior translation of the tibia on the femur, and positive special tests which suggested injury to the posterior cruciate ligament (PCL). The method of the injury was consistent with this diagnosis, and while the patient had not had imaging done on the knee to corroborate the diagnosis, it was decided by the patient and practitioner together that based on our objective and subjective findings, conservative treatment would begin with “PCL sprain” as the working diagnosis. At this point the patient was considering the possibility of surgical intervention if conservative treatment did not allow him to return to his prior level of function. His question, and one that the practitioner had as well was, “In the athletic population that sustains a PCL injury, are the long-term functional outcomes of physical therapy conservative management more effective than those following surgical reconstruction?”

Traditionally, PCL injuries have received less attention than those of the anterior cruciate ligament (ACL), which is widely considered to play a more important role in stabilizing the knee and ensuring normal biomechanics. ACL injuries are much more common (Rosenthal et al., 2012), and patients with ACL injuries also tend to score much lower on subjective knee rating scales than do those with PCL injury, indicating that ACL injuries limit function more, and are the cause of more impairment than PCL injuries (Shelbourne et al., 1999). This is due at least in part to the fact that the ACL is most vital in stabilizing the knee in full and near-full extension, whereas the PCL is taut, stabilizes the knee, and prevents posterior tibial translation in deep flexion (Sohn et al., 2010). Because the vast majority of weight bearing and lower extremity closed chain activities require relatively little knee flexion (walking, running, climbing...
Rehabilitation of Isolated PCL Injury: Long-term Function and Return to Sport

stairs), it makes sense that the PCL is less vital to the stability of the knee during typical everyday activities. Instability due to deficiency of the PCL is more often noted during activities such as sprinting, cutting, deep squats, and vertical jumping (Toritsuka et al., 2004).

Biomechanical studies have demonstrated altered gait mechanics and arthrokinematics in PCL deficient knees, while cadaveric studies have revealed similarly altered arthrokinematic movements resulting in altered contact pressures on joint surfaces, in particular the medial and patellofemoral compartments. A study of the kinematics of gait in PCL deficient knees compared to controls found altered mechanics, including decreased posterior tibial translation during stance, as well as increased external tibial rotation and varus of the knee during stance phase of gait (Orita et al., 2015). The authors of that study argue that those altered mechanics are likely contributors to joint degeneration, however, these results may be equivocal, as another similar biomechanical study found few differences in gait and jump mechanics between participants with PCL deficient knees and controls, namely a reduction in valgus moment during gait, and a decreased force loading rate during vertical jump landing; these differences were deemed likely protective adaptations in the participants with PCL deficient knees, and were seen bilaterally in that group (Fontboté et al., 2005). Furthermore, one cadaveric study used a novel approach to replicate the dynamic stabilizing forces of the hamstrings and quadriceps, and discovered no significantly altered biomechanics or contact pressures beyond posterior tibial translation on arthrometry, between PCL deficient knees, normal knees, single-bundle Transtibial reconstructions, or double-bundle Transtibial reconstructions (Sohn et al., 2010).

An MRI study of young athletes with a history of conservatively treated PCL injury found that, while none of the participants had visible joint degeneration on radiographic examination, and while most were asymptomatic or reported only mild symptoms, all had some degree of early cartilage degeneration determined by T1ρ MRI mapping (Okazaki et al., 2015). While the authors hint that
Rehabilitation of Isolated PCL Injury: Long-term Function and Return to Sport

Conservative treatment is likely to result in subsequent knee joint arthropathy, often beginning with subclinical, asymptomatic cartilage degeneration, there is no comparison of cartilage health in young athletes who have received PCL reconstruction, and therefore no causation can be inferred. Furthermore, it has been demonstrated that chondral damage often occurs simultaneously with PCL injury, and it can be posited that any evidence of chondral damage could be in addition to PCL injury, not because of it.

There is little data available that speaks to the incidence of PCL injury, or what percentage of injuries are treated surgically, but one study on the epidemiology of PCL injury found that traffic accidents and athletic injuries were the most common causes of PCL injury, followed by falls. Most injuries occurred to a flexed knee, with hyperextension of the knee being the method of injury in a small percentage of cases (Schulz et al., 2003).

While there has always been some inconsistency in the treatment of PCL rupture, since the 1960s, many orthopaedic departments have argued for surgical reconstruction or repair. Some early studies, though of low methodological quality, made good arguments for high levels of patient satisfaction with conservative (non-surgical) treatment, and the general sentiment that the patients’ symptoms after rehabilitation did not “justify the economic problems and discomfort” of surgery (Dandy & Pusey, 1982). Even in a population of athletes, there was shown to be an 80% satisfaction rate with the functional outcome of a conservatively treated PCL injury, in terms of everyday, and athletic performance (Parolie & Bergfeld, 1986). These papers presented information that was at the time inconsistent with the common practice of many orthopaedic departments, which since the 1960s, had managed PCL injury surgically (Shirakura et al., 2001). Outcomes of PCL reconstructions have historically been less favorable than those of ACL reconstruction in terms of residual laxity or translation of the tibiofemoral joint (Pierce et al., 2013). For that reason, some orthopaedic departments choose to treat acute, isolated PCL
injuries non-surgically, with cast or brace immobilization and rehabilitation (Jung et al., 2008; Pierce et al., 2013; Shirakura et al., 2001). There is even a precedent for athletes with non-surgically treated PCL rupture to return to professional-level competitive sport (Iwamoto et al., 2003; Parolie & Bergfeld, 1986).

As far as conservative treatment goes, rehabilitation in the past has been rudimentary. It has focused on a period of immobilization with brace or cast in order to reduce acute laxity and shear, followed by strengthening exercises for the quadriceps, which are generally regarded to help support the knee in the absence of the PCL (Margheritini et al., 2002). More recent attempts at creating a set of guidelines for conservative rehabilitation of acute PCL injury have created a more technically sound and comprehensive framework for rehabilitation. Pierce et al (2013) felt that a period of restricted range of motion (ROM), either in an adjustable hinged knee-brace, or a dynamic anterior drawer – “PCL Jack brace“ from 0° to 60° of flexion, with partial weight-bearing should accompany early simple quadriceps strengthening and hamstring and gastrocnemius stretching; this protocol would advance to include closed kinetic chain exercises and a gradually increasing ROM, before advancing to agility and sport specific exercises. Rosenthal et al. (2012) argued for partial weight-bearing and cast or brace immobilization of the knee in full extension to accompany isometric quadriceps strengthening, before advancing to closed chain exercises with a focus on eccentric strengthening. Both sets of authors agreed to avoid early activation of hamstrings, while initially limiting weight-bearing and knee flexion, and while the details differ, the core concepts in the protocols are very similar, and both groups claim good results from use of the protocol in terms of return to sport and quality of life. While there is no physical therapy clinical practice guideline for treatment of isolated PCL injury, it is generally agreed upon that treatment should consist of initial immobilization or restriction of range of motion, as well as maintaining or
increasing quadriceps strength, and maximizing proprioception and neuromuscular control of the affected knee.

Recently, there has emerged, a meaningful body of evidence that points towards both an increase in the incidence of knee joint arthropathy and altered stresses to the tissues of the knee in non-operative cases compared to those treated with PCL reconstruction (Okazaki et al., 2015; Orita et al., 2015). Overall, the body of evidence on the subject is of low quality, and contains no long-term randomized controlled trials comparing those with reconstruction versus those with conservatively treated PCL injury in terms of function, activity tolerance, and joint health. This is reflected in the capricious nature of the prevailing sentiment towards the best way to treat isolated PCL injury in the orthopaedic community. This paper seeks to compile the relevant research and analyze it for quality, methodology, and pertinence to the focus of long-term function and return to sport.

**Case Description**

The patient who was the inspiration for this paper was a young, athletic male in his mid-twenties who had injured his left knee two weeks prior to his visit to a rural New Mexico outpatient physical therapy clinic. The method of injury was such: while running at speed, the individual fell to his knees and slid exhausting his forward momentum, with his knees flexed and ankles plantarflexed. He did note a catch and “crunching” noise upon standing that did not return subsequently. There was no immediate effusion, but the next day, the patient noted some mild swelling without bruising. The patient also gave subjective reports of feeling excess motion when flexing the left knee immediately after the injury and in the two weeks following.

Upon examination, his lower extremity range of motion was grossly normal, but he guarded against and did not feel comfortable moving into full knee flexion either passively or actively. His strength was also
grossly normal, but knee flexion on the left side was slightly limited due to pain. The patient’s gait was abnormal in that he lacked heel strike on the left and walked only on the toes and forefoot of the left foot, while exhibiting reduced knee and hip flexion as well as reduced step length on the left side. In supine with the knee and hip flexed to 90°, there was no observable posterior sag, however there was a positive posterior drawer test which revealed moderate laxity, as well as a dial test that was positive for PCL sprain, but equivocal for posterolateral corner involvement. There was mild swelling of the left knee joint upon examination. Tests for involvement of other ligaments were negative.

The patient was an avid runner, as well as a recreational soccer player, and regularly engaged in a number of other physical and athletic activities. Physical activity was obviously an important part of his life and one of his main goals for therapy was to return to his prior level of activity without pain. He was also adamant that he did not want to return to sport too early if it would risk the health of the joint in the long term. He had questions for the practitioner regarding the possibility of ligament reconstruction, although he admitted he was very hesitant to undergo surgery unless it was absolutely necessary. Essentially, his sentiment was that he wished to try conservative treatment, and if that did not facilitate a return to prior level of function in terms of sport and activities of daily living, then he would consider surgical intervention.
Methods

Search
A search was conducted using three databases: PubMed, Google Scholar, and CINAHL. In PubMed, the terms “posterior cruciate ligament [MeSH]” AND “conservative treatment” OR “nonsurgical treatment” OR “non operative treatment” were searched and returned 35 results. In Google Scholar the terms, “posterior cruciate ligament” AND (“conservative” OR “nonsurgical” OR “non operative”) AND “surgical” were searched in various combinations and returned 212 results. In CINAHL, the terms “posterior cruciate ligament” AND “injury” AND “conservative” were searched and 15 results were returned. Some of the selected articles were found in multiple search engines, but 8 total were selected for review.

Inclusion/Exclusion Criteria
Articles were included if they were: available in full text; English language; regarding human subjects; randomized control trials, or prospective or retrospective cohort studies. Articles were excluded if they were: not relevant to the topic; literature reviews; opinion articles; or surgical or rehab protocols.

Article Reviews

Reference #1


Level of Evidence: 2a PEDRO score: N/A

Purpose: This systematic review proposed to review the literature regarding treatment of isolated PCL injuries. It was noted that there is a wide variety of conclusions regarding the best type of treatment for isolated PCL injuries amongst the literature on the subject. Some studies have concluded that conservative management (non-operative) results in drastically increased risk of knee joint degeneration and osteoarthritis, while other studies have shown very favorable functional outcomes for
Rehabilitation of Isolated PCL Injury: Long-term Function and Return to Sport

conservatively treated PCL injuries. Furthermore, with recent and ongoing advances and investigations into methods of reconstruction for PCL injury, there is further room for study on this topic, as it is possible that new methods will produce significantly better results than did older methods, or conservative management.

Methods: PUBMED, EMBASE, and Cochrane databases were searched using a variety of search terms, and the results narrowed down based on the following inclusion criteria: English language, human subject, stability outcomes measures, and subjects with isolated PCL injury. After further narrowing the search based on relevance, 4 individual studies and 2 systematic reviews (consisting of 19 individual studies) were included, totaling 23 studies for final review, 3 of which dealt with conservative treatment and 20 of which measured outcomes after surgical reconstruction. The outcome of interest for the study was ‘stability’, measured as side-to-side-difference (STSD) in posterior translation, measured in millimeters by both the Telos, and KT-1000 arthrometer devices.

Results: The systematic review found that the average STSD in studies dealing with conservative treatment ranged from 3.5 to 5.3 mm (Telos) and from 3.0 to 5.2 mm on KT-1000, while the average ranged from 2.0 to 3.7 mm (Telos) and from .7 to 5.9 mm (KT-1000) in the studies dealing with surgical repair as a treatment. In addition, weighted means were obtained from the pooled results in both groups, but showed very different result: the estimated weighted mean in STSD was 3.49, 95% CI [.95-6.03] (Telos) and 2.64, 95% CI [.76-4.51] for conservative treatments, while it was 8.09, 95% CI [7.11-9.07] (Telos) and 8.45, 95% CI [6.44-10.47] (KT-1000) for surgical repair. While this statistic presents the very opposite picture of the two treatments, it was generally disregarded by the authors.
Bottom Line: This is an article with a relatively high level of evidence when compared to most of the studies being done on this topic. Its quality is further improved by the fact that it is a systematic review of many diverse studies. However, there are some issues to be taken with the research. First, it notes that most of the studies it included were low level evidence (only 4 of the included studies were level 1 or 2 evidence), and frequently methodologically flawed. Second, it does not include any functional measure in it outcomes, only joint laxity, which cannot be directly linked to function – although the authors seek to justify this by arguing that reducing laxity (improving biomechanics) will result in better kinematics, and therefore should result in less degenerative disease later in life. Last, the authors make a point to calculate statistics based on weighted means, but fail to address the results, and their discrepancy with the other measures. Essentially, this study argues that surgical reconstruction will result in less laxity, therefore reducing the risk of degenerative arthritis later in life, although, surgery admittedly carries the risk of complications, which were numerous and ranged from reduced range of motion to arthrofibrosis and surgical site infections. The bottom line is there is most likely a better overall outcome for most people with surgery versus conservative treatment, but also more risk for complications.

Reference # 4

Level of Evidence: 4  
PEDRO score: 3/10

Purpose: PCL injuries are relatively common in athletes, but no treatment guidelines have been established for athletes or non-athletes. The purpose of this study was to demonstrate the efficacy of
Rehabilitation of Isolated PCL Injury: Long-term Function and Return to Sport

conservative treatment of isolated PCL injuries in high level and professional athletes. It is generally accepted that conservative treatment is the preferred treatment for isolated PCL injuries, and that functional outcomes are generally adequate for the general public, as well as athletes, even if objective measures of laxity may remain after conservative rehabilitation. However, there is very little high quality research available regarding the functional outcomes of high level and professional athletes using a non-operative approach to their rehabilitation from isolated PCL injuries.

Methods: Two professional baseball players, a catcher and an outfielder, who presented to the Department of Sports Medicine at the Keio University School of Medicine with complaints of knee pain after acute injuries were diagnosed by MRI with isolated tears of both bundles of the posterior cruciate ligament. They opted for conservative treatment, and began with 3 weeks of immobilization of the knee in full flexion in a brace. Quadriceps strengthening exercises were performed both while in the immobilizer (isometric) and after its removal and eventually, running exercises were initiated. The exact exercises performed in therapy were not reported.

Results: At 6 and 8 weeks, the subjects were allowed to return to sport, and were able to return without incident. The first (catcher) gave subjective reports of pain and swelling during and after athletic performance, that subsided and eventually disappeared with time. The second subject (outfielder) maintained subjective reports of instability during running that did not significantly affect his performance. The first subject showed maximum torque of the quadriceps and hamstrings that were greater in the injured knee compared to the uninjured knee, while the second subject showed lower maximum torque for the quadriceps of the injured knee compared to the uninjured knee. The results for his hamstrings were equivocal. While the second subject maintained complaints of subjective instability
while running, it should be noted that the objective laxity of his injured knee was less than that of the first subject, who reported no instability.

Bottom line: This study demonstrates the possibility for even athletes at the highest level of competition to quickly return to sport after isolated PCL injury, with only a short bout of conservative physical therapy and immobilization. Surgical repair of the PCL ligament would require many months of immobilization, non-weight-bearing status, and muscular rehabilitation, that many athletes, especially at the top levels are not willing to endure. Since both athletes in this study were able to return to sport at the same level in less than 2 months, and maintain their performance for at least 2 years, with minimally invasive treatment, there is a good argument for non-operative rehabilitation of athletes with isolated PCL injuries who are attempting to return to sport. However, this is merely a case report, gives few functional outcomes, does little to quantify performance, and vaguely represents the physical therapy administered, and therefore it should not be used in isolation to make the decision to treat non-operatively.

Reference # 6


Level of Evidence: 2  
PEDRO score: 10/10

Purpose: The purpose of this study is to evaluate functional and stability outcomes of two different techniques for surgical reconstruction of the PCL. Both techniques (double-bundle, and single-bundle) involve the creation of tibial tunnels through which a tibialis anterior tendon allograft is passed and
secured. There is much debate among surgeons who routinely do this procedure about which of several methods produces the best results in terms of stability and functional outcomes, and indeed individual surgeons often make claims regarding the successes of their surgeries that may be difficult for other surgeons to reproduce. The double-bundle technique is newer and reflects a recent move amongst orthopedic surgeons to perform more anatomical reconstructions, in this case, replicating the anterolateral and posteromedial bundles of the PCL, in order to preserve the most natural arthrokinematics possible.

Methods: For a two year period between 2007 and 2009, 69 individuals presenting with grade 2 or 3 PCL injury to the Third Hospital of Hebei Medical University in Shijiazhuang, China were enrolled in the study. For a change of 2.0 mm in decreased posterior translation, which was considered a clinically significant effect size, it was determined that each group would require 20 participants to achieve 80% power. Of the 69 enrolled subjects, 10 refused surgical treatment and 9 had multi-ligament injuries which excluded them from the study. The 50 remaining individuals were randomized to either the double-bundle or the single-bundle group. All examiners were blinded to allotment, and all surgeries were conducted by the same surgeon. The single-bundle graft was done with a 10 mm diameter tendon bundle, while the double-bundle consisted of a 6 mm diameter posteromedial bundle and a 7 mm diameter anterolateral bundle. The single bundle was placed through two tunnels (one in the tibia and one through the femur), while the double-bundle was placed through four tunnels (two in the tibia and two in the femur). All patients had the same postoperative rehabilitation, consisting of 6 weeks in a long leg brace with non-weight bearing orders. Knee flexion exercises began 1 week post-surgery, and at 8 weeks, participants were allowed to fully bear weight through the limb. Participation in sport was allowed at 1 year post-operatively.
Results: Of the 50 participants, 4 were lost to follow-up (3 in the single-bundle group, 1 in the double-bundle group) due to moving far away, or changes in phone number that precluded communication of follow-up assessments. The remaining subjects were evaluated pre-operatively, then at 3, 6, 12, and 24 months post-operatively, using a KT-1000 arthrometer to measure posterior translation, and the Lysholm, Tegner, and IKDC scales which all assess knee function, pain, swelling, and other metrics. There were improvements in Lysholm and Tegner scores for both groups and no significant between group difference. IKDC objective and subjective scores showed significantly better improvement at final follow-up for the double bundle group. As well, there was a larger effect on reducing posterior tibial translation noted in the double bundle group at final follow-up. It should be noted however, that just over 26% of the total study participants were graded on the IKDC objective scale as having abnormal, or severely abnormal knees, even after reconstruction. There were no reported adverse events as the result of the reconstructive surgeries.

Bottom-line: The results of the study indicate that either surgery is likely to improve patient satisfaction with their knee, and produce good results in terms of stability of the knee joint. The double-bundle technique fared better in terms of outcomes, but is also a slightly more time-consuming and expensive surgery. The study emphasis was definitely on the increased stability produced by the surgery, and unfortunately, there was little attempt to quantify the subjective (functional) patient outcomes, and on average, the participants averaged scores in the range of 15% to 35% impaired in terms of function at final follow-up. This seems to be on the low side of functional outcomes considering the procedural costs and rehabilitation time required post-surgery.
Rehabilitation of Isolated PCL Injury: Long-term Function and Return to Sport

-Reference # 11


**Level of Evidence: 4**

**PEDRO score: 3/10**

Purpose: The purpose of this study was to investigate the effectiveness of nonoperative treatment of isolated PCL. This is an older study performed by investigators at the Sports Medicine Section of the Cleveland Foundation Clinic in order to justify their choice to treat such injuries non-operatively. They felt that the typically good outcomes obtained in their clinic, in addition to the decreased cost and patient investment of conservative treatment, made it a good treatment choice, and were seeking to verify this assertion with evidence.

Methods: Twenty-five subjects (11 acute subjects presenting to the clinic within 24 hours of injury, and 14 with chronic (old) PCL injuries that played for teams managed by the clinic) with isolated PCL injury were obtained. Most were injured in a number of athletic settings, but one obtained injury in a motor vehicle crash, and one in a fall. Subjects with acute injuries were treated with a Lennox Hill Brace that prevented full extension and they began immediately performing active range of motion, and progressive resistive hamstrings and quadriceps strengthening, with the focus being on the quadriceps. Subjects with chronic injuries were provided a strengthening program minus the brace. At follow-up, measurements were taken of both active and passive posterior drawer tests using a KT-1000 arthrometer and compared side to side. Additionally, subjects were placed in a Cybex and quadriceps strength was compared side to side at three different velocities (45, 90, and 180 deg/sec). Finally,
subjects received lateral radiographs to determine presence of joint space narrowing (osteoarthritis), and/or signs of early arthritic changes to the joint.

Results: Both objective (posterior translation, quadriceps strength, joint space) and subjective measures (questionnaire regarding subject satisfaction, return to prior level of function, pain, etc.) were taken of all original study participants. Most participants (80%) were satisfied with their involved knee after treatment; 76% rated their knee as being 75-100% as well-functioning as prior to injury; 68% had full return to previous level of activity without impairment; 36% did show evidence of arthritis upon lateral radiograph. Active drawer test revealed significantly less posterior translation in those satisfied with their knees, and quadriceps strength was greater on the involved side, for all three testing velocities, in all those satisfied with their knees. Interestingly, for those with acute injuries that were treated immediately with standardized, vigorous physical rehabilitation, involved quadriceps strength was greater than uninvolved at all three velocities, satisfaction was 100%, and return to sport at same level without impairment was 100%.

Bottom line: There is definitely the potential for very good recovery and return to prior level of function (return to sport) for those with isolated PCL injury being treated nonoperatively. The bottom line is that outcomes are best in individuals who are able to receive immediate and appropriate therapy for their injury. Quadriceps strength and motor control are essential to controlling posterior translation, and in those who are able to increase quadriceps strength and reduce posterior translation by proper co-contraction and quadriceps control, return to sport outcomes will be improved. There is, as with any ligamentous injury, an increase in the likelihood of the development of arthritis, however the development of arthritis is not necessarily related to time since injury. This means that the likelihood of the development of arthritis is not predetermined, is likely unique to each injury, and depends on many
factors, including the severity and complexity of the injury, the quality of rehabilitation, and the ability or lack thereof to control posterior translation.

Reference # 13

**Level of Evidence: 2c**

**PEDRO score: 3/10**

Purpose: The purpose of this study was to observe the progression and natural history of a patient with acute PCL injury throughout time, in terms of subjective scoring of the knee (Noyes knee score), objective assessment of the knee including stress radiographs and arthrometry to evaluate posterior translation (laxity), plain films to determine presence or progression of joint degeneration, incidence of meniscal injury, and quadriceps strength. One previous study had prospectively looked at patients with isolated PCL injury and collected similar measurements, however the follow-up for that study was short (mean 2.6 years) and it only consisted of 13 participants. That study found that while only 3 out of 13 participants achieved good objective results (low grade of laxity), all 13 obtained good subjective results in terms of functional scores.

Methods: 142 consecutive patients at the Indianapolis Methodist Sports Medicine Center seen for acute PCL injury were initially enrolled in the study. Four decided to have PCL reconstruction elsewhere, and 5 could not be located for follow-up. The remaining 133 were through physical examination, arthrometry, and radiographs, deemed to satisfy inclusion criteria (posterior laxity, positive posterior drawer) and not the exclusion criteria (other ligamentous laxity, bony avulsion injury, chronic nature of injury).
Participants were also asked to fill out serial Noyes knee score forms at least one year apart in order to track the progression of function and subjective participant evaluation. About one half of the study participants (68) returned for a final physical examination.

Results: At final follow-up, it was found that 63 of 68 participants had laxity less than on initial exam, while 5 had greater. Thirty-nine of 68 participants had no evidence of degeneration; 15 had evidence of degeneration that was equal in both knees; 3 had evidence of degeneration in the uninvolved knee only; 10 had evidence of degeneration in the involved knee only. It was found that incidence of degeneration in the involved compared to uninvolved knee was not statistically significant, although likely clinically relevant due to its prevalence. Participant subjective scoring of their involved knee was generally high, whether they returned for follow-up examination or not (Noyes mean score of 85.6/100 and 82.8/100, respectively), and was found to be unrelated to objective laxity. Return to sport was also generally good, with roughly one half of participants returning to the same or higher level of sport.

Bottom Line: The vast majority of patients treated nonoperatively in this study experienced no decline in subjective scores over time, which ranged from 2.3 to 11.4 years of follow-up. There was also no change in objective assessment from initial injury to follow-up, including laxity of the knee. Increased posterior laxity in the knee was not associated with decreased subjective scores, or ability to return to sport. While there was some likely correlation between PCL injury and knee joint degenerative changes on the involved side, the incidence was not statistically significant, and again was not related to degree of posterior laxity in the knee. More than 80% of the participants were able to return to their same sport after injury, with about one half of the total population returning to the same or higher level of competition; there were only 2 participants in the entire study who were not able to return to any sport.

**Level of Evidence**: 4  
**PEDRO score**: 2/10

**Purpose**: The purpose of this study was to investigate whether or not conservative, non-surgical treatment was effective for patients with isolated PCL injury. Previous research and publications had come to equivocal conclusions, some asserting that the PCL was not essential for maintaining proper joint mechanics and would not lead to degenerative changes in the knee, while other had postulated that degenerative change is directly linked to the amount of time since injury (i.e. without reconstruction of the PCL, the knee joint will continue to degenerate at a faster than normal rate).

**Methods**: Twenty-two participants were selected from amongst those presenting at Osaka Rosai Hospital with isolated PCL injuries. They were selected based on the criteria: greater than 5 mm of abnormal posterior displacement of the tibial plateau during posterior drawer and posterior sag tests; negative Lachman; negative varus/valgus instability; no excessive external tibial rotation; no pivot shift; no genu recurvatum; no previous injury to knee; radiographs showing closed epiphyseal plates; and no bony lesion or arthritic changes. The 22 subjects’ knees were then subjected to arthroscopy to determine the presence of other (non-ligamentous) articular lesions. Arthroscopy showed that no patients had any other ligamentous damage, and indeed the PCL was at least 70% attenuated in all 22 individuals. All of the individuals who were treated non-operatively, and were deemed safe to return to sport were assessed at a mean follow-up time of 51 months (range: 24 to 96 months) using the International Knee Documentation Committee (IKDC) subjective self-evaluation form.
Results: Those with grade III or IV injury to the medial femorotibial articular surfaces (4 individuals) were excluded, and recommended not to return to sport. Two subjects who had sustained lateral meniscal tears in addition to PCL injury, were deemed to be candidates for surgical reconstruction and repair and were also excluded. One participant underwent surgery due to persistent instability, and another was encouraged to stop his sport due to the progression of a Grade II to a Grade III chondral lesion before his follow-up. This left 14 participants who were able to return to sport without surgery. Of the 14, 11 were able to resume their same level of activity without surgical repair. Of the 3 who were cleared to return to sport, but were not able to maintain the same level, one stopped for social reasons, and another not because of his initial injury, but because of an ACL injury to the contralateral leg. Of the 13 subjects who were considered cleared for sport at follow-up, none had arthritic symptoms, 3 scored normal, 5 nearly normal, and 5 abnormal on the IKDC evaluation.

Bottom Line: This is a fairly low quality piece of research due to its design, which is poor in terms of controlling for bias, and depth of statistical analysis. It also has a very small number of subjects, and presumably is lacking in diversity. It fails to do much in-depth statistical analysis, and instead gives its results in terms such as “most participants were able”, etc. However, the study’s outcome measure (IKDC subjective form) is appropriate for athletes returning to sport, and it does offer some support for the conservative treatment of isolated PCL injuries, as well as the suggestion that perhaps the chondral injury that often accompanies a PCL injury is the major player in declining function of the injured knee, not the deficiency of the PCL. This study would inform treatment of a patient with PCL injury, by illustrating the importance of evaluation of the knee cartilage either by arthroscopy or MRI.
Reference # 16


**Level of Evidence:** 2b **PEDRO score:** 4/10

Purpose: The purpose of this study was to compare long-term stability and functional outcomes of operative (suture repair) versus non-operative treatment of isolated PCL injuries. The research in this area is evenly split two ways, with a fair number of articles indicating that treatment of PCL injuries conservatively results in poor stability and eventual cartilage damage and joint degeneration, and a decent number of studies suggesting that there is no functional difference between treatments, including one previous study by one of the authors which suggested that primary suture repair often lead to persistent instability. The study was particularly pertinent to the authors and the efficacy of their own treatment methods, as they had as a group treated all patients with acutely torn PCLs surgically until 1986, when the previously noted study called into question the efficacy of the repair surgery, at which point all patients with isolated PCL injuries were then treated non-operatively.

Methods: The authors of the study retrospectively compared 20 patients (from 1982 to 1986) who had had a primary repair of an isolated PCL tear using an end-to-end multiple suturing technique, to 20 patients (from 1986 to 1990) who were treated non-operatively. The non-operative subjects received 4 weeks of immobilization in full extension with immediate isometric quadriceps activation, weight bearing allowed at 3 weeks, and isotonic and range of motion exercises at 4 weeks. The operative group received the same treatment in their post-surgical rehabilitation. Outcomes measures for the two groups included displacement ratio (DMR), a measurement of passive stability obtained by lateral stress radiograph taken with a 147 N anterior to posterior force applied to the proximal tibia, and a knee rating
score based on a 100 point scale developed by the Japanese Orthopaedic Association for grading knee ligament injuries.

Results: The results of the study showed that the patients who were treated with end-to-end multiple suturing repair had significantly (p<.0001) higher DMR scores, indicating increased passive stability and decreased posterior tibial translation upon application of force as compared to the conservatively treated group. These scores ranged from 43 to 59%, (mean 46.9 ± 3.7) for the operative group, and from 28 to 45%, (mean 37.1 ± 4.8) for the non-operative group at follow-up. On the other hand, the knee rating scores for the operated and non-operated groups were from 78 to 100, (mean 92.9 ± 5.1), and from 84 to 95, (mean 90.9 ± 2.8) respectively at follow-up. The difference in knee rating scores between groups was determined to not be statistically significant. The DMR range for the operated group was still significantly lower than controls that had no PCL injury, indicating that even with surgical repair, abnormal passive knee motion persisted.

Bottom Line: This study makes a strong argument for gains in passive knee stability following surgical repair. However, functional knee rating outcomes showed no difference between operative and non-operative groups. One could argue that passive joint movement or laxity is not a very good measure of the health of a joint, and does not provide much insight into the way that a joint moves actively, during weight bearing and activities, and therefore does not necessarily provide insight into how a joint will change over time in terms of chondral wearing and degeneration. One might also posit that in the absence of data regarding the function of the joint decades down the line, the subjective measurement of knee function is, in this instance, of greater importance. Seeing as the study showed no difference between the operative and non-operative groups in terms of function and subjective assessment of the
knee, the bottom line is that PCL repair will result in greater passive stability of the knee joint, but not in any functional difference after appropriate rehabilitation.

Reference #19

Level of Evidence: 4  
PEDRO score: 3/10

Purpose: The purpose of this study was to investigate the effectiveness of conservative (non-surgical, without immobilization) rehabilitation of athletes with isolated PCL injuries for return to sport. Previous studies have looked at conservative management in terms of general function outcomes in conservative treatment of PCL injuries, but little high-quality research exists that addresses the ability of high-level athletes to return to sport, using only conservative management.

Methods: The study was conducted on 16 male athletes, all competitive rugby players who had received an acute, isolated PCL injury (diagnosed via manual instability tests and T2 weighted MRI). All subjects were treated conservatively (no surgery or immobilization) with immediate strengthening and range of motion exercises, as well as anti-inflammatory drugs, and were allowed weight bearing as tolerated status. At a one year follow up, all participants completed a questionnaire regarding their time until return to competition, reasons for prolonged rehab (greater than 3 months), and changes in athletic abilities measured by subjective report of current ability to do a variety of rugby-specific skills (e.g. tackling, kicking, high speed running) compared to prior ability.
Results: Fourteen of the 16 study participants (88%) were able to return to their prior level of competition. Of the 14 players who returned to sport, half (7) were considered to have a delayed return to sport (greater than 3 months of rehab). Amongst those who gave injury-related reasons (pain, laxity, etc.) for their delay in return to sport, the range of rehab was between 4 and 7 months, while several individuals who gave other reasons for their delay (work, graduation, other injury) took up to 10 months to recover enough to return to sport. Of the two study participants who had not returned to sport at 1 year, one had an additional unspecified chondral injury, and another a diagnosis of lateral discoid meniscus, and they cited pain and instability, respectively, as the reason for their inability to return to sport. For the 88% of participants who were able to return to their prior level of sport, most cited some decreased ability, with 9 out of 14 noting some reduced ability to do high speed running.

Bottom Line: In terms of the oxford or PEDRO scales, this is a low quality piece of evidence. It uses purposive sampling, and lacks a control group. In defense of this article, there are no high quality studies that provide any evidence as to the efficacy of different types of treatment strategies on the rehabilitation of PCL injuries, and it is an assumedly undervalued topic of research. The study matches its low quality research designation by using a low experimental design, and poor reporting. Specifically, there is little mention of the severity of PCL injury in each case (grade of sprain) and instead all injuries, regardless of severity, are lumped into the overarching category of PCL injury; furthermore, the sample is small and lacks sufficient baseline reporting, which should include more information regarding the subjects; lastly, the specific methodology of treatment is never mentioned. The bottom line is that this study is an interesting foray into the prospect of treating certain injuries conservatively, and while it produces some noteworthy results, it alone is not enough to inform treatment.
### Article Summary Table

<table>
<thead>
<tr>
<th>Author</th>
<th>Oxford Level of Evidence</th>
<th>Pedro Score</th>
<th>General Purpose</th>
<th>Outcomes Measures</th>
<th>Results</th>
<th>Answers the PICO? (yes/no)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ahn, S.</td>
<td>2a</td>
<td>N/A</td>
<td>To review the literature regarding surgical vs. conservative treatment of PCL injury and stability outcomes between groups.</td>
<td>Side to side difference in Posterior laxity</td>
<td>Side to side difference in posterior translation was found to favor studies conducting reconstruction surgeries. However, complications, ranging from loss of ROM, to infection, and nerve damage, occurred only in the surgical groups, at rates between 4.1% and 26.7% of surgeries.</td>
<td>no</td>
</tr>
<tr>
<td>Iwamoto, J.</td>
<td>4</td>
<td>3/10</td>
<td>To assess the viability of nonsurgical treatment of isolated complete PCL rupture in 2 elite-level, professional baseball players.</td>
<td>Posterior translation, Return to Sport</td>
<td>In both cases, the players were able to return to their positions, without complaints of subjective instability after less than 2 months of nonsurgical rehabilitation.</td>
<td>yes</td>
</tr>
<tr>
<td>Li, Y.</td>
<td>2</td>
<td>10/10</td>
<td>To assess differences between two techniques of isolated PCL reconstruction (single-bundle vs. double-bundle) in terms of subjective and objective scoring.</td>
<td>Posterior laxity, Lysholm score, Tegner activity score, IKDC score</td>
<td>The double-bundle technique yielded significantly better results in terms of laxity and IKDC score, but was statistically no better than the single-bundle technique in terms of Tegner or Lysholm score. More than one quarter of operated knees received IKDC scores of abnormal or severely abnormal after surgery.</td>
<td>no</td>
</tr>
<tr>
<td>Author(s)</td>
<td>Journal</td>
<td>Citation</td>
<td>Study Design</td>
<td>Primary Outcome Measures</td>
<td>Study Results</td>
<td>Conclusion</td>
</tr>
<tr>
<td>---------------------------</td>
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</tr>
<tr>
<td>Parolie, J. M.</td>
<td></td>
<td>4</td>
<td>3/10</td>
<td>To track the long term functional results and ability to return to sport in athletes with PCL injury, in order to assess the necessity of surgical reconstruction</td>
<td>Posterior translation, Quadriceps strength, subjective questionnaire</td>
<td>80% of participants were satisfied with their knees, 76% rated their knee to be between 75 and 100% of normal. 68% had full return to previous level of sport without disability, 16% returned to same level with subjective feelings of decreased performance, 16% did not return to the same sport, or returned at a lower level</td>
</tr>
<tr>
<td>Shelbourne, K. D.</td>
<td></td>
<td>2c</td>
<td>3/10</td>
<td>To track the ‘natural history’ of patients with isolated PCL injury, treated without surgery with long-term follow-up in terms of objective and subjective results.</td>
<td>Posterior laxity, Tegner activity score, Lysholm score, Noyes knee score</td>
<td>Laxity remained static or decreased over time; Increased laxity was not correlated with decreased subjective scores or ability to return to sport</td>
</tr>
<tr>
<td>Shino, K.</td>
<td></td>
<td>4</td>
<td>2/10</td>
<td>To track the joint health and ability to return to sport of athletes with conservatively treated isolated injury to the PCL.</td>
<td>IKDC activity level, return to sport</td>
<td>Of those participants without significant cartilage damage (14), 11 returned to their same level of sport, 1 stopped sport due to social reasons, 1 due to a subsequent injury to the other knee, and 1 due to subjective complaints.</td>
</tr>
<tr>
<td>Shirakura, K.</td>
<td></td>
<td>2b</td>
<td>4/10</td>
<td>To compare two groups of patients with isolated PCL injuries:</td>
<td>Japanese Orthopaedic Association scale for knee ligament</td>
<td>No significant difference is knee degeneration between groups; laxity was lower in the surgical</td>
</tr>
<tr>
<td>Toritsuka, Y.</td>
<td>4</td>
<td>3/10</td>
<td>To prospectively examine the return to sport of rugby players, with conservatively treated PCL injury, and determine what specific skills were most affected by the injury.</td>
<td>Subjective rating of rugby-specific skills</td>
<td>14 of 16 participants returned to the same level of sport, with a mean return time of 3 months. Return to sport was generally good, although some participants did report some decreased ability in regards to certain skills, including high speed running, quick turning, and jumping.</td>
<td>yes</td>
</tr>
</tbody>
</table>

PCL – Posterior Cruciate Ligament; ROM – Range of Motion; IKDC – International Knee Documentation Committee
Discussion

The articles chosen for review in this analysis are all lacking in some way. For the most part the available literature is of low methodological quality, and is graded at a low level of evidence according to the Oxford Center for Evidence Based Medicine or Pedro scales. One systematic review looked at 40 different studies that reported on the results after treatment of isolated PCL injury (either surgical or conservative). It scored each study using the modified Coleman methodology scale, and found an average rating of 52/100, with no correlation between methodological quality and reported results, and could determine no difference in results between surgical and conservative treatment, at least in part due to the fact that there were 12 outcomes scales used between the 40 studies (Watsend et al., 2009).

Of the articles that dealt with conservative treatment only for isolated PCL injury, reported outcomes tended to be good but not great, in that most participants returned to sport, but relatively high numbers of people never achieved their same prior level of function in terms of return to sport, ability to do activities of daily living, or pain. Shino et al. (1995) looked at 19 athletes that were treated conservatively for isolated PCL injury, found that 5 participants could not return to the same level of sport either due to significant cartilage injury that was concomitant to their PCL injury, or additional, unrelated ligament injury; however, all 14 participants without serious coexisting chondral damage or subsequent injury were able to return to their same sport, 11 at the same level, and 3 at lower levels of competition. A study of competitive male rugby players found that 88% were able to return to their same level of sport without surgery, but many felt that their performance suffered somewhat after the injury; in particular in the area of high speed running, 9 out of 14 participants felt their ability was affected by the injury (Toritsuka et al., 2004). Parolie and Bergfeld (1986) found similar results at an average of 6 year follow-up, in terms of return to sport, reporting that 84% of participants returned to their sport, 68% at the same level, and 16% at a lower level. Overall satisfaction with function of
participants’ knees was 80% with conservative treatment, and it was noted that all patients that were evaluated and began rehabilitation in the acute phase of their injury returned to the same level of sport and were satisfied with their knees, while all participants who did not return to the same level or were unsatisfied had inconsistent or delayed rehab. Another study with a 5 year follow-up found that 50 percent of athletically active participants returned to and remained at the same or higher level of sport after conservative treatment, and another third of total participants returned to the same sport but at a lower level of competition (Shelbourne et al., 1999). Unfortunately, all of these studies were single group cohort designs that can make no comparison to the long-term functional outcomes of surgical repair or reconstruction.

Only two of the selected studies directly compare surgical and conservative outcomes. Shirakura et al. (2001) compared two equally-sized groups of participants treated either surgically, with suture repair and immobilization, or conservatively with just immobilization. They found that while the operated-on knees were more stable (i.e. had less posterior translation on arthrometry), there was no significant difference between groups in terms of knee function or subsequent joint degeneration at follow-up. One recently conducted systematic review, which had the highest level of evidence of the articles reviewed, looked at 3 studies reporting on the results of conservative treatment and 20 studies on the results of surgical intervention (Ahn et al., 2016). The authors’ only outcome measure was side to side difference in posterior laxity, which was found to be significantly lower in participants with surgically treated knees, and which is also supported by Shirakura et al. (2001). There were, unfortunately, no functional outcomes used in this study (Ahn et al., 2016). Previous studies, although lacking in their methodology, have adequately determined there to be no relationship between degree of arthrometer-measured laxity and participant satisfaction or functional ability either with regard to activities of daily living or return to sport (Parolie & Bergfeld, 1986; Shelbourne et al., 1999).
Similar to the cohort studies reporting on the outcomes of conservative treatment, a study by Li et al. (2014), which compared the results of two different Transtibial PCL reconstruction techniques, delivered generally favorable results concerning laxity as well as function. The authors showed that while a double-bundle PCL graft was significantly better than a single-bundle technique in terms of laxity on arthrometry, there was an equivocal difference in terms of knee function between groups. The functional outcomes obtained in this study (Lysholm Scale and Tegner Activity Scale) were determined to be between 88 and 90 and between 6.2 and 6.4 respectively, and were similar to, but slightly higher than the results of Shelbourne et al. (1999), which obtained Lysholm and Tegner scores of 83.4 and 5.7 respectively after conservative rehabilitation. This article was included to show that there is not a clinically significant difference in outcomes amongst surgical techniques, and that conservative rehab can be generally compared to operative treatment, regardless of the specific technique implemented. It has also been shown that there is no significant difference between Transtibial and tibial inlay techniques, which are the two existing surgical options for PCL reconstruction (Shin et al., 2016). It should be noted that when weighing the benefits and risks of surgery versus conservative treatment, there has been found to be a relatively high incidence of complication with surgical intervention for PCL repair or reconstruction. Of the complications listed, limited range of motion was the most common and benign, while some, such as graft site infection, arthrofibrosis, and Regional Sympathetic Dystrophy, were more concerning (Ahn et al., 2016). In addition, PCL reconstruction surgery often results in substandard outcomes, as evidenced by 26% of surgical patients being rated as having abnormal or severely abnormal knees in regards to function and stability (Li et al., 2014).

Surgeons who perform PCL reconstructions might argue that decreased joint laxity provides better arthrokinematics over the life span and reduces wear and tear on the joint, however there have been few attempts in the literature to compare long term joint health between groups of individuals who
were either treated surgically or conservatively. The only study found in this literature search attempting to do so dealt with PCL repair, not reconstruction, but found at 6 year follow-up that operated-on knees were not less likely to have gone through degenerative change, as evidenced by stress radiographs; in fact, there were three operated-on knees that showed evidence of degenerative change compared to one from the conservatively treated group. Furthermore, if elimination of joint laxity is the only sure way to prevent degenerative changes down the line, then it must be noted that while PCL reconstruction reduces knee joint laxity, it fails to normalize it, resulting in residual laxity when compared to uninjured knees (Shirakura et al., 2001). Moreover, damage to the articular cartilage at the time of PCL injury may in fact be as much a determining factor in future arthropathy as residual posterior laxity (Shino et al., 1995). Who then is to say what is an appropriate amount of reduction in laxity, enough to lessen the chances of arthritic change in joint later in life?

While all of the articles evaluated in this paper that dealt with outcomes of conservative treatment reported good outcomes, they either presented very simple explanations of their conservative rehabilitation, or failed to report just what the rehabilitation consisted of. Most studies utilized a period of immobilization with or without weight-bearing restrictions, and quadriceps strengthening exercises, then either a progression to running or back to practice for their specific sport (Toritsuka et al., 2004; Iwamoto et al., 2003; Parolie & Bergfeld, 1986; Shino et al., 1995; Shelbourne et al., 1999). From the perspective of a rehabilitation specialist these means of rehabilitation might seem lacking, and indeed, none of the analyzed articles utilized any of the more advanced rehabilitation measures as described in more recent tentative rehab guidelines by Pierce et al. (2012), and Rosenthal et al. (2012). It could be reasonably argued that if those same studies had utilized advanced rehabilitation techniques aimed at maximizing proprioceptive ability, neuromuscular control, and normalizing biomechanics of those with
PCL deficient knees, they would have yielded even better results with regard to function and incidence of joint degeneration at follow-up.

Utilization of specific rehabilitation techniques aside, all studies of conservative treatment of athletes with PCL injury yielded good results in terms of return to sport, even at the professional level, where physical demands would be expected to be very high. Some articles cite running at speed to be a task the performance of which suffers as the result of an isolated PCL injury (Toritsuka et al., 2004; Iwamoto et al., 2003); another determined running to be only minorly affected, while agility maneuvers such as cutting and turning were more problematic (Shino et al., 1995). Either way, even with some subjective reports of reduced ability to do certain athletic tasks, outcomes for return to sport were good on the whole. Return to sport was found to be possible for most athletes at around 3 months post injury with just conservative rehabilitation, although there are also outliers for whom full return to sport took more or less time (Toritsuka et al., 2004; Iwamoto et al., 2003).

Conclusion

Due to advances in surgical techniques, and increased understanding of surgical procedures, the outcomes of PCL reconstruction have vastly improved, and have been demonstrated to provide very good results with regard to joint stability and function. Stability outcomes, in particular, appear to be significantly better with surgical intervention than with conservative rehabilitation, while functional results have been in line with those of conservative rehabilitation. Ultimately, the research has drawn parallels between reconstruction surgery and stability, but has failed to show concrete connection between surgical intervention and less joint degeneration. Laxity may well be the primary cause of joint arthropathy, but if so, it has yet to be satisfactorily demonstrated as such in the literature. There is a
distinct lack of studies looking at the long-term joint health of people with surgically reconstructed PCLs. As well, there is a definite absence of any randomized controlled trials comparing conservative treatment and surgical reconstruction to controls in regard to long-term joint health and degeneration.

While it can be demonstrably argued that conservatively treated athletes can achieve their pre-injury capacity for performance in sport even at the professional level, there can be no guarantees that resumption of sport after isolated PCL injury will not lead to increased occurrence of degenerative changes and eventual osteoarthritis. In all likelihood, PCL injury is likely to increase the odds that one will eventually acquire osteoarthritis, whether the injury is treated conservatively or surgically, especially if activity levels are high. The benefits of surgical intervention are improved stability and reduced laxity, and possibly, though not necessarily, a higher level of function. However, the potential gains in function and stability that surgery might provide must be weighed against the financial, temporal, and emotional costs of surgical intervention, as well as the potential for surgical complications, and poor functional outcomes. Furthermore, in most instances, surgical reconstruction can reduce, but not completely normalize, posterior laxity.

The systematic reviews by Ahn et al. (2016), and Watsend et al. (2009) have come to different conclusions in terms of outcomes for conservative versus surgical treatment of isolated PCL injuries. While Ahn et al. concluded that surgical reconstruction resulted in better stability outcomes, Watsend et al. uncovered no difference in outcome, either with regard to stability or function. Both reviews, however, came to the same conclusion that there is a definite lack of high quality methodology and standardization of outcomes measures, as well as a general dearth of high level evidence in terms of the treatment of isolated PCL injury. Watsend et al. state that, based on the evidence available, there can be no firm recommendation given in regard to how to treat isolated PCL injury of any severity.
While it is true there is no clear answer to the question, the decision to treat conservatively or surgically must be made on an individual basis. The decision should be guided by the presentation of the patient, the severity of signs and symptoms, and the individual values and needs of the patient. For the patient who was the impetus of this paper, a safe return to sport could be considered his major goal for treatment, and surgery was only to be considered if it was the only chance of him achieving something similar to his prior level of function. Based on the evidence reviewed here in this paper, it seems that the patient and therapist arrived together at a very reasonable decision to treat the patient’s knee conservatively first and gauge the results and determine later if surgical reconstruction was warranted.

The chosen treatment for this patient was multi-tiered: it began with ceasing previous competitive and recreational activities such as running and soccer, periodic application of ice, a compression brace at the behest of the patient, and elevation, as well as discouraging activities that required knee flexion greater than 45 degrees of flexion, a home exercise program that consisted of quad sets and straight leg raises, and gait training; next more closed chain exercises such as squats and lunges were integrated into the home exercise program, as long as they were pain-free and performed in a restricted range of motion; grade 1 and 2 mobilizations were also integrated for pain control after exercise; the patient was counseled to very slowly increase the range of motion of the knee with exercises to his tolerance. Physical therapy treatment of the patient proceeded in this fashion, with good results, and after 4 weeks of therapy, the patient began to integrate short, low intensity jogging back into his routine. But for the occasional minor setback in regard to pain, the patient was able to gradually increase his activity level, while subjective instability of the knee steadily decreased.

In retrospect and in consideration of the aforementioned evidence, treatment of this patient was reasonable, but could have included immobilization or at least a brace-restricted range of motion, perhaps smaller than the 45 degrees that was allowed. There was also no implementation of higher
level agility and proprioceptive exercises as recommended by some of the previously noted rehabilitation guidelines. The patient was, however, largely satisfied with his outcome and at discharge from therapy, felt that his activity tolerance was still improving and would continue to do so, allowing him to satisfactorily return to his previous activities.

One of the major benefits of physical therapy as an adjunct to traditional western medicine is cost reduction, as the treatments received in the physical therapy office rarely approach the monetary cost of those of the hospital. That, in addition to the gestalt of the available evidence, is the basis for the conclusion of this paper. Conservative physical therapy treatment, in many if not most cases, is sufficient to help patients with isolated PCL injury return to their prior level of function with regard to sport and activities of daily living. In cases where there may be injuries to other structures, or symptoms persist or worsen with treatment, or objective or subjective laxity is severe enough to impede function, an orthopaedic surgeon should be consulted.
Appendix: Appraisal of evidence

Reference # 1

Systematic Review – Evidence Appraisal Worksheet

Citation:

Level of Evidence (Oxford scale): 2a

<table>
<thead>
<tr>
<th>Appraisal Criterion</th>
<th>Reader’s Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1 – formulating the question</strong></td>
<td>The authors clearly identify the focus and question of the review: they seek to compare two different interventions (reconstruction vs. conservative treatment) in terms of outcomes (laxity/joint translation) in those with isolated PCL injury (roughly 4:1 M:F ratio; ages in late twenties to early thirties), relying on relevant, available research.</td>
</tr>
<tr>
<td>- Do the authors identify the focus of the review</td>
<td></td>
</tr>
<tr>
<td>- A clearly defined question should specify the types of:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- people (participants),</td>
</tr>
<tr>
<td></td>
<td>- interventions or exposures,</td>
</tr>
<tr>
<td></td>
<td>- outcomes that are of interest</td>
</tr>
<tr>
<td></td>
<td>- studies that are relevant to answering the question</td>
</tr>
<tr>
<td><strong>Step 2 – locating studies</strong></td>
<td>231 initial identified studies, found from 3 databases, with well-defined search terms; lacking any mention of search for “grey literature”</td>
</tr>
<tr>
<td>- Should identify ALL relevant literature</td>
<td></td>
</tr>
<tr>
<td>- Did they include multiple databases?</td>
<td></td>
</tr>
<tr>
<td>- Was the search strategy defined and include:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Bibliographic databases used as well as hand searching</td>
</tr>
<tr>
<td></td>
<td>- Terms (key words and index terms)</td>
</tr>
<tr>
<td></td>
<td>- Citation searching: reference lists</td>
</tr>
<tr>
<td></td>
<td>- Contact with ‘experts’ to identify ‘grey’ literature (body of materials that cannot be found)</td>
</tr>
</tbody>
</table>
easily through conventional channels such as publishers)  
- Sources for ‘grey literature’

<table>
<thead>
<tr>
<th>Part 3: Critical Appraisal/Criteria for Inclusion</th>
<th>Relevance of studies was deemed based on objective inclusion criteria, and were not excluded on the basis of any methodological issues with studies (i.e. studies were not excluded because they may have been ‘low quality’ as deemed by one or more researchers. There was no reported blinding on article selection, and included is one study previously completed by the chief investigator.</th>
</tr>
</thead>
</table>
| • Were criteria for selection specified?          | • Did more than one author assess the relevance of each report  
- Were decisions concerning relevance described; completed by non-experts, or both?  
- Did the people assessing the relevance of studies know the names of the authors, institutions, journal of publication and results when they apply the inclusion criteria? Or is it blind? |

<table>
<thead>
<tr>
<th>Part 3 – Critically appraise for bias:</th>
<th>Selection methods for any of the included studies were not identified. Also, there is no mention of the blinding, or attrition for any of the individual studies included in the systematic review. Data is exhaustively reported, although not all of it is discussed adequately.</th>
</tr>
</thead>
</table>
| • Selection –                        | • Were the groups in the study selected differently?  
- Random? Concealed?  
- Performance-  
- Did the groups in the study receive different treatment?  
- Was there blinding?  
- Attrition –  
- Were the groups similar at the end of the study?  
- Account for drop outs?  
- Detection –  
- Did the study selectively report the results?  
- Is there missing data? |

<table>
<thead>
<tr>
<th>Part 4 – Collection of the data</th>
<th>No data form included. Coding is by lead author, and is easy to follow. Excluded studies are not identified in the study.</th>
</tr>
</thead>
</table>
| • Was a collection data form used and is it included? | • Are the studies coded and is the data coding easy to follow?  
- Were studies identified that were excluded & did they give reasons why (i.e., which criteria they failed). |
## Are the results of this SR valid?

<table>
<thead>
<tr>
<th>Appraisal Criterion</th>
<th>Reader’s Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Is this a SR of randomized trials? Did they limit this to high quality studies at the top of the hierarchies</td>
<td>The authors admit as a limitation to this study’s relevance the paucity of high quality research in this area. Most of the studies included are cohort designs of level 4 evidence, with very few RCT studies included. Unfortunately, there is yet to be an RCT comparing surgical and non-surgical treatment groups. The possibility exists that the results of this research are suspect due to the fact that they are based on poor quality research.</td>
</tr>
<tr>
<td>a. If not, what types of studies were included?</td>
<td></td>
</tr>
<tr>
<td>b. What are the potential consequences of including these studies for this review’s results?</td>
<td></td>
</tr>
<tr>
<td>2. Did this study follow the Cochrane methods selection process and did it identify all relevant trials?</td>
<td>Selection process was not well defined, and it can be assumed that the Cochrane method was not utilized adequately when selecting studies for this review. This introduces the possibility of bias into the study.</td>
</tr>
<tr>
<td>a. If not, what are the consequences for this review’s results?</td>
<td></td>
</tr>
<tr>
<td>3. Do the methods describe the processes and tools used to assess the quality of individual studies?</td>
<td>There is vague mention made to there being methodological flaws in many of the studies, but generally, studies were not excluded based on quality, only on relevance to the topic. Likely, this means that bias is low, but the information included comes from admittedly low quality sources, and is therefore suspect, as is the validity of this SR.</td>
</tr>
<tr>
<td>a. If not, what are the consequences for this review’s results?</td>
<td></td>
</tr>
<tr>
<td>4. What was the quality of the individual studies included? Were the results consistent from study to study? Did the investigators provide details about the research validity or quality of the studies included in review?</td>
<td>The results of individual studies were consistent within the realm of expected variance. Specific evaluation of the quality of individual studies was not included in the article.</td>
</tr>
<tr>
<td>5. Did the investigators address publication bias</td>
<td>No</td>
</tr>
</tbody>
</table>

## Are the valid results of this SR important?

<table>
<thead>
<tr>
<th>Appraisal Criterion</th>
<th>Reader’s Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>6. Were the results homogenous from study to study?</td>
<td>Since most included studies were cohort designs and not RCTs, the results in STSD between studies were relatively</td>
</tr>
</tbody>
</table>
### Can you apply this valid, important evidence from this SR in caring for your patient/client? What is the external validity?

<table>
<thead>
<tr>
<th>Appraisal Criterion</th>
<th>Reader’s Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>9. Is your patient different from those in this SR?</td>
<td>My patient fits the general demographic of included studies (male, late twenties)</td>
</tr>
<tr>
<td>10. Is the treatment feasible in your setting? Do you have the facilities, skill set, time, 3rd party coverage to provide this treatment?</td>
<td>Here, the treatment is generally immobilization, quadriceps strengthening – easy clinical application.</td>
</tr>
<tr>
<td>11. Does the intervention fit within your patient/client’s stated values or expectations? a. If not, what will you do now?</td>
<td>Yes, my patient is wary of going for surgery, and is seeking to find if conservative treatment is a reasonable avenue.</td>
</tr>
</tbody>
</table>

### What is the bottom line?

<table>
<thead>
<tr>
<th>Appraisal Criterion</th>
<th>Reader’s Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summarize your findings and relate this back to clinical significance</td>
<td>This article is a SR of generally low-quality evidence. It fails to note much of its methodology in terms of article selection and vetting, as well as blinding, etc. Some of its methodological flaws are forgivable as they do not seriously endanger the study’s validity, while other speak to its lack of thoroughness in reporting. The article is a systematic review of low quality research, but</td>
</tr>
</tbody>
</table>
that is acceptable, as it deals with an area of research that is quite poorly hashed-out.

Reference # 4

Intervention – Evidence Appraisal Worksheet

Citation:

Level of Evidence (Oxford scale): 4

<table>
<thead>
<tr>
<th>Appraisal Criterion</th>
<th>Reader’s Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Study Purpose</strong></td>
<td>Evidence is presented from the literature review to suggest that in general, conservative treatment is generally recommended for simple isolated PCL injuries. However, there is still not a significant weight of evidence that suggests that high level athletes will be able to return to sport at their same level without surgical reconstruction of the posterior cruciate ligament. This report presents 2 cases of professional baseball players who both sustained isolated PCL ruptures, verified by MRI, and were able to return</td>
</tr>
<tr>
<td>Stated clearly?</td>
<td></td>
</tr>
<tr>
<td>Usually stated briefly in abstract and in greater detail in introduction. May be phrased as a question or hypothesis.</td>
<td></td>
</tr>
<tr>
<td>A clear statement helps you determine if topic is important, relevant and of interest to you. Consider how the study can be applied to PT and/or your own situation. What is the purpose of this study?</td>
<td></td>
</tr>
</tbody>
</table>
Rehabilitation of Isolated PCL Injury: Long-term Function and Return to Sport

<table>
<thead>
<tr>
<th>Literature</th>
<th>to their same level of sport, and maintain for at least 2 years, when the study was published.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relevant background presented?</td>
<td>Appropriate background literature is presented, including reference to cadaveric studies, and previous studies regarding the natural history of PCL injuries, and recovery using only conservative treatment. The need for this report is justified as there is a dearth of this sort of evidence regarding professional and high level athletes who have sustained PCL injuries. The report corroborates the idea that high level and even professional athletes may satisfactorily return to sport without the need for surgical reconstruction, and can do so much quicker than they would be able with a reconstructive surgery.</td>
</tr>
<tr>
<td>A review of the literature should provide background for the study by synthesizing relevant information such as previous research and gaps in current knowledge, along with the clinical importance of the topic.</td>
<td></td>
</tr>
<tr>
<td>Describe the justification of the need for this study</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Does the research design have strong internal validity?</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Appraisal Criterion</strong></td>
<td><strong>Reader’s Comments</strong></td>
</tr>
<tr>
<td>Discuss possible threats to internal validity in the research design. Include:</td>
<td>Assignment – No groups, no assignment. Subjects were obtained conveniently.</td>
</tr>
<tr>
<td>➢ Assignment</td>
<td>Attrition – No attrition (100% follow-up)</td>
</tr>
<tr>
<td>➢ Attrition</td>
<td>History – Subjects were not engaged in sport during rehabilitation, and therefore possibility of recurring damage was negligible.</td>
</tr>
<tr>
<td>➢ History</td>
<td>Instrumentation – Consistent and appropriate tools were used to measure subject ability to return to sport. The tools used were a Biodex machine to measure maximal muscular torque at a number of degrees of knee flexion, and measurement of posterior tibial translation (not</td>
</tr>
</tbody>
</table>
using an arthrometer, presumably done by hand), as well as subjective reports of instability.

Maturation – N/A

Testing – The only real testing done, was whether the subjects were able to return to sport.

Compensatory Equalization of Treatment – N/A

Compensatory Rivalry – N/A

Statistical Regression – N/A

**Are the results of this therapeutic trial valid?**

<table>
<thead>
<tr>
<th>Appraisal Criterion</th>
<th>Reader’s Comments</th>
</tr>
</thead>
</table>
| 12. Did the investigators randomly assign subjects to treatment groups?  
  a. If no, describe what was done  
  b. What are the potential consequences of this assignment process for the study’s results? | No treatment group. Just two individuals treated conservatively. |
| 13. Did the investigators know who was being assigned to which group prior to the allocation?  
  a. If they were not blind, what are the potential consequences of this knowledge for the study’s results? | No groups, no assignment |
| 14. Were the groups similar at the start of the trial? Did they report the demographics of the study groups?  
  a. If they were not similar – what differences existed?  
  b. Do you consider these differences a threat to the research validity? How might the differences between groups affect the results of the study? | The two subjects obtained their injury in different ways, but both injuries were isolated, of the same degree, and diagnosed by MRI. |
<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>15. Did the subjects know to which treatment group they were assigned?</td>
<td>N/A</td>
</tr>
<tr>
<td>a. If yes, what are the potential consequences of the subjects’ knowledge for this study’s results</td>
<td></td>
</tr>
<tr>
<td>16. Did the investigators know to which treatment group subjects were assigned?</td>
<td>N/A</td>
</tr>
<tr>
<td>a. If yes, what are the potential consequences of the subjects’ knowledge for this study’s results</td>
<td></td>
</tr>
<tr>
<td>17. Were the groups managed equally, apart from the actual experimental treatment?</td>
<td>N/A</td>
</tr>
<tr>
<td>a. If not, what are the potential consequences of this knowledge for the study’s results?</td>
<td></td>
</tr>
<tr>
<td>18. Was the subject follow-up time sufficiently long to answer the question(s) posed by the research?</td>
<td>Yes. Subject were followed from the time of treatment to the time of publication, which was 2.5 and 2 years after the two subjects had returned to sport. At the time of publication, both subjects were still playing in their same roles.</td>
</tr>
<tr>
<td>a. If not, what are the potential consequences of this knowledge for the study’s results?</td>
<td></td>
</tr>
<tr>
<td>19. Did all the subjects originally enrolled complete the study?</td>
<td>Both subjects participated in rehabilitation and returned to sport</td>
</tr>
<tr>
<td>a. If not how many subjects were lost?</td>
<td></td>
</tr>
<tr>
<td>b. What, if anything, did the authors do about this attrition?</td>
<td></td>
</tr>
<tr>
<td>c. What are the implications of the attrition and the way it was handled with respect to the study’s findings?</td>
<td></td>
</tr>
<tr>
<td>20. Were all patients analyzed in the groups to which they were randomized (i.e. was there an intention to treat analysis)?</td>
<td>N/A</td>
</tr>
<tr>
<td>a. If not, what did the authors do with the data from these subjects?</td>
<td></td>
</tr>
<tr>
<td>b. If the data were excluded, what are the potential consequences for this study’s results?</td>
<td></td>
</tr>
</tbody>
</table>

Are the valid results of this RCT important?
### Appraisal Criterion

21. What were the statistical findings of this study?
   - When appropriate use the calculation forms below to determine these values
   - Include: tests of differences With p-values and CI
   - Include effect size with p-values and CI
   - Include ARR/ABI and RRR/RBI with p-values and CI
   - Include NNT and CI
   - Other stats should be included here

<table>
<thead>
<tr>
<th>Reader’s Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Both subjects were able to return to their prior level of sport without noticeable detriment to their performance. One subject maintained subjective reports of instability that did not affect his play. There were no statistics presented</td>
</tr>
</tbody>
</table>

22. What is the meaning of these statistical findings for your patient/client’s case? What does this mean to your practice?  
   | N/A |

23. Do these findings exceed a minimally important difference? Was this brought up or discussed?  
   - If the MCID was not met, will you still use this evidence?  
   | N/A |

### Can you apply this valid, important evidence about an intervention in caring for your patient/client? What is the external validity?

<table>
<thead>
<tr>
<th>Appraisal Criterion</th>
</tr>
</thead>
</table>

24. Does this intervention sound appropriate for use (available, affordable) in your clinical setting? Do you have the facilities, skill set, time, 3rd party coverage to provide this treatment?  

<table>
<thead>
<tr>
<th>Reader’s Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intervention consisted of immobilization for 3 weeks with a brace, quadriceps exercises, and running exercises at 6 weeks post injury.</td>
</tr>
</tbody>
</table>

25. Are the study subjects similar to your patient/client?  
   - If not, how different? Can you use this intervention in spite of the differences?  

<table>
<thead>
<tr>
<th>Reader’s Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study subjects were both in their mid 30s, while my patient is in his early twenties. All are athletes, with a similar goal of looking to return to sport and avoid surgery.</td>
</tr>
</tbody>
</table>

26. Do the potential benefits outweigh the potential risks using this intervention with your patient/client?  

<table>
<thead>
<tr>
<th>Reader’s Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes. There are few short term risks to therapeutic exercise as a modality.</td>
</tr>
</tbody>
</table>
27. Does the intervention fit within your patient/client’s stated values or expectations?  
a. If not, what will you do now?  
Yes, the patient is very hesitant to go in for surgery and wishes to treat conservatively if there is a good prognosis for recovery and return to sport without surgery.

28. Are there any threats to external validity in this study?  
Both study subjects were baseball players, so it is fair to imagine that return to a different sport may not yield as good results.

What is the bottom line?

<table>
<thead>
<tr>
<th>Appraisal Criterion</th>
<th>Reader’s Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>PEDRO score (see scoring at end of form)</td>
<td>2/10</td>
</tr>
<tr>
<td>Summarize your findings and relate this back to clinical significance</td>
<td>The findings of the study were that both athletes, professional baseball players were able to return to their previous roles on the field at 6 and 8 weeks post injury. Their rehab consisted of 3 weeks of immobilization, quadriceps exercises, and running exercises. One of the two players maintained subjective complaints of instability when shifting from weight-bearing to non-weight-bearing in deep knee flexion and while running that did not significantly affect his play. Return to sport was quick and without complaint, and no subsequent injuries occurred, and indeed, noted pain and edema during performance continued to diminish over time after return to sport.</td>
</tr>
</tbody>
</table>

Reference # 6

Intervention – Evidence Appraisal Worksheet

Citation:

**Level of Evidence (Oxford scale):** 2

**Is the purpose and background information sufficient?**

<table>
<thead>
<tr>
<th>Appraisal Criterion</th>
<th>Reader’s Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Study Purpose</strong></td>
<td>The purpose of this study is clearly stated in the introduction: To compare the effectiveness in terms of stability (reduction of laxity/translation) and function/patient satisfaction.</td>
</tr>
<tr>
<td>Stated clearly?</td>
<td>Usually stated briefly in abstract and in greater detail in introduction. May be phrased as a question or hypothesis. A clear statement helps you determine if topic is important, relevant and of interest to you. Consider how the study can be applied to PT and/or your own situation. What is the purpose of this study?</td>
</tr>
</tbody>
</table>

| **Literature**      | This study includes background information including cadaveric studies regarding the anatomy and physiology of the posterior cruciate ligament, its two bundles, and corresponding insertion points. It also presents a review on a variety of currently practiced surgical techniques and tibial tunnel placement for the various techniques. However, since there is no general agreement on which techniques yield the best results, this study, which compares a two-tunnel, single-bundle reconstruction and a four-tunnel, double-bundle reconstruction, seeks to compare two commonly practiced techniques. |
| Relevant background presented? | A review of the literature should provide background for the study by synthesizing relevant information such as previous research and gaps in current knowledge, along with the clinical importance of the topic. Describe the justification of the need for this study |

**Does the research design have strong internal validity?**

<table>
<thead>
<tr>
<th>Appraisal Criterion</th>
<th>Reader’s Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Discuss possible threats to internal validity in the research design. Include:

- **Assignment**
- **Attrition**
- **History**
- **Instrumentation**
- **Maturation**
- **Testing**
- **Compensatory Equalization of treatments**
- **Compensatory rivalry**
- **Statistical Regression**

<table>
<thead>
<tr>
<th>Assignment</th>
<th>All participants, and examiners were blinded to group assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attrition</td>
<td>4/50 pts were lost to follow-up (8% attrition rate). This is an acceptable amount of attrition</td>
</tr>
<tr>
<td>History</td>
<td>Long follow-up period, but with two groups, hopefully there is maximal reduction in threats due to history</td>
</tr>
<tr>
<td>Instrumentation</td>
<td>Instruments used were the Lysholm scale, Tegner activity scale, IKDC subjective/objective knee form, and the KT-1000 arthrometer. These are all validated and appropriate instruments for what the experimenters sought to measure.</td>
</tr>
<tr>
<td>Maturation</td>
<td>Two groups should control optimally for threats due to maturation</td>
</tr>
<tr>
<td>Testing</td>
<td>The measurements taken did not allow for the possibility of ‘learning’ how to manipulate testing</td>
</tr>
<tr>
<td>Compensatory Equalization of Treatments</td>
<td>Since examiners were blinded to group assignment, and both groups received the same postoperative rehabilitation, there is little possibility for this threat</td>
</tr>
<tr>
<td>Compensatory Rivalry</td>
<td>Since all subjects were blinded to their allocation, there is little possibility for this threat.</td>
</tr>
<tr>
<td>Statistical Regression</td>
<td>There is no mention of outliers in terms of laxity, but all subjects with non-isolated injuries were excluded from the study, and the groups showed no statistically significant differences at baseline to suggest any outliers could have affected internal validity</td>
</tr>
</tbody>
</table>
### Are the results of this therapeutic trial valid?

<table>
<thead>
<tr>
<th>Appraisal Criterion</th>
<th>Reader’s Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>29. Did the investigators randomly assign subjects to treatment groups?</td>
<td>Subjects were randomly assigned to treatment groups.</td>
</tr>
<tr>
<td>a. If no, describe what was done</td>
<td></td>
</tr>
<tr>
<td>b. What are the potential consequences of this assignment process for the study’s results?</td>
<td></td>
</tr>
<tr>
<td>30. Did the investigators know who was being assigned to which group prior to the allocation?</td>
<td>Investigators were also blinded to the allocation of subjects.</td>
</tr>
<tr>
<td>a. If they were not blind, what are the potential consequences of this knowledge for the study’s results?</td>
<td></td>
</tr>
<tr>
<td>31. Were the groups similar at the start of the trial? Did they report the demographics of the study groups?</td>
<td>Group characteristics showed no statistically significant differences at baseline. Demographics were reported (age, gender, MOI, duration of injury)</td>
</tr>
<tr>
<td>a. If they were not similar – what differences existed?</td>
<td></td>
</tr>
<tr>
<td>b. Do you consider these differences a threat to the research validity? How might the differences between groups affect the results of the study?</td>
<td></td>
</tr>
<tr>
<td>32. Did the subjects know to which treatment group they were assigned?</td>
<td>Subjects were blinded to their group assignment</td>
</tr>
<tr>
<td>a. If yes, what are the potential consequences of the subjects’ knowledge for this study’s results</td>
<td></td>
</tr>
<tr>
<td>33. Did the investigators know to which treatment group subjects were assigned?</td>
<td>Investigators were blinded to allocation of subjects</td>
</tr>
<tr>
<td>a. If yes, what are the potential consequences of the subjects’ knowledge for this study’s results</td>
<td></td>
</tr>
<tr>
<td>34. Were the groups managed equally, apart from the actual experimental treatment?</td>
<td>Other than the surgical technique used, both groups were treated the same, and received the same postoperative instructions and rehabilitation</td>
</tr>
</tbody>
</table>
a. If not, what are the potential consequences of this knowledge for the study’s results?

35. Was the subject follow-up time sufficiently long to answer the question(s) posed by the research?
   a. If not, what are the potential consequences of this knowledge for the study’s results?
   Follow-up time was 2 years. This is long enough to show what the final result of surgical reconstruction would be in terms of stability, but is not long enough to look at long-term patient satisfaction, development of knee OA, etc.

36. Did all the subjects originally enrolled complete the study?
   a. If not how many subjects were lost?
   b. What, if anything, did the authors do about this attrition?
   c. What are the implications of the attrition and the way it was handled with respect to the study’s findings?
   46 out of 50 original participants completed the study. Attrition was due to subjects moving, or changing phone numbers and not being available for follow-up. The authors did an intention to treat analysis and included all original participants in the statistical calculations.

37. Were all patients analyzed in the groups to which they were randomized (i.e. was there an intention to treat analysis)?
   a. If not, what did the authors do with the data from these subjects?
   b. If the data were excluded, what are the potential consequences for this study’s results?
   All subjects were analyzed in the groups they were originally assigned to (intention-to-treat analysis)

Are the valid results of this RCT important?

<table>
<thead>
<tr>
<th>Appraisal Criterion</th>
<th>Reader’s Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>38. What were the statistical findings of this study?</td>
<td>There were no statistically significant differences between groups regarding Lysholm or Tegner scores. However, the IKDC subjective form showed significantly more improvement at last follow-up for the subjects who received the double-bundle reconstruction. In addition, the double-bundle group had a statistical significantly greater improvements (reduction) in side to side difference (STSD) of posterior translation on the KT-1000 arthrometer. 80% of all participants were scored on the IKDC objective form to have</td>
</tr>
<tr>
<td>a. When appropriate use the calculation forms below to determine these values</td>
<td></td>
</tr>
<tr>
<td>b. Include: tests of differences</td>
<td></td>
</tr>
<tr>
<td>With p-values and CI</td>
<td></td>
</tr>
<tr>
<td>c. Include effect size with p-values and CI</td>
<td></td>
</tr>
<tr>
<td>d. Include ARR/ABI and RRR/RBI with p-values and CI</td>
<td></td>
</tr>
<tr>
<td>e. Include NNT and CI</td>
<td></td>
</tr>
<tr>
<td>f. Other stats should be included here</td>
<td></td>
</tr>
</tbody>
</table>
normal or nearly normal knees (grade A and B) at 24 month follow-up.

<table>
<thead>
<tr>
<th></th>
<th>Single-bundle</th>
<th>Double-bundle</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre op</td>
<td>Post op</td>
</tr>
<tr>
<td>STSD (mm)</td>
<td>9.6 +/- .9</td>
<td>4.1 +/- 1.3</td>
</tr>
</tbody>
</table>

39. What is the meaning of these statistical findings for your patient/client’s case? What does this mean to your practice?

Depending on the type of surgery received (single-bundle or double-bundle) there are generally good outcomes in terms of stability and patient satisfaction, with somewhat better outcomes for double-bundle surgical reconstruction. However, regardless of the surgical technique, there is still a 20% chance that knee mechanics will remain abnormal, and some possibility that some laxity may persist. IKDC subjective forms reveal good, but not great scores in terms of functional ability (ranging roughly from 55% to 85% function).

40. Do these findings exceed a minimally important difference? Was this brought up or discussed?
   a. If the MCID was not met, will you still use this evidence?

The examiners determined a 2 mm change in posterior translation from baseline to follow-up to be significant, but I don’t believe there is any scientific basis for this.

Can you apply this valid, important evidence about an intervention in caring for your patient/client? What is the external validity?

**Appraisal Criterion**

<table>
<thead>
<tr>
<th>41.</th>
<th>Does this intervention sound appropriate for use (available, affordable) in your clinical setting? Do you have the facilities, skill set, time, 3rd party coverage to provide this treatment?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>This is not an appropriate intervention for a PT clinic, but it is an appropriate option for my patient to consider outside of physical therapy if he decides that he wants to have surgery.</td>
</tr>
<tr>
<td>Question</td>
<td>Response</td>
</tr>
<tr>
<td>----------</td>
<td>----------</td>
</tr>
<tr>
<td><strong>42. Are the study subjects similar to your patient/ client?</strong>&lt;br&gt;a. If not, how different? Can you use this intervention in spite of the differences?</td>
<td>Subjects are generally in their 20s, and many of them received their injury during sporting activity.</td>
</tr>
<tr>
<td><strong>43. Do the potential benefits outweigh the potential risks using this intervention with your patient/client?</strong></td>
<td>Maybe. The study claims to have attained a 0% incidence of surgical complications, which is good, but also requires a 1 year prohibition from return to sport, which is considerably longer recovery time than in patients considering non-operative treatment.</td>
</tr>
<tr>
<td><strong>44. Does the intervention fit within your patient/client’s stated values or expectations?</strong>&lt;br&gt;a. If not, what will you do now?</td>
<td>My patient is very hesitant towards receiving surgery based on the inherent risks and cost, as well as increased rehabilitation time.</td>
</tr>
<tr>
<td><strong>45. Are there any threats to external validity in this study?</strong></td>
<td>All surgeries were done by the same surgeon with and anterior tibialis allograft, which may be quite different than what a local surgeon might use.</td>
</tr>
</tbody>
</table>

**What is the bottom line?**

<table>
<thead>
<tr>
<th>Appraisal Criterion</th>
<th>Reader’s Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PEDRO score (see scoring at end of form)</strong></td>
<td>10/10</td>
</tr>
<tr>
<td><strong>Summarize your findings and relate this back to clinical significance</strong></td>
<td>The findings of this study showed that there were some relatively small differences in knee function as determined by the IKDC subjective form between groups. There were significant improvements for both surgical groups in terms of laxity (greater improvements for the double-bundle group). However it must be noted that preoperative scores were not noted for the IKDC form, so in a way, the study only seeks to compare two surgical techniques against one another, and never validates that either surgery creates any improvement in a patients’ function based on subjective evaluation of their knee.</td>
</tr>
</tbody>
</table>
Reference # 11

Intervention – Evidence Appraisal Worksheet

Citation:

Level of Evidence (Oxford scale): 4

<table>
<thead>
<tr>
<th><strong>Is the purpose and background information sufficient?</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Appraisal Criterion</strong></td>
<td><strong>Reader’s Comments</strong></td>
</tr>
<tr>
<td><strong>Study Purpose</strong></td>
<td>The clearly stated purpose of this prospective</td>
</tr>
<tr>
<td>Stated clearly?</td>
<td>cohort study is to determine the efficacy of</td>
</tr>
<tr>
<td>Usually stated briefly in abstract and in greater</td>
<td>non-operative treatment of isolated posterior</td>
</tr>
<tr>
<td>detail in introduction. May be phrased as a question or</td>
<td>cruciate ligament, as there is a continuing</td>
</tr>
<tr>
<td>hypothesis.</td>
<td>debate in the sports medicine and surgical</td>
</tr>
<tr>
<td>A clear statement helps you determine if topic is</td>
<td>communities about what the appropriate treatment</td>
</tr>
<tr>
<td>important, relevant and of interest to you. Consider</td>
<td>for an isolated PCL injury is – surgical repair,</td>
</tr>
</tbody>
</table>
Rehabilitation of Isolated PCL Injury: Long-term Function and Return to Sport

Literature

Relevant background presented?

A review of the literature should provide background for the study by synthesizing relevant information such as previous research and gaps in current knowledge, along with the clinical importance of the topic.

Describe the justification of the need for this study

should supersede cost as a motivation for treatment.

There is a relatively small literature review focusing on previous studies that had investigated the results of either surgical reconstruction or non-surgical rehabilitation of the posterior cruciate ligament. Seeing as this article was published in the 80s, when there was relatively little research available on the topic, the dearth of literature review is probably appropriate and due to the general paucity of research on the subject. Of the available research, most is of low quality and is lacking in functional outcomes, and so this study seeks to look at both long term laxity and functional ability of non-operative treatment.

Does the research design have strong internal validity?

<table>
<thead>
<tr>
<th>Appraisal Criterion</th>
<th>Reader’s Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discuss possible threats to internal validity in the research design. Include:</td>
<td>Assignment – N/A (No groups are assigned)</td>
</tr>
<tr>
<td>Assignment</td>
<td>Attrition – There was no attrition in the study</td>
</tr>
<tr>
<td>Attrition</td>
<td>History – This study, without a control group, lacked the control in order to prevent any external events from affecting outcomes. However, it seems unlikely that there would be any external events that could have positively influenced outcomes, although it was not explicitly stated whether or not some of the study participants may have had additional therapy or rehab than was given by the investigators (although it was made clear that none received any surgery). However, for the participants with chronic injuries, rehabilitation, while still non-operative, was variable and likely had some effect on their eventual outcome.</td>
</tr>
<tr>
<td>History</td>
<td>Instrumentation – measurements of: posterior translation were made using a KT-1000 arthrometer, presumably calibrated; quadriceps strength by a cybex; presence of arthritis and narrowing of joint space by lateral radiograph.</td>
</tr>
<tr>
<td>Instrumentation</td>
<td>Maturation</td>
</tr>
<tr>
<td>Maturation</td>
<td>Testing</td>
</tr>
<tr>
<td>Testing</td>
<td>Compensatory Equalization of treatments</td>
</tr>
<tr>
<td>Compensatory Equalization of treatments</td>
<td>Compensatory rivalry</td>
</tr>
<tr>
<td>Compensatory rivalry</td>
<td>Statistical Regression</td>
</tr>
</tbody>
</table>
Each of these is a validated instrument with proven reliability. Subjective eval tool was not mentioned and the validity can therefore not be determined, but included pt satisfaction, level of activity, pain, and whether there was a full return to PLOF.

Maturation – Possible threats to validity here as follow ups were over a long period (mean 6.2 years). However, in this instance, it seems unlikely that patient maturation would provide any benefit to function without surgical intervention.

Testing – Testing was objective measure and there was no possibility of plateauing or learning of the test.

Compensatory Equalization of Treatment – N/A (no control groups)

Compensatory Rivalry – N/A (no control groups)

Statistical Regression – Outliers (those with complicated injuries, i.e. patellar fractures with repair, and those with previously performed meniscectomies) were present and included in the study results, and tended to present with poorer outcomes from non-operative treatment. If they had been excluded based on more stringent criteria, it would only have served to stack the results in favor of conservative treatment.

---

**Are the results of this therapeutic trial valid?**

<table>
<thead>
<tr>
<th>Appraisal Criterion</th>
<th>Reader’s Comments</th>
</tr>
</thead>
</table>
| 1. Did the investigators randomly assign subjects to treatment groups?  
a. If no, describe what was done  
b. What are the potential consequences of this assignment process for the study’s results? | No, there was no real ‘assignment’ as there was only one treatment group and no control. Subjects were obtained purposively from the Sports Medicine Section of the Cleveland Clinic Foundation. They were all athletes that either presented to the clinic acutely, or had chronic |
injuries and were members of sports teams that were under care at the clinic. Potential consequences are diminished external validity, due to a small and likely non-diverse subject population.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2. Did the investigators know who was being assigned to which group prior to the allocation?</strong></td>
<td>N/A (only on treatment group).</td>
</tr>
<tr>
<td>a. If they were not blind, what are the potential consequences of this knowledge for the study’s results?</td>
<td></td>
</tr>
<tr>
<td><strong>3. Were the groups similar at the start of the trial? Did they report the demographics of the study groups?</strong></td>
<td>N/A (only on treatment group)</td>
</tr>
<tr>
<td>a. If they were not similar – what differences existed?</td>
<td></td>
</tr>
<tr>
<td>b. Do you consider these differences a threat to the research validity? How might the differences between groups affect the results of the study?</td>
<td></td>
</tr>
<tr>
<td><strong>4. Did the subjects know to which treatment group they were assigned?</strong></td>
<td>N/A (only one treatment group)</td>
</tr>
<tr>
<td>a. If yes, what are the potential consequences of the subjects’ knowledge for this study’s results</td>
<td></td>
</tr>
<tr>
<td><strong>5. Did the investigators know to which treatment group subjects were assigned?</strong></td>
<td>N/A (only one treatment group)</td>
</tr>
<tr>
<td>a. If yes, what are the potential consequences of the subjects’ knowledge for this study’s results</td>
<td></td>
</tr>
<tr>
<td><strong>6. Were the groups managed equally, apart from the actual experimental treatment?</strong></td>
<td>N/A (only one treatment group)</td>
</tr>
<tr>
<td>a. If not, what are the potential consequences of this knowledge for the study’s results?</td>
<td></td>
</tr>
<tr>
<td><strong>7. Was the subject follow-up time sufficiently long to answer the question(s) posed by the research?</strong></td>
<td>The follow-up was long, ranging from 2.2 to 16 years from injury (mean 6.2 years). It was long enough to determine what function of the knee would be like several years down the line, which important if the goal of treatment is return to</td>
</tr>
</tbody>
</table>
a. If not, what are the potential consequences of this knowledge for the study’s results?

sport, as most sporting careers are short-lived relative to a lifetime. However, for the outcome of development of knee Osteoarthritis, the follow-up would have to be closer to 20 years or more to really determine ‘long-term’ outcomes.

8. Did all the subjects originally enrolled complete the study?
   a. If not how many subjects were lost?
   b. What, if anything, did the authors do about this attrition?
   c. What are the implications of the attrition and the way it was handled with respect to the study’s findings?

   b. What, if anything, did the authors do about this attrition?

   c. What are the implications of the attrition and the way it was handled with respect to the study’s findings?

   Yes, there was no attrition.

9. Were all patients analyzed in the groups to which they were randomized (i.e. was there an intention to treat analysis)?
   a. If not, what did the authors do with the data from these subjects?
   b. If the data were excluded, what are the potential consequences for this study’s results?

   N/A (groups not randomized) – but all subjects completed the study and were included in its results.

Are the valid results of this RCT important?

<table>
<thead>
<tr>
<th>Appraisal Criterion</th>
<th>Reader’s Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>10. What were the statistical findings of this study?</td>
<td>80% were satisfied with their knees at follow-up. 76% rated their knees as 75-100% of PLOF, 20% as 50-74% of PLOF. 68% had full return to previous athletic ability without impairment, while 16% returned to same level of sport, but felt some diminished ability. 16% were still active, but participated at a lower level of competition. Subjects who were satisfied had less side to side difference in active posterior drawer and quadriceps strength that was greater than 100% of the uninvolved leg, while those who were unsatisfied had significant side to side difference in active posterior drawer and quadriceps strength less than 100% of the</td>
</tr>
<tr>
<td>a. When appropriate use the calculation forms below to determine these values</td>
<td></td>
</tr>
<tr>
<td>b. Include: tests of differences With p-values and CI</td>
<td></td>
</tr>
<tr>
<td>c. Include effect size with p-values and CI</td>
<td></td>
</tr>
<tr>
<td>d. Include ARR/ABI and RRR/RBI with p-values and CI</td>
<td></td>
</tr>
<tr>
<td>e. Include NNT and CI</td>
<td></td>
</tr>
<tr>
<td>f. Other stats should be included here</td>
<td></td>
</tr>
</tbody>
</table>
uninvolved side. There was little correlation between passive posterior drawer and subject satisfaction. Interestingly, 100% of acute patients, who received standardized, vigorous rehabilitation returned to same level of sport, without impairment, and were satisfied. 36% of subjects did present with symptoms of arthritis that were mostly (8/9) rated as mild on lateral radiograph. There was no correlation of presence or severity of arthritis with time since injury. Statistics were crude, and significance was not statistically determined, not were any CIs.

<table>
<thead>
<tr>
<th>11. What is the meaning of these statistical findings for your patient/client’s case? What does this mean to your practice?</th>
</tr>
</thead>
<tbody>
<tr>
<td>These results speak to the conclusion that improved quadriceps strength and motor control, sought through early and robust rehabilitation are essential in both return to sport and patient satisfaction with outcomes. Based on this study, non-operative treatment should be considered an option for fit athletes who are willing to participate in rehab and are unwilling to receive surgical intervention.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>12. Do these findings exceed a minimally important difference? Was this brought up or discussed?</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. If the MCID was not met, will you still use this evidence?</td>
</tr>
<tr>
<td>There was no discussion of MCID for laxity or subjective function or satisfaction.</td>
</tr>
</tbody>
</table>

**Can you apply this valid, important evidence about an intervention in caring for your patient/client? What is the external validity?**

<table>
<thead>
<tr>
<th>Appraisal Criterion</th>
<th>Reader’s Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>13. Does this intervention sound appropriate for use (available, affordable) in your clinical setting? Do you have the facilities, skill set, time, 3rd party coverage to provide this treatment?</td>
<td>Interventions would be considered simple therapeutic exercise and activity. It is a simple, available intervention requiring no special equipment.</td>
</tr>
</tbody>
</table>
### 14. Are the study subjects similar to your patient/ client?
   a. If not, how different? Can you use this intervention in spite of the differences?

Study participants are similar to my patient, although realistically many were professional athletes, who would likely put a heavier burden on their knee joint, and would therefore require a high level of rehabilitation than my patient for return to PLOF.

### 15. Do the potential benefits outweigh the potential risks using this intervention with your patient/client?

Difficult to say. This would have to be addressed with the patient, especially in terms of trading likely return to sport for the potential for development of knee OA down the line.

### 16. Does the intervention fit within your patient/client’s stated values or expectations?
   a. If not, what will you do now?

Yes, my patient does not like the prospect of receiving surgical intervention, but wished to return to sport, hopefully at the same level.

### 17. Are there any threats to external validity in this study?

Yes – a non-diverse and non-randomly selected subject population.

### What is the bottom line?

<table>
<thead>
<tr>
<th>Appraisal Criterion</th>
<th>Reader’s Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>PEDRO score</td>
<td>3/10</td>
</tr>
<tr>
<td>Summarize your findings and relate this back to clinical significance</td>
<td>There is definitely a good chance of patient satisfaction and return to PLOF without surgical intervention, relying on conservative treatment by a skilled physical therapist, with emphasis on strengthening and motor control of the quadriceps muscle. There are significant concerns about long term joint integrity and the development of knee Osteoarthritis, but that outcome may or may not be diminished by surgical intervention.</td>
</tr>
</tbody>
</table>
Reference # 13

Prognostic Study – Evidence Appraisal Worksheet


**Level of Evidence (Oxford scale):** 2c

---

### Is the purpose and background information sufficient?

<table>
<thead>
<tr>
<th><strong>Appraisal Criterion</strong></th>
<th><strong>Reader’s Comments</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Study Purpose</strong></td>
<td>The clearly stated purpose of this study was to observe and examine, over time, the “natural history” of isolated PCL injuries, and to get a general sense of how athletically active people fare when they decide to go with a nonoperative course of treatment for their injuries, in terms of objective laxity and subjective functioning from the perspective of the injured individual.</td>
</tr>
<tr>
<td>Stated clearly?</td>
<td>A clear statement helps you determine if topic is important, relevant and of interest to you. Consider how the study can be applied to PT and/or your own situation. What is the purpose of this study?</td>
</tr>
<tr>
<td>Usually stated briefly in abstract and in greater detail in introduction. May be phrased as a question or hypothesis.</td>
<td></td>
</tr>
<tr>
<td>Relevant background presented?</td>
<td>A wealth of previous literature including a prior study with similar methodology but shorter follow-up period, cadaveric studies, and studies that looked at the correlation between objective and subjective outcomes as well as prevalence of joint degeneration in nonoperatively treated knees, was referenced. Since the only other study</td>
</tr>
</tbody>
</table>
in current knowledge, along with the clinical importance of the topic. 

Describe the justification of the need for this study

with similar methodology to this one had a relatively short follow-up period, this study was well justified.

**Does the research design have strong sampling techniques?**

<table>
<thead>
<tr>
<th>Appraisal Criterion</th>
<th>Reader’s Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Did the investigators provide sufficient information to describe the sample in their study?</td>
<td>The authors were looking to address medium term outcomes in those with acute and isolated PCL injuries. Patients were consecutive and selected over a 10 year period from 1983 to 1993 from the Methodist Sports Medicine Center in Indianapolis, Indiana. Those excluded had chronic injuries, other ligamentous injury, or bony avulsion of one of the PCL attachments. Those with meniscal injuries were not excluded, as long as the PCL was the only injured ligament.</td>
</tr>
<tr>
<td>Does the study clearly define the group of patients; is there a clear inclusion and exclusion criterion? Is there a clear description of the stage and timing of the problem (illness) studied.</td>
<td></td>
</tr>
<tr>
<td>Are the subjects representative of the population from which they were drawn? Did they capture all eligible subjects?</td>
<td>Subjects are representative of Indiana athletes with PCL injuries. Since this was a single center study, there could be some question of the generalizability of the study to a greater population of ‘American athletes’, or just ‘athletes’</td>
</tr>
</tbody>
</table>

**Are the results of this prognostic study valid?**

<table>
<thead>
<tr>
<th>Appraisal Criterion</th>
<th>Reader’s Comments</th>
</tr>
</thead>
</table>
| 1. **Were the subjects assembled at a common (usually early) point in the course of their disorder?**  
  a. **If not, what are the implications of multiple starting points for this study’s results?** | Subjects were never assembled. As the study was prospective, each participant entered the study at, or soon thereafter, the time of their injury. The implications of this point might be that in all likelihood, each participant, depending on the point at which they entered the study would be treated in a slightly different or evolving fashion. Also, the authors most likely became more experienced at their physical examinations, and |
therefore it is possible that the participants entering in 1993 were getting more accurate physical exam findings as opposed to those entering the study 10 years prior.

<table>
<thead>
<tr>
<th>2. Was the study time frame long enough to capture the outcome(s) of interest? Was patient follow-up sufficiently long and complete?</th>
<th>Yes and No. Study follow-up was a mean of 5.4 years with a range from 2.3 to 11.4 years. This is significant to show function as well as healing or deterioration in the ‘medium term’, but is probably not long enough to make a good argument for what the long term outcomes in terms of joint degeneration (osteoarthritis/arthrosis) will be. This study presents a good look at what athletic functioning during the next couple years will be, but not how the day-today function of the knee will be for the rest of the individual’s life.</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. If not, what are the potential consequences of the follow-up time for the study’s results?</td>
<td></td>
</tr>
<tr>
<td>3. Did all subjects originally enrolled complete the study?</td>
<td>Of the 142 originally selected patients, 4 left the study to have PCL reconstruction, and 5 could not be located to follow up. This represents a less than 7% attrition rate which is acceptable in any study, however, the participants were not included in the studies statistical analysis (intention to treat). It might have been good to continue to send questionnaires to and follow-up with the surgical patients to see how their outcomes related to the nonoperative patients in the study. The implication here is that potentially, those participants with the worst outcomes were excluded from the study’s results.</td>
</tr>
<tr>
<td>a. If not, how many subjects were lost</td>
<td></td>
</tr>
<tr>
<td>b. What if anything did the authors do about this attrition?</td>
<td></td>
</tr>
<tr>
<td>c. What are the implications of this attrition and the way it was handled with respect to the study’s findings?</td>
<td></td>
</tr>
<tr>
<td>4. Were objective outcome criteria applied to the subjects in a masked or blinded fashion?</td>
<td>Yes, all radiographs were read by a radiologist who was blinded to participants, their subjective, and other objective findings.</td>
</tr>
<tr>
<td>a. If not, what are the potential consequences for this study’s results</td>
<td></td>
</tr>
<tr>
<td>5. If subgroups with different prognoses are identified, was there adjustment for important prognostic or risk factors?</td>
<td>There were no different prognoses for any identified subgroups. Those with meniscal tears had no statistically significant increase in joint arthrosis at follow-up. Furthermore, there was</td>
</tr>
<tr>
<td>a. If not, what should have been included? What are the potential</td>
<td></td>
</tr>
</tbody>
</table>
Consequences for the lack of this adjustment: shown to be no difference in prognosis (subjective function and return to sport) based on objective findings of laxity.

6. Was there an independent set of patients to validate the study? If not, what are the potential consequences for this study's results?

- There was not an independent set of patients, but each patient’s uninvolved knee was used as a control in terms of joint arthrosis.

Are the valid results of this prognostic study important?

<table>
<thead>
<tr>
<th>Appraisal Criterion</th>
<th>Reader's Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>7. What were the statistical findings of this study?</td>
<td>67 of 133 (50%) patients returned to sport at the same or higher level. 42 of 133 (32%) returned to the same sport at a lower level. 22 of 133 (17%) could no longer play the same sport, but did return to a different sport. 2 of 133 (1.5%) could not return to sport at all. No statistical significance was found correlating degree of laxity to subjective (Noyes) score or return to sport. No statistical significance was found linking degree of arthrosis/degeneration to subjective scores. No statistical significance was found linking PCL injury to joint arthrosis/degeneration, although the results were on the borderline of significance (clinically significant).</td>
</tr>
<tr>
<td>a. When appropriate use the calculation forms below to determine these values</td>
<td></td>
</tr>
<tr>
<td>b. Report on correlation coefficient and/or coefficient of determination</td>
<td></td>
</tr>
<tr>
<td>c. Did they include a survival curve, ROC, odds ratios, relative risk ratio</td>
<td></td>
</tr>
<tr>
<td>d. How precise are the CIs?</td>
<td></td>
</tr>
<tr>
<td>e. Other stats should be included here</td>
<td></td>
</tr>
<tr>
<td>8. What is the meaning of these statistical findings for your patient/client's case? What does this mean to your practice?</td>
<td>Regardless of objective findings, the best predictor of return to sport and overall function is how my patient reports the function of their knee using a standardized measure such as Noyes, Lysholm, or Tegner scales.</td>
</tr>
</tbody>
</table>

Can you apply this valid, important evidence about this prognostic study in caring for your patient/client? What is the external validity?

<table>
<thead>
<tr>
<th>Appraisal Criterion</th>
<th>Reader's Comments</th>
</tr>
</thead>
</table>
9. How likely are these outcomes over time?  Likelihood of return to sport at the same level is about 50/50. Increased likelihood of joint degeneration of the involved knee compared to uninvolved was not shown to be statistically significant in this study, although the authors felt it was clinically significant.

10. Are the study subjects similar to your patient/client? Study subjects are similar enough in terms of being athletes with the goal of return to sport.
   a. If not, how different? Can you use this test in spite of the differences?

11. Would sharing this information help your patient/client given their expressed values and preferences? Yes, although I don’t know that it’s a strong enough argument either way.

What is the bottom line?

<table>
<thead>
<tr>
<th>Appraisal Criterion</th>
<th>Reader’s Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summarize your findings and relate this back to clinical significance and usefulness of this study</td>
<td>The major findings of the study were there was an increase in medial compartment joint arthrosis in knees with PCL injury, although it was not found to be statistically significant, and it was found to be independent of objectively measured laxity. Furthermore, subjective scores and ability to return to sport were both unrelated to degree of laxity. Bottom line – there is a good chance of returning to sport with nonoperative treatment, and even if one were to undergo surgery to decrease laxity, there is no evidence suggesting that that would improve likelihood of return to sport or subjective scoring of the knee.</td>
</tr>
</tbody>
</table>
Reference # 15

Intervention – Evidence Appraisal Worksheet

Citation:

Level of Evidence (Oxford scale): 4

<table>
<thead>
<tr>
<th>Appraisal Criterion</th>
<th>Reader’s Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Study Purpose</strong></td>
<td>The purpose of the study is to determine whether conservative (non-surgical) treatment is effective and sufficient for the rehabilitation of isolated PCL injuries for athletes looking to return to sport. It is clearly stated.</td>
</tr>
<tr>
<td>Stated clearly?</td>
<td>Yes. The purpose of the study is clearly stated.</td>
</tr>
<tr>
<td>Usually stated briefly in abstract and in greater detail in introduction. May be phrased as a question or hypothesis.</td>
<td></td>
</tr>
<tr>
<td>A clear statement helps you determine if topic is important, relevant and of interest to you. Consider how the study can be applied to PT and/or your own situation. What is the purpose of this study?</td>
<td></td>
</tr>
<tr>
<td><strong>Literature</strong></td>
<td>Relevant research is presented, and the gaps and discrepancies of said research is proposed as the justification of this study. Previous studies have claimed both that: PCL injuries can be treated non-surgically, without concern of later degenerative change; and that degenerative change after PCL injury will progress and is directly correlated to time since injury. Since there is an obvious disagreement between these various studies, many of which are several decades old, it is maintained that there is justification for further study of this topic.</td>
</tr>
<tr>
<td>Relevant background presented?</td>
<td>Yes. Relevant background is presented.</td>
</tr>
<tr>
<td>A review of the literature should provide background for the study by synthesizing relevant information such as previous research and gaps in current knowledge, along with the clinical importance of the topic.</td>
<td></td>
</tr>
<tr>
<td>Describe the justification of the need for this study</td>
<td></td>
</tr>
</tbody>
</table>
### Does the research design have strong internal validity?

<table>
<thead>
<tr>
<th>Appraisal Criterion</th>
<th>Reader’s Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discuss possible threats to internal validity in the research design. Include:</td>
<td>Assignment – N/A (No groups are assigned)</td>
</tr>
<tr>
<td>Assignment</td>
<td>Attrition – There was some attrition, due to PCL injuries that included meniscal damage worthy of surgical repair (2), or instability affecting function (1). Overall 3 out of 22 participants ended up receiving surgery instead of being treated conservatively, but it was not a result of conservative treatment, rather it was due to the complicatedness of their injury.</td>
</tr>
<tr>
<td>Attrition</td>
<td>History – Controls of the study were not sufficient to prevent external factors from influencing outcomes, and with relatively long follow ups (24 – 96 months), these factors were likely to affect outcomes. 1 participant of the original 22 was excluded from returning to sport after he sustained an unrelated additional injury to the contralateral ACL to prevented him from returning to sport.</td>
</tr>
<tr>
<td>History</td>
<td>Instrumentation – measurements of posterior tibial translation (sag/drawer) were done via lateral radiograph. Activity levels were determined according IKDC specifications.</td>
</tr>
<tr>
<td>Instrumentation</td>
<td>Maturation – Possible threats to validity here as study participants were in their late teenage years, and again, follow ups were relatively long.</td>
</tr>
<tr>
<td>Maturation</td>
<td>Testing – Testing was objective measure and there was no possibility of plateauing or learning of the test.</td>
</tr>
<tr>
<td>Testing</td>
<td>Compensatory Equalization of Treatment – N/A (no control groups)</td>
</tr>
<tr>
<td>Compensatory Equalization of treatments</td>
<td>Compensatory Rivalry – N/A (no control groups)</td>
</tr>
<tr>
<td>Compensatory rivalry</td>
<td>Statistical Regression – Outliers (those with significant chondral damage) were excluded from the conservative treatment group</td>
</tr>
<tr>
<td>Statistical Regression</td>
<td></td>
</tr>
</tbody>
</table>
**Are the results of this therapeutic trial valid?**

<table>
<thead>
<tr>
<th>Appraisal Criterion</th>
<th>Reader’s Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>18. Did the investigators randomly assign subjects to treatment groups?</td>
<td>No, there was no random assignment. As there was no control group, the subjects of the study were selected from amongst all athletes presenting with isolated PCL injury to the Osaka Rosai Hospital, who met the inclusion criteria. This presents a problem, as there is no way to compare conservative treatment to those who received surgery. While the lack of random assignment reduces control of the study and increases the possibility for bias, this is just a result of the type of study.</td>
</tr>
<tr>
<td>a. If no, describe what was done</td>
<td></td>
</tr>
<tr>
<td>b. What are the potential consequences of this assignment process for the study’s results?</td>
<td></td>
</tr>
<tr>
<td>19. Did the investigators know who was being assigned to which group prior to the allocation?</td>
<td>Yes, there was no blinding in the study as the participants were all in one group.</td>
</tr>
<tr>
<td>a. If they were not blind, what are the potential consequences of this knowledge for the study’s results?</td>
<td></td>
</tr>
<tr>
<td>20. Were the groups similar at the start of the trial? Did they report the demographics of the study groups?</td>
<td>N/A (no control group)</td>
</tr>
<tr>
<td>a. If they were not similar – what differences existed?</td>
<td></td>
</tr>
<tr>
<td>b. Do you consider these differences a threat to the research validity? How might the differences between groups affect the results of the study?</td>
<td></td>
</tr>
<tr>
<td>21. Did the subjects know to which treatment group they were assign?</td>
<td>Yes, all participants knew they were being treated conservatively. This knowledge shouldn’t affect the outcomes, as there is no group comparison being made.</td>
</tr>
<tr>
<td>a. If yes, what are the potential consequences of the subjects’ knowledge for this study’s results</td>
<td></td>
</tr>
<tr>
<td>22. Did the investigators know to which treatment group subjects were assigned?</td>
<td>N/A (no control group)</td>
</tr>
<tr>
<td>a. If yes, what are the potential consequences of the subjects’ knowledge for this study’s results</td>
<td></td>
</tr>
<tr>
<td>Question</td>
<td>Answer</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>23. Were the groups managed equally, apart from the actual experimental treatment?</strong>&lt;br&gt;a. If not, what are the potential consequences of this knowledge for the study’s results?</td>
<td>N/A (no control group)</td>
</tr>
<tr>
<td><strong>24. Was the subject follow-up time sufficiently long to answer the question(s) posed by the research?</strong>&lt;br&gt;a. If not, what are the potential consequences of this knowledge for the study’s results?</td>
<td>While follow-up time varied, it was at least 24 months in all cases, which seems sufficiently long to track recovery from a sports injury.</td>
</tr>
<tr>
<td><strong>25. Did all the subjects originally enrolled complete the study?</strong>&lt;br&gt;a. If not how many subjects were lost?&lt;br&gt;b. What, if anything, did the authors do about this attrition?&lt;br&gt;c. What are the implications of the attrition and the way it was handled with respect to the study’s findings?</td>
<td>Of the originally selected 22 participants, 3 ended up not being treated conservatively, because it was decided that they had complicated enough injuries to merit surgical reconstruction. These individuals were still included in the study with regards to final results.</td>
</tr>
<tr>
<td><strong>26. Were all patients analyzed in the groups to which they were randomized (i.e. was there an intention to treat analysis)?</strong>&lt;br&gt;a. If not, what did the authors do with the data from these subjects?&lt;br&gt;b. If the data were excluded, what are the potential consequences for this study’s results?</td>
<td>Since the individuals were did not complete the study, could not be considered to have been treated conservatively, there data was included in the analysis, except for their ability to return to sport.</td>
</tr>
</tbody>
</table>

**Are the valid results of this RCT important?**

<table>
<thead>
<tr>
<th>Appraisal Criterion</th>
<th>Reader’s Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>27. What were the statistical findings of this study?</strong>&lt;br&gt;a. When appropriate use the calculation forms below to determine these values&lt;br&gt;b. Include: tests of differences With p-values and Cl&lt;br&gt;c. Include effect size with p-values and Cl&lt;br&gt;d. Include ARR/ABI and RRR/RBI with p-values and Cl&lt;br&gt;e. Include NNT and Cl</td>
<td>14 of the 22 original participants (64%) were able to return to their previous level of sport with only conservative treatment, while 3/22 (14%) received surgery for meniscal/PCL or PCL repairs, leaving 5/22 (23%) that received the conservative treatment, and were not able to, or advised against return to sport.</td>
</tr>
<tr>
<td>Appraisal Criterion</td>
<td>Reader's Comments</td>
</tr>
<tr>
<td>---------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>30. Does this intervention sound appropriate for use (available, affordable) in your clinical setting? Do you have the facilities, skill set, time, 3rd party coverage to provide this treatment?</td>
<td>Unfortunately the “treatment” in this study was defined as no surgery, meaning that there could have been a variety of conservative treatment received by participants (not specified).</td>
</tr>
<tr>
<td>31. Are the study subjects similar to your patient/client?</td>
<td>The subjects of this study were similar to my patient (young, athletes)</td>
</tr>
<tr>
<td>a. If not, how different? Can you use this intervention in spite of the differences?</td>
<td></td>
</tr>
<tr>
<td>32. Do the potential benefits outweigh the potential risks using this intervention with your patient/client?</td>
<td>This depends on the severity of chondral injury, which was the most important factor considered in the study for development of arthritic/degenerative changes.</td>
</tr>
<tr>
<td>33. Does the intervention fit within your patient/client’s stated values or expectations?</td>
<td>N/A (no intervention)</td>
</tr>
<tr>
<td>a. If not, what will you do now?</td>
<td></td>
</tr>
<tr>
<td>34. Are there any threats to external validity in this study?</td>
<td>This study is conducted out of one hospital in Japan, presumably on mostly Japanese individuals, and therefore may not be valid.</td>
</tr>
</tbody>
</table>
applicable to those of other ethnic backgrounds. Furthermore, it likely does not apply to patients receiving skilled physical therapy, as it was not specified if any participants received therapy during the study.

**What is the bottom line?**

<table>
<thead>
<tr>
<th>Appraisal Criterion</th>
<th>Reader's Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>PEDRO score (see scoring at end of form)</td>
<td>2/10</td>
</tr>
<tr>
<td>Summarize your findings and relate this back to clinical significance</td>
<td>The real notable results of this study were that ability to return to sport was determined mostly on the severity of chondral lesions correlated to the PCL injury. The results and discussion of the study were all devoted to the possibility of degenerative change that could occur for those with severe lesions to the meniscus or articular cartilage, and not to the importance of the PCL. Furthermore, of the 5 participants who did not return to sport, it was noted that they did so at the advice of the investigators (due to the ‘high’ potential for degeneration), NOT because they were unable to participate. This article would honestly not be a significant driving force in my decision whether or not to suggest conservative treatment to my patient.</td>
</tr>
</tbody>
</table>
Reference # 16

Intervention – Evidence Appraisal Worksheet


Level of Evidence (Oxford scale): 2b

Is the purpose and background information sufficient?

<table>
<thead>
<tr>
<th>Appraisal Criterion</th>
<th>Reader’s Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study Purpose</td>
<td>Yes, the clearly stated purpose of the study was to compare results, in terms of knee joint stability and function, between PCL midsubstance tears that were treated operatively using primary repair suturing and those that were treated non-operatively with immobilization, and quadriceps strengthening.</td>
</tr>
<tr>
<td>Literature</td>
<td>Yes, a thorough and varied literature review was conducted, showing the wealth of contradictory sources of information, some of which suggested that operative treatment (repair or reconstruction) of the posterior cruciate ligament had no better results than non-operative repair, and some showing that there were significant findings of joint degeneration, decreased stability, and lower subjective reports of function in patients who were treated non-operatively for their PCL injuries.</td>
</tr>
</tbody>
</table>

Stated clearly?

Usually stated briefly in abstract and in greater detail in introduction. May be phrased as a question or hypothesis.

A clear statement helps you determine if topic is important, relevant and of interest to you. Consider how the study can be applied to PT and/or your own situation. What is the purpose of this study?

Literature presented?

A review of the literature should provide background for the study by synthesizing relevant information such as previous research and gaps in current knowledge, along with the clinical importance of the topic.

Describe the justification of the need for this study
Does the research design have strong internal validity?

<table>
<thead>
<tr>
<th>Appraisal Criterion</th>
<th>Reader’s Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>⊳ Discuss possible threats to internal validity in the research design. Include:</td>
<td>Assignment – participants were assigned according to date, with those between 1982 and 1986 being assigned to the repair group and those from 1986-1990 receiving non-operative management (non-random)</td>
</tr>
<tr>
<td>⊳ Assignment</td>
<td>Attrition – no attrition</td>
</tr>
<tr>
<td>⊳ Attrition</td>
<td>History – Long follow-up times with no control group make this a possible threat to internal validity</td>
</tr>
<tr>
<td>⊳ History</td>
<td>Instrumentation – Arthrometer was used in conjunction with lateral radiographs, a procedure that is standardized, repeatable, and accurately measures passive stability and joint stress</td>
</tr>
<tr>
<td>⊳ Instrumentation</td>
<td>Maturation – At least 2 of the participants were aged 13 or less, creating the possibility for some maturation to occur during the follow-up period</td>
</tr>
<tr>
<td>⊳ Maturation</td>
<td>Testing – objective testing left no room for bias</td>
</tr>
<tr>
<td>⊳ Testing</td>
<td>Compensatory Equalization of treatments – N/A as the study was retrospective</td>
</tr>
<tr>
<td>⊳ Compensatory Equalization of treatments</td>
<td>Compensatory rivalry – N/A as the study was retrospective</td>
</tr>
<tr>
<td>⊳ Compensatory rivalry</td>
<td>Statistical regression – There was a normal distribution of objective stability - displacement ratio (DMR)</td>
</tr>
</tbody>
</table>
### Are the results of this therapeutic trial valid?

<table>
<thead>
<tr>
<th>Appraisal Criterion</th>
<th>Reader’s Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>46. Did the investigators randomly assign subjects to treatment groups?</strong></td>
<td><strong>No, the study was retrospective, and based on the hospital policy on treatment of PCL injury, and therefore was temporally based, instead of randomized. If there was a change in MOI or etiology that was based on time of injury it could introduce confounding factors, although this is unlikely.</strong></td>
</tr>
<tr>
<td>a. If no, describe what was done</td>
<td></td>
</tr>
<tr>
<td>b. What are the potential consequences of this assignment process for the study’s results?</td>
<td></td>
</tr>
<tr>
<td><strong>47. Did the investigators know who was being assigned to which group prior to the allocation?</strong></td>
<td><strong>Yes, there was no blinding as this was a retrospective cohort study</strong></td>
</tr>
<tr>
<td>a. If they were not blind, what are the potential consequences of this knowledge for the study’s results?</td>
<td></td>
</tr>
<tr>
<td><strong>48. Were the groups similar at the start of the trial? Did they report the demographics of the study groups?</strong></td>
<td><strong>The groups appear relatively similar, although no p-values are given for between group differences, so this cannot be accurately determined. There were more sports related injuries in the non-operative group compared to the repair group (12/20 compared to 5/20). This could present a threat to validity in terms of seriousness of injury or qualities of the participants.</strong></td>
</tr>
<tr>
<td>a. If they were not similar – what differences existed?</td>
<td></td>
</tr>
<tr>
<td>b. Do you consider these differences a threat to the research validity? How might the differences between groups affect the results of the study?</td>
<td></td>
</tr>
<tr>
<td><strong>49. Did the subjects know to which treatment group they were assign?</strong></td>
<td><strong>Yes, there was no attempt to blind participants.</strong></td>
</tr>
<tr>
<td>a. If yes, what are the potential consequences of the subjects’ knowledge for this study’s results</td>
<td></td>
</tr>
<tr>
<td><strong>50. Did the investigators know to which treatment group subjects were assigned?</strong></td>
<td><strong>Yes, there was no attempt to blind investigators</strong></td>
</tr>
<tr>
<td>a. If yes, what are the potential consequences of the subjects’ knowledge for this study’s results</td>
<td></td>
</tr>
<tr>
<td><strong>51. Were the groups managed equally, apart from the actual experimental treatment?</strong></td>
<td><strong>Yes, both groups received the same treatment other than the surgery, which included immobilization for 4 weeks with isometric</strong></td>
</tr>
<tr>
<td>a. If not, what are the potential consequences of this knowledge for the study’s results?</td>
<td>quadriiceps exercises, WB at 3 weeks, and isotonic and ROM exercises started at 4 weeks.</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>52. Was the subject follow-up time sufficiently long to answer the question(s) posed by the research?</td>
<td>The follow-up time was long enough to assess stability and function after injury, but not long enough to assess cumulative joint degeneration. This means that the study, will give a good idea of function and stability in the range of 5 to 10 years post injury, but not after a participant has aged significantly.</td>
</tr>
<tr>
<td>53. Did all the subjects originally enrolled complete the study?</td>
<td>Yes</td>
</tr>
<tr>
<td>54. Were all patients analyzed in the groups to which they were randomized (i.e. was there an intention to treat analysis)?</td>
<td>Yes</td>
</tr>
<tr>
<td>55. What were the statistical findings of this study?</td>
<td>Operative group’s displacement ratios (DMRs) ranged from 43 to 59% (mean – 46.9+/−3.7), while the non-operative group scored DMRs ranging from 28 to 45% (mean – 37.1+/−4.8) indicating significantly (p&lt;.00001) less passive stability. Subjective knee rating scores ranged from 78 to 100 (mean 92.9+/−5.1) for the operative group and from 84 to 95 (mean90.9+/−2.8)</td>
</tr>
<tr>
<td>a. When appropriate use the calculation forms below to determine these values</td>
<td>Reader’s Comments</td>
</tr>
<tr>
<td>b. Include: tests of differences With p-values and CI</td>
<td></td>
</tr>
<tr>
<td>c. Include effect size with p-values and CI</td>
<td></td>
</tr>
<tr>
<td>d. Include ARR/ABI and RRR/RBI with p-values and CI</td>
<td></td>
</tr>
<tr>
<td>e. Include NNT and CI</td>
<td></td>
</tr>
<tr>
<td>f. Other stats should be included here</td>
<td>and the difference was not significant (p&gt;.05).</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td><strong>56. What is the meaning of these statistical findings for your patient/client’s case? What does this mean to your practice?</strong></td>
<td>Knee stability (passive) will be better in those with repair compared to those treat non-operatively, but subjective scores of knee functioning should be no different.</td>
</tr>
<tr>
<td><strong>57. Do these findings exceed a minimally important difference? Was this brought up or discussed? a. If the MCID was not met, will you still use this evidence?</strong></td>
<td>There is no established MCID for the DMR score, and clinical significance was not talked about in this study.</td>
</tr>
</tbody>
</table>

**Can you apply this valid, important evidence about an intervention in caring for your patient/client? What is the external validity?**

<table>
<thead>
<tr>
<th>Appraisal Criterion</th>
<th>Reader’s Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>58. Does this intervention sound appropriate for use (available, affordable) in your clinical setting? Do you have the facilities, skill set, time, 3rd party coverage to provide this treatment?</strong></td>
<td>This treatment (surgical repair) would require a referral to an orthopaedic surgeon, and would not occur in the PT office.</td>
</tr>
<tr>
<td><strong>59. Are the study subjects similar to your patient/client? a. If not, how different? Can you use this intervention in spite of the differences?</strong></td>
<td>The study subjects cover a range of the general population, and therefore cannot be generalized to one type of patient.</td>
</tr>
<tr>
<td><strong>60. Do the potential benefits outweigh the potential risks using this intervention with your patient/client?</strong></td>
<td>Based on this study, I would say no.</td>
</tr>
<tr>
<td><strong>61. Does the intervention fit within your patient/client’s stated values or expectations? a. If not, what will you do now?</strong></td>
<td>Perhaps. My patient is willing to have surgery if it deemed to be medically necessary, however prefers to refrain if good non-surgical outcomes are possible.</td>
</tr>
<tr>
<td><strong>62. Are there any threats to external validity in this study?</strong></td>
<td>The subject population is (presumably) not racially or geographically diverse, and is not specific to athletes, and so may not reflect the possible outcomes of my patient.</td>
</tr>
</tbody>
</table>
What is the bottom line?

<table>
<thead>
<tr>
<th>Appraisal Criterion</th>
<th>Reader’s Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>PEDRO score (see scoring at end of form)</td>
<td>3/10</td>
</tr>
<tr>
<td>Summarize your findings and relate this back to clinical significance</td>
<td>This study used passive joint translation with an applied anterior to posterior force on the tibia in 90 degrees of knee flexion as a means of objectively evaluating knee stability. While this type of measurement seems to be the standard when measuring joint stability, it fails to assess functional stability of the knee, which is likely a much more complicated measure. I fail to see how the passive stability of a joint gives a good sense of how that joint moves during gait, for example, when the joint is much closer to full extension, and muscles are engaged, approximating the joint, and drastically increasing the stability of the joint. This sentiment seems to be corroborated by the fact that subjective and functional scoring of knee function by the patient shows no significant difference between groups. While I would relate all the finding to my patient, I might stress the fact that patient satisfaction with their knee did not increase with surgery.</td>
</tr>
</tbody>
</table>

Reference # 19

Intervention – Evidence Appraisal Worksheet

Citation:

Level of Evidence (Oxford scale): 4
## Is the purpose and background information sufficient?

<table>
<thead>
<tr>
<th>Appraisal Criterion</th>
<th>Reader’s Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Study Purpose</strong></td>
<td></td>
</tr>
<tr>
<td>Stated clearly?</td>
<td>Purpose is clearly stated. Rather than seeking to study to outcomes of conservative treatment of isolated PCL injuries in terms of overall function, as previous studies had, the authors of the study stated their intent to measure outcomes in terms of ability to return to sport (PLOF)</td>
</tr>
<tr>
<td>Usually stated briefly in abstract and in greater detail in introduction. May be phrased as a question or hypothesis.</td>
<td></td>
</tr>
<tr>
<td>A clear statement helps you determine if topic is important, relevant and of interest to you. Consider how the study can be applied to PT and/or your own situation. What is the purpose of this study?</td>
<td></td>
</tr>
</tbody>
</table>

| **Literature**      |                   |
| Relevant background presented? | The study includes reference to relevant background literature, including previous studies that have looked at effectiveness of conservative management of PCL injury for non-athletes. Specifically, the authors point out a gap in knowledge of how conservative treatment would affect outcomes, in patients whose goals include return to high-level athletics, and seek to fill that gap. |
| A review of the literature should provide background for the study by synthesizing relevant information such as previous research and gaps in current knowledge, along with the clinical importance of the topic. | |
| Describe the justification of the need for this study | |

## Does the research design have strong internal validity?

<table>
<thead>
<tr>
<th>Appraisal Criterion</th>
<th>Reader’s Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discuss possible threats to internal validity in the research design. Include: Assignment, Attrition, History, Instrumentation, Maturation, Testing</td>
<td>Assignment – No control group, subjects selected purposively</td>
</tr>
<tr>
<td>Assignment – No attrition (100% follow-up)</td>
<td></td>
</tr>
<tr>
<td>History – it was not possible to control for external events, and therefore time of return to sport was affected in some cases by history</td>
<td></td>
</tr>
</tbody>
</table>
Rehabilitation of Isolated PCL Injury: Long-term Function and Return to Sport

- Compensatory Equalization of treatments
- Compensatory rivalry
- Statistical Regression

(attendance, other injury, and work were reasons given for delayed return to sport)

Instrumentation – Consistent and appropriate tools were used to measure subject ability to return to sport. The tool used was a sport specific questionnaire that assessed CLOF to PLOF in terms of Rugby specific skills, however was NOT a validated study tool.

Maturation – N/A

Testing – by questionnaire only, no objective performance measurement

Compensatory Equalization of Treatment – N/A

Compensatory Rivalry – N/A

Statistical Regression – No statistical outliers at baseline.

<table>
<thead>
<tr>
<th>Appraisal Criterion</th>
<th>Reader’s Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>63. Did the investigators randomly assign subjects to treatment groups?</td>
<td>There was only one group in the design, so there was no assignment process, only selection process.</td>
</tr>
<tr>
<td></td>
<td>a. If no, describe what was done</td>
</tr>
<tr>
<td></td>
<td>b. What are the potential consequences of this assignment process for the study’s results?</td>
</tr>
<tr>
<td>64. Did the investigators know who was being assigned to which group prior to the allocation?</td>
<td>Yes, there was no control group. The study was a quasi-experimental prospective design.</td>
</tr>
<tr>
<td>a. If they were not blind, what are the potential consequences of this knowledge for the study’s results?</td>
<td></td>
</tr>
<tr>
<td>65. Were the groups similar at the start of the trial? Did they report the demographics of the study groups?</td>
<td>Again, there was only an experimental group</td>
</tr>
<tr>
<td>a. If they were not similar – what differences existed?</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td><strong>66. Did the subjects know to which treatment group they were assigned?</strong>&lt;br&gt;a. If yes, what are the potential consequences of the subjects’ knowledge for this study’s results?</td>
<td>Yes, there was no control group, only an experimental group</td>
</tr>
<tr>
<td><strong>67. Did the investigators know to which treatment group subjects were assigned?</strong>&lt;br&gt;a. If yes, what are the potential consequences of the subjects’ knowledge for this study’s results?</td>
<td>Yes, there was no control group, only an experimental group</td>
</tr>
<tr>
<td><strong>68. Were the groups managed equally, apart from the actual experimental treatment?</strong>&lt;br&gt;a. If not, what are the potential consequences of this knowledge for the study’s results?</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>69. Was the subject follow-up time sufficiently long to answer the question(s) posed by the research?</strong>&lt;br&gt;a. If not, what are the potential consequences of this knowledge for the study’s results?</td>
<td>Yes. Subject follow-up time was 1 year. It seems unlikely that subjects would return to sport after that long of a recovery, and it is a sufficiently long recovery in order to allow for ‘complete’ recovery in most subjects.</td>
</tr>
<tr>
<td><strong>70. Did all the subjects originally enrolled complete the study?</strong>&lt;br&gt;a. If not how many subjects were lost?&lt;br&gt;b. What, if anything, did the authors do about this attrition?&lt;br&gt;c. What are the implications of the attrition and the way it was handled with respect to the study’s findings?</td>
<td>Yes, there was no attrition in the study. All 16 subjects completed the follow up at 1 year</td>
</tr>
<tr>
<td><strong>71. Were all patients analyzed in the groups to which they were randomized (i.e. was there an intention to treat analysis)?</strong>&lt;br&gt;a. If not, what did the authors do with the data from these subjects?</td>
<td>Yes, again there was only one study group, but all individuals completed the follow-up, and were included in the data.</td>
</tr>
</tbody>
</table>
### Are the valid results of this RCT important?

<table>
<thead>
<tr>
<th>Appraisal Criterion</th>
<th>Reader’s Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>72. What were the statistical findings of this study?</strong></td>
<td>88% of subjects returned to same level of sport, however most reported at least some decrement in ability</td>
</tr>
<tr>
<td>a. When appropriate use the calculation forms below to determine these values</td>
<td></td>
</tr>
<tr>
<td>b. Include: tests of differences with p-values and CI</td>
<td></td>
</tr>
<tr>
<td>c. Include effect size with p-values and CI</td>
<td></td>
</tr>
<tr>
<td>d. Include ARR/ABI and RRR/RBI with p-values and CI</td>
<td></td>
</tr>
<tr>
<td>e. Include NNT and CI</td>
<td></td>
</tr>
<tr>
<td>f. Other stats should be included here</td>
<td></td>
</tr>
</tbody>
</table>

For patients who are similar in characteristics to those studied, conservative management of isolated PCL injury is possible and can be considered, but would most likely result in some measure of decreased sport performance.

### Can you apply this valid, important evidence about an intervention in caring for your patient/client? What is the external validity?

<table>
<thead>
<tr>
<th>Appraisal Criterion</th>
<th>Reader’s Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>75. Does this intervention sound appropriate for use (available, affordable) in your clinical setting? Do you have the facilities, skill set, time, 3rd party coverage to provide this treatment?</strong></td>
<td>Treatment is basic strengthening and ROM of the knee. Most PT facilities should have all necessary equipment and skilled individuals to perform.</td>
</tr>
</tbody>
</table>
76. Are the study subjects similar to your patient/client?
   a. If not, how different? Can you use this intervention in spite of the differences?

   Study subjects were all male athletes aged 17 to 32. Patient is a 27 year old male athlete.

77. Do the potential benefits outweigh the potential risks using this intervention with your patient/client?

   Yes. There are few if any risks to therapeutic exercise as a modality.

78. Does the intervention fit within your patient/client’s stated values or expectations?
   a. If not, what will you do now?

   Yes, the patient is very hesitant to go in for surgery and wishes to treat conservatively if there is a good prognosis for recovery without surgery.

79. Are there any threats to external validity in this study?

   Yes the study consisted of male subjects all from one hospital in one city (Osaka, Japan), assumedly from few ethnic backgrounds. There is some likelihood that the results of this study may not carry over to a patient from different ethnic or geographical location.

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**What is the bottom line?**

<table>
<thead>
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<tbody>
<tr>
<td>PEDRO score (see scoring at end of form)</td>
<td>3/10</td>
</tr>
<tr>
<td>Summarize your findings and relate this back to clinical significance</td>
<td>Clinical findings were that non-surgical, conservative treatment, consisting of knee strengthening and ROM exercises, was an effective means of treating isolated PCL injuries if the goal of the patient was return to sport. The outcomes measure return to sport and give some subjective measure of the completeness of recovery in terms of what sport specific skills are like compared to PLOF after one year, and so are good for measuring return to sport for athletes, but provide no information about function, pain, or need for surgery later in life, or athletic ability beyond one year post-treatment.</td>
</tr>
</tbody>
</table>
References


