Chiropractic management of a postoperative complete anterior cruciate ligament rupture using a multimodal approach: a case report

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Abstract

Objective: The purpose of this case report is to describe the chiropractic management of a patient who had postoperative reconstructive surgery for an anterior cruciate ligament (ACL) tear.

Clinical Features: A 25-year-old man experienced a rupture of his left ACL, as well as a bucket-handle tear of the medial meniscus and full-thickness tear within the posterior horn of the lateral meniscus, following direct-contact trauma while playing basketball.

Intervention and Outcome: Postoperative care included a 12-week functional chiropractic rehabilitation program along with Active Release Technique, Graston Technique, and Kinesio Taping. Following treatment, the patient recorded a 0/10 on the Numeric Pain Scale, recorded improvement on the Patient Specific Functional and Pain Scales, returned to play with no complications, and had complete restoration of range of motion and lower extremity muscle strength. At 1-year follow-up, the patient reported no pain and was fully functional.

Conclusion: A multimodal approach to the treatment of a postsurgical ACL repair was successful in restoring functional ability, as well as complete subjective pain relief. Chiropractic care may be a beneficial addition to the care of postoperative patients.

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Introduction

Anterior cruciate ligament (ACL) disruption is a common and debilitating injury that frequently affects

the athletic population. The only study to examine the prevalence of ACL injuries in the general population revealed an annual incidence rate of 1 case for every 3500 people.¹ Injury to the ACL is considered problematic because of residual functional instability and predisposition to meniscal injuries, early-onset osteoarthritis, and failure of secondary knee stabilizers.² Unfortunately, injury to the ACL often occurs in combination with injury to the menisci, articular

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cartilage, or surrounding ligaments. Combination injuries negatively affect the patient's outcomes and often necessitate surgical reconstruction. Other factors that indicate the need for surgical repair include those patients who participate in recreational activities and sports or who perform manual work.

Anterior cruciate ligament biomechanics are complex, and disruption of this ligament has detrimental effects. Furthermore, even with surgical reconstruction, the biomechanical function of an intact ACL is difficult to duplicate. Anterior cruciate ligament disruption invariably results in knee kinematic alterations, such as deterioration of the physiologic roll-glide mechanism of the femorotibial joint, resulting in an increased anterior tibial translation and internal rotation.³

The consensus on appropriate postoperative care has greatly evolved over the past 2 decades. Twenty years ago, it was agreed that ACL reconstructed knees should be immobilized for at least 6 weeks to allow the graft to fully heal. Presently, active early rehabilitation is believed to be the standard postoperative protocol.⁴ The primary objective of rehabilitation following ACL reconstruction surgery is to restore knee function by increasing neuromuscular control. Currently, however, there is debate over various aspects of the most beneficial type of postoperative ACL rehabilitation program. Arguments exist over effectiveness of accelerated vs decelerated programs, neuromuscular vs strength-based exercises, and open- vs closed-chain focused programs.^{5,6}

Based on current research, we decided that a postoperative program combining both neuromuscular and strength-based exercises in conjunction with specialized soft tissue techniques should be implemented in our treatment program. The purpose of this case study is to report on a patient who improved in recovery with functional rehabilitation, a program customized for the patient based on findings from functional evaluations, along with the addition of the following adjunctive therapies: Active Release Technique (ART), Graston Technique (GT), and Kinesio Taping (KT).

Case report

A 25-year-old male student presented with medial anterior-inferior left knee pain following trauma. The patient stated that the injury occurred while playing basketball when he received a contact force from an opponent directed medial to lateral across his left knee.

The patient reported his pain at the time of injury as a 10/10 according to the Numeric Pain Scale. Physical examination was limited because of the patient's pain level and amount of left knee swelling. Range of motion was limited to 20° to 30° knee flexion on the left. Orthopedic test results were unremarkable with the exception of the Apley compression test. Result of neurologic examination was within normal limits for sensory and deep tendon reflexes bilaterally; however, muscle strength for left knee extension was graded as a +2/5 and left ankle dorsiflexion as a +3/5.

Magnetic resonance imaging of the left knee was needed to fully evaluate the extent of injury. The following impressions were made from the imaging results: complete rupture of the ACL with associated joint effusion and osseous contusions (Fig 1), bucket-handle tear of the medial meniscus with large meniscal fragment located within the intercondylar notch (Figs 2 and 3), and full-thickness tear of the posterior horn of the lateral meniscus (Fig 4).

Surgical reconstruction of the ACL rupture and bucket-handle tear of the medial meniscus was performed. A hamstring tendon autograft was used to replace the ACL. This type of graft has several advantages relative to the common patellar tendon graft, including less anterior knee pain following surgery, less postoperative stiffness, smaller incision, and faster recovery.^{7,8} However, it needs to be taken into consideration that studies have also indicated the possibility for decreased hamstring strength in these patients following surgery.⁹ Postoperatively, the patient was referred for physical therapy. The patient

Fig 1. Rupture of the ACL with associated joint effusion and osseous contusions.

Fig 2. Bucket-handle tear of the medial meniscus.

chose to be treated by the board-certified chiropractic sports physician at the school that he was attending.

An examination was performed 1 week following surgery. Inspection revealed moderate localized edema of the left knee. Muscular palpation revealed hypertonicity of the left quadriceps and hamstring muscles. Range of motion of the left knee was limited to 30° flexion and -30° extension. Orthopedic tests could not be performed on the patient's knee during this

Fig 3. Double posterior cruciate ligament sign medial meniscus tear.

Fig 4. Full-thickness tear of the posterior horn of the lateral meniscus.

examination because of the acute nature of the postsurgical knee. Patient's muscle strength was tested at the lower extremity; knee extension on the left tested +2/5, hip flexion tested +3/5, and ankle dorsiflexion tested +4/5 on the left.

A 12-week rehabilitation program with emphasis on closed-chain kinetic exercises, neuromuscular-based exercises, strength-based exercises, and proprioceptive work was implemented. [Table 1](#) presents the exercises and therapies and when were implemented in the 12-week treatment program. Functional assessments used before and throughout the 12-week rehabilitation program enabled us to develop an appropriate exercise program customized to the patient's needs. Functional evaluations help determine overactive and inhibited muscles, as well as altered firing patterns. We were also able to establish when the patient was able to safely progress with more challenging activities. The functional tests used in this case included single leg balance, double leg squat, single leg squat, Vele test, Janda hip extension test, Janda hip abduction test, active straight leg raise, and modified Thomas test. Although certain exercises may have been performed over several weeks, we continually increased the difficulty of the exercises with an increase in time, resistance, or hold count and/or an increase in instability. In the beginning weeks, we were careful to choose appropriate exercises for the patient because his graft was in the process of healing. For instance, the wall squats performed in weeks 1 to 2 required the patient to not squat beyond 45° flexion.

Table 1 Twelve-week treatment protocol: rehabilitation exercises and adjunctive therapies

	Weeks 1-2	Weeks 2-4	Weeks 3-5	Weeks 6-8	Weeks 9-12
Proprioceptive exercises					
Single leg stance	x				
Single leg balance with external stimuli		x			
Single leg balance on trampoline			x	x	
Biomechanical Ankle Platform System	x	x	x	x	
Balance reach activities		x			
Functional exercises					
1/4 squats	x				
Wall squats	x				
Single leg squat		x	x	x	x
Lunges		x	x	x	x
Heel raises			x	x	x
Calf stretches			x	x	x
Theraband hip ROMs		x			
Step ups/downs			x	x	
Bilateral stance with body blade	x				
Cariocas					x
Jumps with boxes					x
Stationary bike	x	x		x	
Walking on treadmill				x	
Running					x
Sports drills					
Figure 8s					x
40-yd sprints					x
Shuffle drills					x
Double leg jumps					x
Skipping with Theraband resistance					x
KT	x	x	x		
GT			x	x	x
ART					x

During weeks 2 to 4, the patient's range of motion increased to 120° of knee flexion. Proprioceptive activities performed during these weeks included single leg stance with addition of external stimuli, such as body blade work and ball throws. The lunges performed by the patient during these weeks began

with lunges toward the nonsurgical knee progressing toward the surgical knee in various vectors.

During weeks 3 to 5, the patient reached 125° of knee flexion. Proprioceptive activities performed during these weeks consisted of single leg balance on a minitrampoline with addition of external stimuli using soft medicine balls. The time the patient worked on the stationary bike increased to 15 minutes.

During weeks 9 to 12, the patient was able to perform the following functional lower extremity exercises without difficulty: cariocas, running (with doctor approval first) on the treadmill progressing to 30 minutes, and jumps with boxes. Sports drills were also implemented during these weeks.

Adjunctive therapies were also used throughout the 12-week treatment period in hopes to reach a quicker recovery, consisting of complete subjective pain relief and gain in full functional ability. Kinesio Taping was implemented during the first week of treatment and used through the fifth week of the program. The purpose of the KT in this case was to reduce the amount of swelling of the knee for the patient to gain more range of motion and reduce his pain level. The muscles targeted were as follows: transverse abdominus muscle, gastrocnemius muscle, peronei muscles, hamstring muscles, and quadriceps muscles.

Graston Technique was added to the treatment protocol at week 5 of postoperative rehabilitation. Targeting the left quadriceps, hamstrings, adductor and abductor muscle groups, and gastrocnemius and soleus muscles with GT reduced the amount of fibrotic adhesions and hypertonicity, which allowed the patient to increase his range of motion, decrease pain, and increase functionality.

Active Release Technique was used as an adjunctive therapy beginning in week 10 of the treatment program. We needed to establish the patient's full range of motion before beginning ART; therefore, it was not implemented until later in the rehabilitative process. In this case, ART was applied to the rectus femoris, patellar tendon, articular genu, vastus medialis and lateralis, gastrocnemius, soleus, medial and lateral collateral ligaments, medial and lateral menisci, biceps femoris, semimembranosus, and semitendinosus muscle.

In addition to determining which exercises were most appropriate for our patient, functional assessments also enabled recognition of which tissues we needed to perform the adjunctive therapies on. Functional evaluations determined which of the patient's muscles were inhibited or overactive. Written informed consent was obtained from the patient for publication of this case report and accompanying images.

Before treatment, the following outcome measures were recorded: Numeric Pain Scale, Patient Specific Functional and Pain Scales,¹⁰⁻¹³ muscle strength, and range of motion of the patient's surgical knee. The patient began with a 10/10 based on the Numeric Pain Scale; and following the 12 weeks of treatment, the patient recorded a 0/10. According to the Patient Specific Functional and Pain Scales, the patient noted, before beginning treatment, that the 3 activities he was having the most difficulty performing were walking, running, and playing basketball. He rated the 3 activities as having a score of 3, 0, and 0, respectively (in a scale of 0 to 10, with 0 being unable to perform the particular activity). Following the 12-week treatment plan, the patient rated the same 3 activities as a score of 10 (walking), 10 (running), and 9 (playing basketball). The patient was able to return to play with no complications and had complete restoration of lower extremity ranges of motion and lower extremity muscle strength. The patient's knee flexion reached 130° at the end of the 12 weeks; and muscle testing revealed extension on the left grading at a +5/5, hip flexion testing as a +5/5, and ankle dorsiflexion testing as a +5/5.

Follow-up with the patient 1 year following the conclusion of his 12-week treatment program revealed no pain and full restoration of function; and the patient stated that he had been able to play basketball, recreational flag football, and softball with no complications. The patient has had no recurrence, discomfort, or loss of function since the conclusion of the treatment program.

Discussion

Although rehabilitation therapy is not a new concept in the postoperative recovery of ACL injuries, we believe that our protocol was effective for we used functional evaluations at the beginning and throughout the 12-week program. Functional assessments should be performed on a postsurgical patient to develop an appropriate rehabilitation program customized to the patient's individual needs. Functional evaluations help determine overactive and inhibited muscles as well as altered firing patterns. Functionally based exercises were used that mimicked the motions of activities of daily living and challenged the patient globally rather than solely focusing on the patient's knee complex.

In this case, full recovery of a postsurgical knee was achieved with rehabilitation and adjunctive therapies. These therapies included ART, GT, and KT. Active Release Technique is a soft tissue management system

that is believed to restore optimal motion and function of the soft tissue and release entrapped nerves or blood vessels. The treatment method consists of identifying and trapping the affected tissue while the body part is actively moved by the patient. Although there are numerous patient and physician testimonials to account for the success of this type of therapy, there is minimal scientific research available that investigates this popular technique. However, George et al¹⁴ found that ART provided significant improvements in symptom severity and functional status in a small sample of carpal tunnel syndrome patients.

Graston Technique is a form of instrument-assisted soft tissue mobilization designed to break down scar tissue and fascial restrictions. According to the company's official Website, <http://www.grastontechnique.com/>, the technique can decrease overall time of treatment, foster a faster recovery, and resolve chronic conditions thought to be permanent. In 1997, Craig et al¹⁵ found, through research conducted on rat tendons, that morphologic and functional changes resulting from instrument-assisted soft tissue massage suggest that the controlled microtrauma induced through the GT protocol may promote healing by increased fibroblast recruitment.

Kinesio Tex Tape is made from a cotton strip with an acrylic adhesive and is designed to mimic the qualities of human skin. The proposed mechanisms include (1) correcting muscle function by strengthening weakened muscles, (2) improving circulation of blood and lymph, (3) decreasing pain through neurologic suppression,¹⁶ and (4) increasing proprioception through increased stimulation of cutaneous mechanoreceptors.¹⁷ Kinesio Taping has been found to improve postsurgical recovery of ACL repair surgery.¹⁷ Additional claims of the function of KT are that it is able to reduce pain, swelling, and muscle spasms,¹⁸ as well as increase joint range of motion.¹⁷

Although there have been numerous studies published on rehabilitation programs for postsurgical ACL repairs, there is currently limited research on the effectiveness of taking on a multimodal approach to the treatment of this patient population. A case series published in 2008 did investigate the use of a multimodal approach in the treatment of patients with patellofemoral syndrome. Five patients were treated with a combination of manipulation directed at the joints of the lower extremity, trunk and hip stabilization exercises, patellar taping, and foot orthotics. The study found that 4 of their 5 patients improved significantly in function and reported a reduction in subjective pain.¹⁹ The use of adjunctive therapies in our case helped

relieve the patient's subjective pain and restore proper biomechanics and function of his knee joint. Removing adhesions with GT and ART can decrease pain and increase and restore normal range of motion for the muscle being treated. In this particular patient, fibrotic adhesions were found, using palpation and instrument-aided palpation, in specific muscles and tissues in the lower extremity. These findings may vary in each postsurgical patient, yet it was not unexpected to find these results because there were altered biomechanics and postsurgical adhesions in this case. Therefore, it may be warranted to evaluate each postoperative ACL repair patient for fibrotic changes in the tissues surrounding the knee and hip joints.

The rehabilitation protocol used in this case was one that focused on the implementation of functional activities, closed-chain kinetic exercises, and the use of a combination of strength and neuromuscular exercises. This type of program was based on the findings of recent research.^{5,6} Our patient was able to return to play with no complications following the 12-week program, which could be attributed to this type of rehabilitation protocol.

This case also demonstrates the wide range of therapeutic modalities available to chiropractic physicians in the care of postsurgical patients. Hoskins et al²⁰ discussed that multimodal chiropractic practitioners may be better suited than unimodal practitioners in managing athletic injuries because they incorporate passive and active care management strategies to address important phases of care in the continuum of injury. Often, postsurgical cases would solely be referred to physical therapists; but chiropractors are fully trained in the areas of rehabilitation and soft tissue modalities and are capable of receiving referrals for these types of cases. Furthermore, because of their diagnostic training, chiropractic practitioners may have an additional advantage to identify other additional complications or medical issues. However, it is necessary to note that the supplementary techniques (ART, KT, and GT) used in this case report each take additional education and certification.

Limitations

Some limitations of the study include the possibility of the patient having a similar recovery without the adjunctive therapies. Furthermore, without comparison groups, it is difficult to determine if a functionally based rehabilitation program is more effective than the standard physical therapy protocols. It is not possible to extrapolate that the care given or patient responses

would be the same for other patients or other chiropractic practices. It is also not possible to infer that multimodal chiropractic care is superior to any other type of postsurgical care. Therefore, more studies are needed to determine the additional benefit of adjunctive therapies, as well as using a rehabilitation program formatted from functional evaluation findings.

Conclusion

As athletics become more demanding and competitive, ACL injuries will likely continue to increase, demanding that chiropractic physicians continue to stay current with the most recent evidence and support research efforts in postsurgical cases. A recovery that removes the athlete from play in the least amount of time but that still allows a full gain in function and complete reduction in subjective pain is noteworthy. The patient reached maximum therapeutic benefit in 12 weeks, was able to return to sports and other activities without complications, and had maintained these results 1 year posttreatment. This case demonstrates that multimodal chiropractic care may be an effective method to establishing the recovery of postoperative ACL reconstruction patients.

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References

1. Miyasaka KC, Daniel DM, Stone ML. The incidence of knee ligament injuries in the general population. *Am J Knee Surg* 1991;4:43-8.
2. Beynnon BD, Johnson RJ, Abate JA, Fleming BC, Nichols CE. Treatment of anterior cruciate ligament injuries, part I. *Am J Sports Med* 2005;33(10):1579-602.
3. Dargel J, Gotter M, Mader K, et al. Biomechanics of the anterior cruciate ligament and implication for surgical reconstruction. *Strat Traum Limb Recon* 2007;2:1-12.
4. Beynnon BD, Uh BS, Johnson RJ, et al. Rehabilitation after anterior cruciate ligament reconstruction: a prospective, randomized, double-blind comparison of programs administered over 2 different time intervals. *Am J Sports Med* 2005;33:347-59.

5. Bynum EB, Barrack RL, Alexander AH. Open versus closed kinetic chain exercises after anterior cruciate ligament reconstruction: a prospective randomized study. *Am J Sports Med* 1995;23:401-6.
6. Risberg MA, Inger H. The long-term effect of 2 postoperative rehabilitation programs after anterior cruciate ligament reconstruction. *Am J Sports Med* 2009;37:1958-66.
7. Pinczewski LA, Deehan DJ, Salmon LJ, et al. A five-year comparison of patellar tendon versus four-strand hamstring tendon autograft for arthroscopic reconstruction of the anterior cruciate ligament. *Am J Sports Med* 2002;30(4):523-36.
8. Shaieb MD, Kan DM, Chang SK, et al. A prospective randomized comparison of patellar tendon versus semitendinosus and gracilis tendon autografts for anterior cruciate ligament reconstruction. *Am J Sports Med* 2002;30(2):214-20.
9. Tashiro T, Kurosawa H, Kawakami A, et al. Influence of medial hamstring tendon harvest on knee flexor strength after anterior cruciate ligament reconstruction: a detailed evaluation with comparison of single- and double-tendon harvest. *Am J Sports Med* 2003;31(4):522-9.
10. Chatman A, Neel J, Hyams S, Binkley J, Stratford P, Schomberg A, et al. The Patient Specific Functional Scale: measurement properties in patients with knee dysfunction. *Phys Ther* 1997;77:820-9.
11. Stratford P, Gill C, Westaway M, Binkley J. Assessing disability and change on individual patients: a report of a patient specific measure. *Physiother Can* 1995;47:258-63.
12. Stratford PW, Binkley J. Applying the results of self-report measures to individual patients: an example using the Roland-Morris Questionnaire. *J Orthop Sports Phys Ther* 1999;29:232-9.
13. Westaway M, Stratford PW, Binkley J. The Patient Specific Functional Scale: validation of its use in persons with neck dysfunction. *J Orthop Sports Phys Ther* 1998;27:331-8.
14. George JW, Tepe R, Busold D, Keuss S, Prather H, Skaggs CD. The effects of active release technique on carpal tunnel patients: a pilot study. *J Chiropr Med* 2006;5(4):119-22.
15. Craig JD, Ganion LR, Gehlsen GM, et al. Rat tendon morphologic and functional changes resulting from soft tissue mobilization. *Med Sci Sports Exer* 1997;31:3-9.
16. Kase K, Tatsuyuki H, Tomoki O. Development of Kinesio tape. *Kinesio taping perfect manual*. Kinesio Taping Association 1996;6-10:117-8.
17. Murray H. Effects of Kinesio taping on muscle strength after ACL-repair. *J Orthop Sports Phys Ther* 2001;30:1-3.
18. Halseth T, McChesney JW, DeBeliso M, et al. The effects of Kinesio taping on proprioception at the ankle. *J Sports Sci Med* 2004;3:1-7.
19. Lowry CD, Cleland JA, Dyke K. Management of patients with patellofemoral pain syndrome using a multimodal approach: a case series. *J Orthop Sports Phys Ther* 2008;38(11):691-702.
20. Hoskins W, Pollard H, Garbutt P. How to select a chiropractor for the management of athletic conditions. *Chiropr Osteopat* 2009;17:3.