# Two cases of medial knee pain involving the medial coronary ligament in adolescents treated with conservative rehabilitation therapy

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Objective: This case study chronicled the assessment, treatment and management of two adolescent patients presenting with acute knee pain, diagnosed as medial meniscus tear, with or without a medial collateral ligament sprain, with coronary ligament involvement. Cases: Patient 1: A 16 year old male football player presented with right medial knee pain of 2 days duration after having been tackled during practice from the left side. Patient 2: A 16 year old female presented with right medial knee pain that began 1 week prior to presentation after a fall down the stairs.

Treatment: Treatment was initiated in both cases using inflammatory control techniques of icing and fascial stripping and progressed to rehabilitative exercises including VMO (vastus medialis oblique) exercises and squatting exercises to strengthen the quadriceps femoris musculature and proprioceptive exercise. Rehabilitation occurred over a four week duration in both cases with progression of exercises on an individual basis. Both cases resolved within four weeks and return to normal activities resumed at the three week mark including a return to play in patient 1. Both patients reported complete resolution of symptoms at the four week mark with no recurrence on follow up a number of months later.

Summary: Conservative management, including icing, fascial stripping, and rehabilitative exercises may be

Objectif : Cette étude de cas décrivait l'évaluation, le traitement et la prise en charge de deux patients adolescents présentant une douleur aiguë au genou, diagnostiquée comme étant une déchirure du ménisque interne, avec ou sans entorse du ligament latéral interne, et impliquant le ligament coronaire.

Les cas : Patient 1 : Un joueur de football de 16 ans s'est présenté avec des douleurs au genou droit interne 2 jours après avoir plaqué du côté gauche durant une pratique. Patient 2 : Une jeune femme de 16 ans s'est présentée avec une douleur au genou droit interne qui a commencé une semaine après une chute dans les escaliers.

Traitement : Le traitement a été entrepris dans les deux cas en utilisant des techniques de contrôle inflammatoire d'application de glace et d'éveinage des fascias, et cheminait graduellement vers des exercices de réadaptation, notamment des exercices du muscle vaste interne du membre inférieur oblique et des exercices d'accroupissement pour renforcer les quadriceps et l'exercice proprioceptive. La réadaptation s'est étalée sur une période de quatre semaines dans les deux cas avec l'ajout graduel des exercices sur une base individuelle. Les deux cas ont été résolus dans un délai de quatre semaines, et le retour aux activités a eu lieu au bout de trois semaines, y compris un retour au *jeu pour le patient 1. Les deux patients ont signalé une* guérison complète des symptômes au bout de quatre semaines sans rechute lors du suivi quelques mois plus tard.

Sommaire : Un traitement prudent, incluant l'application de glace, l'éveinage des fascias et des

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beneficial in the treatment of medial meniscus tears with coronary ligament involvement in adolescents. (JCCA 2011; 55(2):120–127)

KEY WORDS: pain, adolescent, chiropractic, rehabilitation

## Introduction

According to the National Board of Chiropractic Examiners 2005 Job Analysis of Chiropractic, the chief presenting complaint on an initial visit of 8.9% of chiropractic patients in 2003 was a lower extremity complaint. It was reported on a scale of 0 to 4, where 0 meant the practitioners never treated the condition and 4 meant that the practitioners routinely treated the condition, that extremity joint dysfunction earned a rating of 3.2. Additionally the respondents indicated that 89.3 % of the respondents were the sole managers of the condition and 9.4% of the respondents co-managed the condition.<sup>1</sup> There was no specific data listed for knee disorders in the NBCE 2005 job analysis. Although the specific incidence and prevalence of knee injuries in adolescents that is not sport specific was not specifically reported in the research, it was reported that overall 5% of meniscal injuries involve patients under the age of 15.<sup>2</sup> Currently, there are few published case reports regarding knee injuries in adolescents as well as little information regarding the involvement of the coronary ligaments in knee injuries. The purpose of this article is to report two cases of knee injuries in adolescents and their management using conservative treatment and rehabilitation methods.

## **Case Reports**

## Case 1

A 16 year old male football player presented with right medial knee pain of two days duration after having been tackled during practice from the left side at the level of his lower thighs and knees. He reported that the force of the tackle was directed at his lower legs and that his feet were planted on the ground at the time of the tackle. He reported that following the tackle he was unable to get off the field due to knee pain. He attended his medical doctor the day after the injury and was told he had a medial exercices de réadaptation, peut être bénéfique pour les déchirures du ménisque interne impliquant le ligament coronaire chez les adolescents. (JCCA 2011; 55(2):120–127)

MOTS CLÉS : genou, douleur, adolescent, chiropratique, réadaptation

collateral ligament sprain and was advised to seek physiotherapy, ice, and elevate the leg.

He presented to the chiropractic clinic the following day favouring his right leg due to pain and unable to bend or straighten his right knee fully. He reported that his mother gave him oral arnica on the evening prior to the assessment and that he iced several times over the course of the evening, both of which he felt helped his pain and inflammation. The specific dosage of arnica was not known. He reported that putting pressure over the outside of his knee and walking tended to increase the pain. He described the pain as being dull with occasional sharpness associated with certain movements such as walking or pivoting, ascending and descending stairs, as well as quick movements. He denied referred pain or any parathesias and rated the pain as 3/10 in the office and 7/10 at its worst on a Verbal Rating Scale where 0 is no pain and 10 is the worst pain he had ever experienced. Past medical history was unremarkable.

The examination revealed limitations in right knee flexion which was absent for the last ten degrees of flexion and found to be full in extension with pain reported at the end range of both motions. The neurological screening of the upper and lower extremities was found to be unremarkable bilaterally. A focused examination of the right knee revealed no edema or bruising when compared to the left knee. Varus stress testing at zero and thirty degrees of flexion was negative bilaterally. Valgus stress testing of the right knee at zero and thirty degrees was reportedly painful and revealed a slight laxity when compared to the left knee which was considered a weak positive test for a medial collateral ligament injury. Anterior and posterior drawer testing was found to be negative bilaterally. Apley's compression and distraction test of the right knee produced pain in both compression and distraction (compression portion of test: with the patient prone with knee flexed to 90 degrees clinician grasps calcaneus

and applies a downward force while rotating the tibia internally and externally to test for meniscal tear; distraction portion: with the patient prone with knee flexed to 90 degrees, clinician stabilizes upper leg above knee and distracts the lower leg grasping the ankle and rotates the tibia internally and externally to assess collateral ligaments and for meniscal tears).<sup>3</sup> McMurray's test (with the patient supine, the clinician places one hand at knee joint line and other hand grasping distal tibia. With the knee maximally flexed to begin, extend knee with external rotation of the tibia; pain or snapping indicates a possible medial meniscus tear)<sup>3</sup> was positive when performed on the right knee. Palpation of the medial coronary ligament of the right knee elicited pain. Based on the orthopaedic testing and history, the patient was diagnosed with a right knee medial collateral ligament sprain, likely a grade 1, and possible medial meniscus tear with medial coronary ligament involvement.

A course of therapy consisting of two visits per week for four weeks was initiated and consisted of Transcutaneous Electrical Nerve Stimulation (TENS) and laser therapy to the right medial knee to control inflammation with instructions to ice four times per day for ten minutes. An in clinic and home rehabilitation exercise program was also initiated. The rehabilitation exercises consisted of VMO exercises to strengthen the quadriceps femoris muscle, wobble board exercises including double and single leg balancing and double leg squats, squats, squats with adduction using a ball for resistance, resisted side stepping and the subsequent progression of these exercises. For the VMO exercises the patient was instructed to sit with his knee bent and approximately 4 inches from the floor and then to slowly straighten his lower leg without moving the thigh (Figure A i and ii). He was instructed to do ten to fifteen repetitions three times per day. During the first week, the rehabilitation focused on VMO exercises, wobble board exercises and simple squat exercises with the other exercises and progressions being added in the second week of treatment. VMO exercises were given with the intention of ensuring the maintenance of strength of the quadriceps muscle rather than specifically treating the injured tissue. After two weeks of therapy, the patient reported that he no longer had any pain unless he was running at full speed doing sprints in practice. By the middle of the third week of care, he no longer had any pain during practice and was cleared to return to play by the team doc-



Figure A i VMO style exercise start position.



Figure A ii VMO style finish position.

tor. He was at this time provided instruction for advanced wobble board training (one legged squats) at home. He was discharged after the fourth week of care and reported no return of pain and no difficulty playing football. On a three month and 4 month follow up of the patient, he did not report any return of pain or disability in his right knee.

# Case 2

A 16 year old female presented with right medial knee pain that began 1 week prior to presentation after a fall down the stairs. The patient reported that she "missed a stair" approximately 1 month prior and fell down the stairs which at the time caused a small amount of pain in the right knee, but reports that she ignored this pain assuming that it would disappear in time. She reported that approximately two weeks prior to her visit to the chiropractic office, she once again "missed a stair" and fell but did not have any increased pain immediately. She was unable to report specifically how she landed on her knee. She reported that the pain began in her right knee one week prior to her visit and could not identify a specific cause for the pain other than the two prior falls. She reported that she had attended the emergency room a few days prior and that x-rays were taken of her right knee and found to be unremarkable. She reported that she was referred to an orthopaedic surgeon but that the appointment was not for two weeks. She reported that she then went to see a naturopath one day prior who prescribed topical arnica to control the inflammation and performed acupuncture therapy which the patient reported did not change the pain. She reported that nothing seemed to ease the pain and that walking aggravated the pain to such a degree that she missed a few days of school. She rated the pain as a 10/10 on the Verbal Rating Scale where 0 is no pain and 10 is the worst pain she has ever experienced and reported that the pain was very sharp in nature. Her past medical history was unremarkable.

She presented for the examination being carried in to the clinic by her boyfriend and when asked to weight-bear during the examination, required support on both her right and left side. Inspection of the right knee did not reveal any edema or bruising. Range of motion of the right knee was found to be full in extension and limited to 90 degrees of flexion with pain reported at the end range of both motions. There was pain reported on light palpation of the medial joint line of the knee and the medial coronary ligament of the right knee. Neurological testing of the upper and lower extremities was found to be unremarkable bilaterally. The following orthopaedic tests were found to be positive for the right knee: Apley's compression/ distraction, and McMurray's test. The anterior and posterior drawer test, as well as valgus and varus stress testing at zero and thirty degrees were found to be negative. The patient was diagnosed with a right knee medial meniscus tear with medial coronary ligament involvement and started on a one month course of therapy consisting of edema control methods, rehabilitation in clinic twice per week as well as a home exercise program.

During the first visit, the patient was treated with instrument assisted fascial stripping using Gua Sha tools over the right medial knee and coronary ligament as well as laser therapy. She was instructed with VMO exercises as described above. After the pain and edema control methods were completed on the first visit, the patient was able to get off of the table on her own and ambulate unassisted, though with a slight limp favouring her right knee. She was given instructions to ice four times per day for 10 minutes each as well as do 10-15 repetitions of the VMO exercises three times daily to ensure the maintenance of quadriceps strength. During the first week of care she was also given simple squatting exercises as well as wobble board exercises to perform in the clinic as well as at home. After the first week of care, she presented to the clinic reporting that her pain levels had dropped to 0/10 and reported that she continued her exercises daily. She was given further advanced squatting exercises including squats with adduction and one legged squats during her second week of care. At the end of two weeks of her four week rehabilitation program, the patient and her mother elected to drop out of care, despite the advice of the doctor to the contrary, as she reported that her pain had not returned. On a three month and 6 month follow up with the patient's mother it was reported that the patient's pain had not returned.

#### Discussion

Knee problems and injuries are extremely common in sports and falls. Other disease processes regarding the knee joint such as osteoarthritis are also very common but usually not seen in the adolescent population.<sup>4</sup> One article reported that 30 million children in the US participate in sports and that the incidence of overuse and acute injuries of children has been increasing as the number of children participating in sports grows.<sup>5</sup> The ankle and knee joints were reported to be the most commonly injured joints of the body, with non-traumatic knee pain being one of the most common complaints of the young athlete.<sup>5</sup>

Meniscal injury rates have been reported to be 60 per 100,000 with the medial meniscus being injured more frequently than the lateral meniscus.<sup>6</sup> In fact, one study reported the annual incidence of medial meniscal injuries specifically as 60 to 70 per 100,000 people and the male to female ratio is reported to be 2.5–4:1.<sup>6</sup> Another study reported that "medial meniscus disorders made up 37% of overall cartilage lesions found after analyzing 25,124

knee arthroscopies."<sup>6</sup> The menisci are firmly attached to the tibial plateau by the strong meniscotibial or coronary ligaments.<sup>7</sup> Hammer reports that typically these ligaments are anatomically separate structures although they are seen to blend with the joint capsule, and medial collateral ligament.<sup>7</sup> It is likely that since the coronary ligaments are so closely married to both the collateral ligaments and the menisci, they suffer sprain injuries when damage to either structure occurs.<sup>7</sup> When treating medial knee injuries it should be recalled that the deep fibers of the medial collateral ligament attach to the medial meniscus which is why these two structures are often injured in conjunction.<sup>8</sup> In contrast, the lateral collateral ligament does not attach to the lateral meniscus.<sup>8</sup> It is suggested that a conservative approach for meniscal injuries be attempted prior to surgical intervention.<sup>9</sup> The natural history of a meniscal injury is dependant on the type and location of the tear.<sup>10</sup> It was reported by one source that vertical tears in the menisci that are located in the well vascularized periphery should not be surgically repaired as they have good healing potential if left alone.<sup>10</sup>

Knee pain of acute and chronic nature is very commonly seen in a chiropractic practice. Diagnosis of knee injuries can be challenging as the knee articulation is complex and contains several structures vulnerable to injury due to the nature of the joint as well as the fact that the large muscles surrounding the knee, specifically the quadriceps, are capable of splinting the knee and thus masking symptoms in some cases.<sup>11</sup> Ligamentous knee anatomy is illustrated in Figure B and C (reprinted with permission).<sup>12</sup> It should be remembered that as there are physical and physiological differences between adults and children, these factors may predispose the younger population to injury, or alter the types of injuries seen in the two populations following similar mechanisms of injury.<sup>5,13</sup> Patellofemoral pain syndrome, anterior cruciate ligament tear, collateral ligament tear, meniscus tear, iliotibial band syndrome, Osgood-Schlatter's disease, meniscotibial sprain, bursitis and muscle strains are all common problems that may affect the adolescent knee.<sup>5,7,14,15,16</sup> In addition, care should be taken to rule out more distant sources of knee pain including referred pain from other origins such as would be seen in a slipped capital femoral epiphysis and/ or other structures including trigger points or nerve root compression.<sup>5,14</sup>

Acute medial meniscus injuries often present with a



Figure B Articular surfaces of the knee joint. A. Extended. B. Flexed. C. Anterior view (flexed)

patient history of a twisting injury about the loaded knee joint while the knee was in flexion.<sup>5,14</sup> This may be combined with a trauma directed across the knee.<sup>1</sup> Symptoms may include joint line pain, swelling, antalgic gait, locking or a feeling of instability, buckling or "giving way" and a feeling of being unable to fully extend the knee.<sup>13,16</sup> The swelling or effusion noted is generally of delayed onset and may not be visible until one to three days post injury.<sup>16</sup> In contrast an anterior cruciate ligament injury generally has immediate swelling as it is vascularized to a much greater degree than the menisci.<sup>13,16</sup> It is interesting to note that the menisci of children under the age of 10 years are resistant to tears as the meniscus is composed of dense collagen bundles arranged in an interlacing pattern



Figure C Menisci of the knee joint. A. Superior view.

that are well vascularized, which promotes "moist and pliable tissue."  $^{12}$ 

The role of the menisci in the knee joint is to assist in load transmission as well as joint stability.<sup>4</sup> In fact, "the menisci bear between 40 and 70% of the load across the knee; the remainder of that load is transmitted by the direct contact of articular cartilage."<sup>18</sup> It has been shown that "complete meniscotomy leads to tibiofemoral joint space narrowing, condyle flattening, and osteophyte formation" and one study reports that removal of the medial meniscus decreases the tibiofemoral contact area by as much as 50 to 70%.<sup>4</sup> Contact stresses in the articular areas are thereby doubled as contact area is inversely proportional to contact stress.<sup>3</sup>

Commonly, medial meniscus damage does not occur in isolation as it is much more firmly attached to the tibial condyles than the lateral meniscus.<sup>7,18</sup> This is also the reason that the medial meniscus is more commonly injured that the lateral meniscus.<sup>17</sup> Approximately 33% of meniscal tears are associated with ACL injuries.<sup>17</sup> Some meniscal tears are asymptomatic and may remain that way or heal spontaneously.<sup>19</sup> Meniscal injuries are typically diagnosed by history and physical including joint line ten-

ducted on the patients outlined in this report. Thessaly's test is performed by the patient rotating his knee and body internally and externally three times each while weight bearing on the leg being tested at 5 degrees and then again at 20 degrees.<sup>3</sup> The following indicate positive test results: discomfort at the joint line, locking or catching.<sup>3</sup> These tests may also be present in a knee with injured coronary ligaments.<sup>7</sup> In contrast, coronary ligament injury may be present, and the primary injury, if the meniscal and collateral ligament tests are negative and rotational stresses of the tibia are positive.<sup>7</sup> Pain with lateral rotation of the tibia incriminates the medial coronary ligament whereas pain with medial rotation of the tibia incriminates the lateral coronary ligament.<sup>7</sup> The gold standard in diagnosing a meniscal tear is arthroscopy, however, this procedure is invasive and MRI is becoming "the imaging modality of choice to evaluate intra-articular tissues of the knee, including the menisci."11 Meniscal injuries usually have limited findings on plain film radiography.<sup>13</sup> An MRI of the knee in most cases will reveal an area of increased signal intensity extending to one or more articular surfaces.<sup>13,15</sup> Accuracy rates for diagnosing meniscal tears with MRI have been reported as 90%.<sup>11</sup> As waiting times for MRI can be lengthy, not every case of suspected meniscal tear necessitate referral for MRI and treatment should be initiated prior to obtaining MRI results. Cases where locking of the joint occurs should be im-

derness, Apley's test and McMurray's test.<sup>14,19</sup> However, one study reported that the aforementioned orthopaedic

tests are insensitive and non specific for detecting menis-

cal tears in ACL-intact knees.<sup>19</sup> In a recent review, Mc-Murray's test is described as being the "primary test for the examination of knee menisci" and reports a sensitivity range between 16–70% and a specificity range of 59-98% based on all of the historical research data.<sup>3</sup> This review reported the sensitivity range for Apley's test at 13–41% and a specificity range of 80–93%.<sup>3</sup> The review also presented information on Thessaly's test which had a sensitivity range of 65–95% and specificity range of 80–97%.<sup>3</sup> Thessaly's test "performed better than all other tests evaluated" in the review.<sup>3</sup> As this information was found during the research stages of this case study, this test was not con-

Cases where locking of the joint occurs should be immediately referred for an orthopaedic consultation if the locking cannot be resolved quickly or if locking recurs. Symptoms of medial meniscus tears not complicated by locking can be managed conservatively. Treatment may include: reassurance, custom orthotics, taping, rehabilitative exercises, icing, soft tissue manipulation, chiropractic adjustments, massage, fascial stripping, non steroidal anti-inflammatory medication, corticosteroid injection, and analgesic medication.<sup>6,7,9,14,20,21,22,23</sup> If conservative intervention fails to relieve symptoms, surgical approaches may be explored, such as a partial or full meniscotomy or meniscus repair.<sup>4,9</sup>

As with other acute inflammatory conditions, beneficial effects of icing, NSAIDs, manipulation, and soft tissue treatment including massage and myofascial stripping with the intent to restore normal movement have been noted for both meniscal and coronary ligament injuries.<sup>6,7,14,20,21,24</sup> One study outlined the efficiency of both instrument assisted techniques as well as soft tissue mobilization done with the clinician's hands noting that while the clinical improvements were not different between the therapy groups, improvement in both groups was maintained on a 3 month follow up.<sup>24</sup>

While the symptom presentation and history in these cases ruled out patellofemoral pain syndrome, Osgood Schlatters disease, slipped capital femoral epiphysis and delayed onset effusion, and the negative anterior drawer tests ruled out anterior cruciate ligament tear, the remaining six conditions stayed on the differential list. No evidence of remote trigger points, nerve compression or involvement of the iliotibial band were noted in either case. Instability was not noted in either case on valgus or varus testing of the knee, although these tests were painful. On initial examination in both cases immediate ruling out of bursitis and muscle strain were not possible due to the exquisite nature of the pain. In addition, it was thought likely that some muscle strain about the knee was to be present as it is uncommon for only one structure to be damaged during an acute knee injury. With the symptom presentation in both cases of either antalgic gait or inability to weight bear, delayed onset effusion, inability to fully extend the knee, and in case 1 the typical history of a twisting injury about the loaded knee joint while the knee was in flexion accompanied by direct trauma across the knee, it was suspected that the menisci and coronary ligaments were involved. Positive orthopaedic tests including Apley's test, McMurray's test, and medial joint line tenderness were conducted to confirm this diagnosis as advanced imaging was not immediately available.

Previous studies have recommended a course of con-

servative treatment prior to surgical referral including icing, manipulation, and soft tissue treatment including massage and myofascial stripping.<sup>6,7,14,20,21,22,23</sup> The patients in these cases were initially treated with either instrument assisted or non instrument assisted friction massage at the medial joint line and over the coronary ligaments as well as icing and rehabilitation exercises over the course of four weeks. Rehabilitation exercises included exercises to target the VMO and thereby strengthen the quadriceps muscle, squatting exercises, stability exercises on the wobble board and exercise ball which were progressed to more advanced versions of these exercises to meet the individual patient's needs. Improvement was noted by both patients within the first week of care and return to play was initiated after week 3 for patient 1. No pain remained for either patient after week 4 of care and active therapy was halted for both patients at this time.

There are several factors that may have influenced the favourable outcome of these cases. The rehabilitation exercises were attempted due to the success of such programs seen for meniscal injuries in the literature. Soft tissue techniques including fascial stripping were used to attempt to break down scar tissue that may have accumulated in the area, promote the laying down of more organized scar tissue and decrease edema.<sup>25</sup> With the onset of manual therapy, the patients seemed to have a rapid reduction of subjective symptoms, but it is important to note other factors that may have produced a favourable outcome in this case such as the cessation of playing football in patient 1 and therefore rest to the affected knee.

Further study is needed to identify other possible treatment avenues such as specific rehabilitative exercises for injured menisci and coronary ligaments. This research might take the form of other case reports or a small scale clinical trial (RCT)<sup>4</sup> to compare the effectiveness of treatment with and without specific exercise prescription or treatment with rehabilitation with and without soft tissue treatment. Additionally, the use of other outcome measures for knee injuries such as the Knee injury and Osteoarthritis Outcome Score (KOOS) would be a simple addition that could better quantify the measurement of improvement for future cases or research.

## Summary

Although favourable results were obtained, it is important to remember that the nature of this investigation was that of a case study, and therefore no inferences can be made with respect to effectiveness of the care administered in general. The patients in this manuscript may have improved by virtue of the natural healing of their injuries, the rest, ice or perhaps the arnica helped as well. Case studies, while a starting point in the research, are by their nature limited as the protocols were carried out on one, or in this case two, patients. Limited as it may be, this case does suggests that conservative management using rehabilitative exercise, icing, and fascial stripping of two cases of medial meniscus injury with associated coronary ligament injury may be helpful. Conservative management of meniscal injuries should be explored prior to more invasive procedures such as injection of corticosteroids or surgery.

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## References

- 1 NBCE 2005 Job Analysis of Chiropractic (homepage on the internet).Greeley, CO: National Board of Chiropractic Examiners. Available from: http://ibce.org/publication/ job-analysis.html
- 2 Odgers C, Galinat B. Meniscal Injuries in Children and Adolescents. Clinical Case presentation, Orthopaedic Department The Alfred I. Dupont Institute, May 8, 1996. Available at http://gait.adi.udel.edu/educate/menisc.htm.
- 3 Chivers M, Howitt S. Anatomy and physical examination of the knee menisci: a narrative review of the orthopedic literature. JCCA. 2009; 53(4):319–333.
- 4 Fazalare J, McCormick K, Babins D. Meniscal repair of the knee. Orthopaedics. March 2009; 32(3):199–206.
- 5 Adirim J, Cheng T. Overview of injuries in the young athlete. Sports Med. 2003; 33(1):75–81.
- 6 Brantingham H, Globe G, Tong V, Bates C, Jukes G, Van-Houten C, Doorly K. Diversified chiropractic adjusting and management of five clinically diagnosed meniscus injury patients with MRI imaging in four cases. J Am Chiropr Assoc. July 2008; 11–24.
- 7 Hammer W. Meniscotibial (coronary) ligament sprain: diagnosis and treatment. Chiropractic Sports Medicine. 1988; 2(2):48–50.
- 8 Standring S. Gray's Anatomy; The Antatomical Basis of Clinical Pratice. Fortieth Edition. Elsevier Limited 2008.
- 9 Rimington T, Mallik K, Evans D, Mriczek K, Reider B.

A prospective study of the nonoperative treatment of degenerative meniscus tears. Orthopaedics. August 2009; 32(8):558.

- McCarty E, Marx R, Wickiewicz T. Meniscal tears in the athelete: operative and non operative management. Phys Med Rehabil Clinics of North America. Nov. 2000; 11(4):867–879.
- 11 Pollard H, McHardy A, Hoskins W, Windsham R, Onley R. Chiropractic treatment of lower extremity conditions: a literature review. JMPT. 2006 Oct; 29(8):658–671.
- 12 Drake R, Vogl W, Mitchell A, editors. Gray's Anatomy for Students Second Edition. Churchill Livingstone 2010/2005. figures 6.69 and 6.70 Copyright Elsevier. (Reprinted with permission).
- 13 Yomtob C. Meniscal injury in the juvenile knee: an MRI case study. Topics in Diagnostic Radiology and Advanced Imaging. Fall 1995; 12–15.
- 14 Souza T. Treatment of common knee disorders: Part II specific conditions. Chiropractic Sports Medicine. 1990; 4(2):119–127.
- 15 Grenier J, Wessely M. Knee MRI Part II: MR imaging of common internal derangements affecting the knee. Clinical Chiropractic. 2004; 7:131–140.
- 16 Hunter R, Hunter J. The Young Athelete: Special Consderations. In: Hyde T et al. Conservative Management of Sports Injuries. Second Edition. Lippincott 2007.
- 17 Goldblatt J, Smith JS. Managing meniscal injuries: the diagnosis. J Musculoskeletal Med. March 2005; 146–142.
- 18 Ozkc G, Circi E, Gonc U, Irgit K, Pourbagher A, Tandogan R. Radial tears in the root of the posterior horn of the medial meniscus. Knee Surgery Sports Traumatology Arthrosc. 2008; 16:849–854.
- 19 Shelbourne KD, Benner R. Correlation of joint line tenderness and meniscus pathology in patients with subacute and chronic anterior cruciate ligament injuries. J Knee Surg. 2009; 22:187–190.
- 20 Seplow W. Management of lateral meniscus injury. Sports Chiropractic & Rehabilitation. 1996; 10(2):86–88.
- 21 Polkinghorn B. Conservative treatment of torn medial meniscus via mechanical force, manually assisted short lever chiropractic adjusting procedures. J Manip Physiol Thera. September 1994; 17(7):474–484.
- 22 Souza T, Hyde T. The Knee. In: Hyde T et al. Conservative Management of Sports Injuries. Second Edition. Lippincott 2007.
- 23 Palo J. "Knee Needs" the problems that plague our largest joint. J Am Chiropr Assoc. September 1998; 42–44.
- 24 Burke J, Buchberger D, Carey-Loghmani T, Dougherty P, Greco D, Dishman J. A pilot study comparing two manual therapy interventions for carpal tunnel syndrome. J Manip Physiol Thera. 2007; 30(1):50–61.
- 25 Pajaczkowski J. Mimicking turf-toe: myofasopathy of the first dorsal interosseous muscle treated with ART. J Can Chiropr Assoc. 2003; 47(1):28–32.