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Canadian Chiropractic Association

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Editor, Journal of the Canadian Chiropractic Association
184 Front Street East, Suite 200, Toronto, ON M5A 4N3
Tel: 416-585-7902 877-222-9303 Fax: 416-585-2970

Email: Dr. Kent Stuber<kstuber@jcca.ca>
Website: www.jcca-online.org

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Contents

JCCA Vol 69 No 4 ISSN 00083194 (Print) and ISSN 1715-6181 (Online)

Original Articles

348 Routine medical care for adults with musculoskeletal disorders in the Indigenous community of Pimicikamak, northern Manitoba before and after implementing the Global Spine Care Initiative model: a retrospective chart review with a 10-month post-implementation window. *A collaborative research project between World Spine Care Canada (WSCC), Pimicikamack Okimawin, and Cross Lake Nursing Station*
Patricia Tavares, DC, FCCOS(C)
Jennifer Ward, DC, PhD (cand)
Steven Passmore, DC, Ph
Melissa Atkinson-Graham, PhD, DC
Randall Smolinski, RN, BN
Muriel Scott, BA
Jean Moss, DC, MBA
Deborah Kopansky-Giles, DC, MSc
Jacqueline C. Ladwig, MSc, PhD
Jordan Myers, DC
Cheryl M. Glazebrook, MSc (PT), PhD
David A. Monias, M.Ed
Helga Hamilton
Donald Z. Mckay, BBA
Scott Haldeman, DC, MD, PhD, FRCP(C)
Sheilah Hogg-Johnson, PhD
André Bussières, DC, PhD

365 Well-being in Australian chiropractors and chiropractic students: factors influencing burnout and job satisfaction
Zoe Ryan, BPsychSc(Hons)
Matt Fernandez, BSpSc, MChiro. PhD
Katie de Luca, BAppSci(Ex&SpSci), MChiro, PhD
Aron Downie, BSc, MChiro, MPhil, PhD
David T McNaughton, MChiro, MRes, PhD

Editorial

379 JCCA December 2025 Sports Chiropractic Special Issue: 17th Edition
Mohsen Kazemi, RN, DC, FRCCSS(C), FCCPOR(C), MSc, PhD

Original Articles

381 Return to cycling protocol after chronic coccydynia: a case report
Melissa Hamilton, MSc, DC, CSCS, FRCCSS(C)
Kristen Mangos, BSc (Hons), DC, RCCSS(C) Resident

396 Multiligament knee injury and dislocation in a 17-year old football player: clinical focus on rehabilitation exercise and return to sport
Noah Lane, BSc (Hons.), DC, RCCSS(C) Resident
George Austin Rees, BSc, DC, RCCSS(C) Resident
Kevin D'Angelo, BSc (Hons.), DC, FRCCSS(C)

Contents

JCCA Vol 69 No 4 ISSN 00083194 (Print) and ISSN 1715-6181 (Online)

414 Platelet-Rich Plasma (PRP)/stem-cell therapy for a partial torn ulnar collateral ligament in a professional football player: case report
Noah Lane, BSc (Hons.), DC, RCCSS(C) Resident
George Austin, Rees, BSc, DC, RCCSS(C) Resident
Kevin D'Angelo, BSc (Hons.), DC, FRCCSS(C)

425 Chiropractic management of L5-S1 disc protrusion in an elite speed skater: a case report
Yeewon Chong, MChiro, BChiroSc, MChiro, ICSC
Henry Pollard, BSc, DC, Grad Dip AppSc, MSportSc, PhD, ICSSD

434 Schwannoma causing chronic medial calf pain in a recreational skiing and running athlete: a case report
Madlaina Gruber, DC
Christopher White, DC, MSc
Glenn Cashman, DC, MSc, FRCCSSC

Narrative Reflections in Chiropractic

441 The bi-directional adjustment?
Jordan A. Gliedt, DC

Conference Proceedings

444 Abstracts of the Scientific Poster Award Competition of the 2025 Royal College of Chiropractic Sports Sciences (Canada) Conference (RCCSS(C))
Alexander Dennis Lee, BSc(Hons)Kin, DC, FRCCSS(C)

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James J. Young, DC MSc FCCS(C)
Center for Muscle and Joint Health, University of Southern Denmark, Odense, Denmark
Department of Research, CMCC

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Routine medical care for adults with musculoskeletal disorders in the Indigenous community of Pimicikamak, northern Manitoba before and after implementing the Global Spine Care Initiative model: a retrospective chart review with a 10-month post-implementation window.

A collaborative research project between World Spine Care Canada (WSCC), Pimicikamack Okimawin, and Cross Lake Nursing Station

Patricia Tavares, DC, FCCOS(C) [1]
Jennifer Ward, DC, PhD (cand) [2]
Steven Passmore, DC, PhD [3]
Melissa Atkinson-Graham, PhD, DC [4]
Randall Smolinski, RN, BN [5]
Muriel Scott [6]
Jean Moss, DC, MBA [7]
Deborah Kopansky-Giles, DC, MSc [1,8]
Jacqueline C. Ladwig, MSc, PhD [3,9]
Jordan Myers, DC [10]
Cheryl M. Glazebrook, MSc (PT), PhD [3]
David A. Monias, M.Ed. [11]
Helga Hamilton [6]
Donald Z. Mckay, BBA [11]
Scott Haldeman, DC, MD, PhD, FRCP(C) [12,13]
Sheilah Hogg-Johnson, PhD [1]
André Bussières, DC, PhD [14,15]

[1] Canadian Memorial Chiropractic College, Toronto, Ontario
[2] Department of Graduate Studies, Applied Health Sciences, University of Manitoba, Winnipeg, Manitoba
[3] Faculty of Kinesiology and Recreation Management, University of Manitoba, Winnipeg, Manitoba
[4] Faculty of Health Sciences, Ontario Tech University, Oshawa, Ontario,
[5] Cross Lake Nursing Station, Cross Lake, Manitoba
[6] Cross Lake Health Services, Cross Lake, Manitoba
[7] World Spine Care Canada, Concord, Ontario
[8] Department of Family and Community Medicine, University of Toronto, Ontario, Canada
[9] Department of Community Health Sciences, Max Rady College of Medicine, Rady Faculty of Health Sciences, University of Manitoba, Winnipeg, Manitoba
[10] Private Practice, Winnipeg, Manitoba
[11] Pimicikamak Okimawin, Cross Lake Band of Indians, Cross Lake, Manitoba
[12] University of California, Irvine, California, USA
[13] World Spine Care, Tustin, California, USA
[14] Université du Québec à Trois-Rivières, Trois-Rivières, Québec
[15] School of Physical and Occupational Therapy, Faculty of Medicine and Health Sciences, McGill University, Québec

Corresponding author:
André Bussières, Professor, Université du Québec à Trois-Rivières, 3351, boulevard des Forges, Trois-Rivières, Quebec G9A 5H7
Email: andre.bussieres@uqtr.ca
Tel: (819) 699-9404

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Background: *Indigenous communities in northern Manitoba face a high burden of musculoskeletal (MSK) conditions and limited access to care. In October 2023, a new chiropractic service was launched in Cross Lake, Manitoba, aiming to improve MSK care access. This study explored: (1) the nature of MSK-related care provided at the Cross Lake Nursing Station, and (2) changes in clinical management during the first 10 months post-implementation.*

Methods: *We conducted a retrospective chart review (standardized 14-item form) for two periods: December 2021–2022 (pre-implementation) and October 2023–August 2024 (post-implementation). Data on presentations, imaging, treatments, and referrals were analyzed descriptively.*

Results: *Post-implementation, imaging use declined (63.4% to 44.9%), as did prescription of NSAIDs (80.5% to 53.1%), acetaminophen (63.4% to 32.7%), and opioids (21.9% to 8.2%). Muscle relaxant prescriptions increased, while pregabalin/gabapentin remained stable.*

Conclusion: *The new chiropractic service may be associated with reduced use of imaging and common medications for MSK conditions.*

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KEY WORDS: musculoskeletal; spine care; retrospective chart review; medically underserved area; chiropractic; non-pharmacological; Indigenous; opioid

Les soins médicaux de routine pour les adultes atteints de troubles musculo-squelettiques dans la communauté autochtone de Pimicikamak, dans le nord du Manitoba, avant et après la mise en œuvre du modèle du Global Spine Care Initiative model: un examen rétrospectif des dossiers avec une période d'observation de 10 mois après la mise en œuvre. Un projet de recherche collaboratif entre World Spine Care Canada (WSCC), Pimicikamack Okimawin et la Station de soins infirmiers de Cross Lake

Contexte: *Les communautés autochtones du nord du Manitoba font face à un fardeau élevé de conditions musculo-squelettiques (MSK) et à un accès limité aux soins. En octobre 2023, un nouveau service de chiropratique a été lancé à Cross Lake, au Manitoba, visant à améliorer l'accès aux soins musculo-squelettiques. Cette étude a exploré : (1) la nature des soins liés aux conditions MSK fournis à la station de soins infirmiers de Cross Lake, et (2) les changements dans la gestion clinique au cours des 10 premiers mois suivant la mise en œuvre.*

Méthodes: *Nous avons réalisé un examen rétrospectif des dossiers (formulaire standardisé de 14 éléments) pour deux périodes : Décembre 2021–2022 (avant la mise en oeuvre) et octobre 2023–août 2024 (après la mise en oeuvre). Les données sur les présentations, l'imagerie, les traitements et les références ont été analysées de manière descriptive.*

Résultats: *Après la mise en œuvre, l'utilisation d'imageries a diminué (de 63,4 % à 44,9 %), tout comme la prescription d'anti-inflammatoires non stéroïdiens (de 80,5 % à 53,1 %), d'acétaminophène (de 63,4 % à 32,7 %) et d'opioïdes (de 21,9 % à 8,2 %). Les prescriptions de relaxants musculaires ont augmenté, tandis que celles du pregabalin/gabapentin sont restées stables.*

Conclusion: *Le nouveau service de chiropratique pourrait être associé à une réduction de l'utilisation d'imageries et de médicaments courants pour les conditions musculo-squelettiques.*

(JACC. 2025;69(4):348-364)

MOTS CLÉS : musculosquelettique; soins de la colonne vertébrale; examen rétrospectif des dossiers; zone médicalement mal desservie; chiropratique; non pharmacologique; autochtone; opioïde

Introduction

Musculoskeletal (MSK) disorders, including back and neck pain, affect over 1.7 billion people globally and have been the leading cause of disability since 1990.[1] Spine-related disorders disproportionately impact disadvantaged populations, including individuals living in poverty, rural communities, women, and older adults.[2] Without access to appropriate care, these conditions can lead to reduced mobility and poor overall health, with cascading effects including social isolation, diminished work capacity, and poverty.

Spine complaints are among the most common reasons for people to seek care from their primary care clinicians and account for nearly half of all opioid prescriptions.[1-5] Central to the problem is the prevalent use of low-value care-interventions with minimal or no evidence for benefits relative to their potential harm, costs, or healthcare burden.[6] For example, patients with acute low back pain (LBP) who receive diagnostic imaging, opioid prescriptions, and specialist referrals within 6 weeks of the initial visit are more than twice as likely to develop chronic pain than those receiving no such care.[7,8] Similarly, prescribing opioids for non-specific LBP is linked to prolonged work disability, increased medical costs, and higher surgical rate.[7,8]

Systemic and contextual factors contribute to the overuse of low-value spine care, including limited access to non-pharmacologic alternatives, financial barriers, patient expectations, practitioner beliefs, and healthcare systems oriented toward a biomedical care approach.[9-11] In contrast, international clinical guidelines for non-specific LBP recommend emphasizing patient education, staying active, advice on self-care, and home and/or group exercise as first-line treatment.[12] While discouraging passive modalities, the guidelines do recommend therapies like massage, acupuncture, and manual therapy, with a short course of non-steroidal anti-inflammatory drugs (NSAIDs) as secondary care options. Routine use of acetaminophen (paracetamol), skeletal muscle relaxants, antidepressants, anticonvulsants/antiepileptics, opioids and spinal injections for non-specific spine pain are discouraged. Multidisciplinary treatment and psychological therapy may be considered for specific subgroups at risk of delayed recovery.[12-21] Despite the evidence, the uptake of these guidelines in primary care remains suboptimal.[22,23]

World Spine Care (WSC) is a group of four organizations incorporated as not-for-profit charities in their relevant jurisdictions dedicated to bridging the gap in evidence-based treatment for spinal conditions in underserved regions (https://www.worldspinecare.org/). Their mission is to improve the lives, functionality, and participation of individuals living in these communities.[24] To advance this mission, WSC established the Global Spine Care Initiative (GSCI), a multiphase project to develop and implement an evidence-based, culturally adapted, and sustainable model of care (MoC) for spine-related conditions.[25,26] The GSCI MoC incorporates triage tools and care pathways tailored to low-resource settings with limited or no access to spine care.[27,28]

While the GSCI MoC has been applied in WSC clinics in various international settings, the current study marks the first implementation study in a remote Canadian Indigenous community.[29] In partnership with Pimicikamak Okimawin leadership, WSC Canada introduced a chiropractic service in Cross Lake, Manitoba in 2023. Cross Lake is located approximately 800 km north of Winnipeg (https://crosslakeband.ca/), with a population of 6,734 on the treaty and 2,715 on the non-treaty land and includes First Nations, Métis and non-Indigenous people.[30] Cree and English are spoken in this community.[31] Prior to this initiative, limited evidence-based, primary-level spine care was available locally.

Context

Indigenous communities in northern Manitoba experience a disproportionately high burden of injuries, acute illness, and chronic disease, in addition to the legacy of colonization and systemic inequities.[32-34] Communities like Cross Lake First Nation face unique barriers to care, including geographic isolation, limited local health infrastructure, and dependence on fly-in nurses, nurse practitioners and medical doctors (MDs) to deliver care at the Cross Lake Nursing Station, some of whom may be unfamiliar with the cultural context and long-term patient needs.[35,36] Specialized spine care is only available in distant urban centres such as The Pas (401 km away), Thompson (255 km away), or Winnipeg (770 km away). Travel to these distant centres is not patient-centric, logistically difficult, financially burdensome, and often not fully covered by the provincial health system.

To address this critical gap and remove geographic

and financial barriers to evidence-based spine care, WSC Canada introduced a community-based spine care service, co-designed with Pimicikamak leadership to ensure the delivery of culturally relevant care within the existing healthcare system.[29] The service, launched on October 5, 2023, is delivered at the Cross Lake Nursing Station by licensed chiropractors up to three days per week. The proximity to other medical services allows for close interaction with other health care providers. The service is free of charge and can be accessed directly, or through referral from various professionals, namely MDs (northern family medicine physicians and emergency physicians), nurses, and mental health counsellors at the Cross Lake Nursing Station. In July 2023, the WSC clinicians provided formal education to MDs and nursing staff on the application of the GSCI triage and care pathways.[27,28] They also engaged in informal discussions regarding current recommendations from up to date international evidence-based guidelines on the management of spinal pain as outlined by the GSCI[21,37,38] and the World Health Organization[12].

The overarching goal of this study was to evaluate the potential clinical impact of integrating the GSCI MoC in the community in collaboration with local guidance and feedback.[29,39,40] The current study aimed: 1) to describe the nature of routine MSK care delivered to adults by northern family medicine physicians, nurses and nurse practitioners at the Cross Lake Nursing Station over the previous year, and 2) to compare diagnostic imaging use and patient management – including pharmaceutical, non-pharmaceutical treatments, and referrals—before and after the implementation of the new chiropractic service.

Methods

Ethics and Agreements

A research agreement (Pimicikamak Okimawin leadership, World Spine Care, University of Manitoba and Université du Québec à Trois-Rivières) was signed on July 7, 2022, and a data transfer agreement (The Global Spine Care Initiative, Health and Welfare Canada Cross Lake Nursing Station) was signed on August 22, 2022. Ethical approval was obtained from the University of Manitoba's Research Ethics Board (#HE2022-0249).

Design and population

We conducted a retrospective pilot medical chart review of a sample of adults (≥18 years) who presented to the Cross Lake Nursing Station with a primary complaint of musculoskeletal (MSK) pain. A sample size calculation determined that 68 participants were needed for a population of 9,400, with a 90% confidence interval and a 10% margin of error for this exploratory study; given operational constraints, we proceeded with a convenience sample appropriate to this exploratory study.

Data collection procedures

A standardized 14-item data extraction form was developed (Appendix 1), adapted from the GSCI's spine care pathway and clinical flashcards[27,28] used in previous WSC-affiliated clinic. The form was used to collect information on patients' demographics (age, gender), clinical presentation (pain location: lumbar, thoracic, cervical, extremity; duration: acute, chronic; intensity: 0-10 scale; onset: traumatic, gradual), history (first and second episodes of MSK pain; visits related to back and neck pain; function limitations: work, activities of daily living), and care provided (use of diagnostic imaging: radiographs, advanced imaging; prescribed and non-prescribed medication: NSAIDs, non-opioid, other, and opioid medication; non-pharmacological care: physiotherapy, massage, other; patient referrals). The items were reviewed and refined based on team feedback and piloted on the first 10 charts before full implementation, and data incorporated after these were re-reviewed.

Participants were identified through two recruitment methods: 1) Adults with complaints of spinal symptoms or extremity pain who called the Cross Lake Nursing Station for an appointment or were seen by MDs and/or nurses either in the Nursing Station medical clinic or emergency department, were informed of the study and asked for permission to be contacted; and 2) a community Facebook notice inviting eligible individuals to contact the research team. The service was co-designed with Pimicikamak leadership to enhance cultural relevance.

All participants voluntarily provided informed consent, allowing access to their medical records. Two local research assistants retrieved paper-based records for both emergency and scheduled visits. Data extraction was completed by two licensed chiropractors in December 2022 (pre-implementation: December 2021–December 2022) and in August 2024 (post-implementation: October 2023–August 2024). All data were de-identified by the data extractors and entered into a secure digital platform

designed for the study (using JavaScript Object Notation (JSON)) or into an Excel file, with automatic backup to the University of Manitoba's secure server.

Analysis

Descriptive analyses were conducted using SAS v9.4 *(Copyright © 2012-2018, SAS Institute Inc., Cary, NC, USA. SAS and all other SAS Institute Inc. product or service names are registered trademarks or trademarks of SAS Institute Inc., Cary, NC, USA*). Numerical variables were summarized using means and standard deviations, while categorical variables were reported as percentages of the sample endorsing each category. Paired comparison of patients with charts included at both time points was also conducted. Given the exploratory design, convenience sampling, and documentation variability, statistical analysis was limited to descriptive statistics (means, standard deviations, frequencies and percentages) and no inferential hypothesis testing was performed.

Results

Patient Characteristics

Of the 107 patient charts reviewed, 41 were included in the pre-implementation period (mean age=50.9 years, 60.9% self-identified as female), and 49 charts in the post-implementation periods (49.5 years, 67.4% female) (Table 1). The 17 remaining charts were excluded as they did not meet the eligibility criteria (i.e., adults with a primary MSK complaint).

Table 1.
Patient characteristics, presenting complaints, diagnostic imaging, and management.

	Pre-Implementation (n=41) n (%) unless otherwise indicated	Post-implementation (n=49) n (%) unless otherwise indicated	Included in both pre- and post-implementation periods (n=21)	
			Pre-implementation n (%) unless otherwise indicated	Post-implementation n (%) unless otherwise indicated
Gender				
Female	25 (60.9%)	33 (67.4%)	16 (76.2%)	
Male	16 (39.1%)	16 (32.6%)	5 (23.8%)	
Age (years)	50.9 (SD=11.2)	49.5 (SD=12.1)	50.7 (SD=12.0)	
Range	18-70	19-71	18-70	
Onset				
Non-traumatic	36 (87.8%)	38 (77.6%)	19 (90.5%)	18 (85.7%)
Traumatic	5 (12.2%)	11 (22.5%)	2 (9.5%)	3 (14.3%)
Pain location				
• Lumbar	26 (63.4%)	27 (59.2%)	13 (61.9%)	11 (52.4%)
• Thoracic	4 (9.8%)	2 (4.1%)	2 (9.5%)	1 (4.8%)
• Cervical	3 (7.3%)	5 (10.2%)	2 (9.5%)	2 (9.5%)
• Extremities	8 (19.5%)	11 (22.5%)	4 (19.1%)	6 (28.6%)
• Other	0 (0.0%)	2 (4.1%)	-	1 (4.8%)
Pain intensity				
Not reported	32 (78.1%)	41 (83.7%)	16 (76.2%)	16 (76.2%)

	Pre-Implementation (n=41) n (%) unless otherwise indicated	Post-implementation (n=49) n (%) unless otherwise indicated	Included in both pre- and post-implementation periods (n=21)	
			Pre-implementation n (%) unless otherwise indicated	Post-implementation n (%) unless otherwise indicated
Pain duration				
• Acute (< 3 months)	26 (63.4%)	24 (49.0%)	13 (61.9%)	8 (38.1%)
• Chronic (> 3 months)	15 (19.5%)	20 (40.8%)	8 (38.1%)	11 (52.4%)
• Not reported	0 (0.0%)	5 (10.2%)	-	2 (9.5%)
Able to work/ Perform ADLs				
• Yes	24(58.5%)	42 (85.7)	11 (52.3%)	18 (85.7%)
• No	17 (41.5%)	7 (14.3%)	10 (47.6%)	3 (14.3%)
Number of episodes of care for an MSK complaint				
1	32 (78.1%)	40 (81.6%)	15 (71.4%)	15 (71.4%)
2	9 (21.9%)	6 (12.2%)	6 (28.6%)	4 (19.1%)
3	-	3 (6.1%)	-	2 (9.5%)
Number of Visits across episodes				
Range (n)	1 to 24	1 to 24	1 to 24	1 to 5
1	17 (41.5%)	28 (57.1%)	8 (38.1%)	8 (38.1%)
2	7 (17.1%)	11 (22.5%)	3 (14.2%)	7 (33.3%)
3	8 (19.5%)	5 (10.2%)	2 (9.5%)	2 (9.5%)
4	3 (7.3%)	3 (6.1%)	3 (14.3%)	3 (14.3%)
5	1 (2.4%)	1 (2.0%)	-	1 (4.8%)
>5	5 (12.2%)	1 (2.0%)	5 (23.8%)	-
Any Imaging				
• Number of patients	26 (63.4%)	22 (44.9%)	13 (61.9%)	10 (47.6%)
• Number of imaging referrals	33	23	17	13
• Plain film x-rays	20 (48.8%)	12 (14.3%)	9 (42.9%)	6 (28.6%)
• CT scan	5 (12.2%)	4 (8.2%)	3 (14.3%)	1 (4.8%)
• MRI	8 (19.5%)	7 (14.3%)	5 (23.8%)	3 (14.3%)
OTHER				3 (14.3%)
Imaging location	33 imaging referrals	23 imaging referrals	17 imaging referrals	13 imaging referrals
• Local (Cross Lake)	16 (48.5%)	7 (30.4%)	6 (35.3%)	4 (30.8%)
• Remote (Winnipeg, Thomson, Norway House, Winkler)	16 (48.5%)	11 (47.8%)	10 (58.8%)	8 (61.5%)
• Not reported	1 (3.0%)	5 (21.7%)	1 (5.9%)	1 (7.8%)

	Pre-Implementation (n=41) n (%) unless otherwise indicated	Post-implementation (n=49) n (%) unless otherwise indicated	Included in both pre- and post-implementation periods (n=21)	
			Pre-implementation n (%) unless otherwise indicated	Post-implementation n (%) unless otherwise indicated
Non-pharmacological Care	25 (61.0%)	10 (20.4%)	10 (58.8%)	9 (42.9%)
• Patient education, Advice on self-care, applying heat or ice	19 (46.3%)	5 (10.2%)	8 (38.1%)	1 (4.8%)
• Exercise	6 (14.6%)	2 (4.1%)	4 (19.0%)	1 (4.8%)
• Massage therapy	1 (2.4%)	3 (6.1%)	1 (4.8%)	1 (4.8%)
• Assisted device	6 (14.6%)	2 (4.1%)	3 (14.3%)	1 (4.8%)
• Chiropractic Care	----------	6 (12.2%)	----------	5 (23.8%)
Pharmacological care	31 (75.6%)	30 (61.2%)	17 (81.0%)	14 (66.7%)
• Prescription NSAIDs	28 (68.3%)	15 (30.6%)	16 (76.2%)	6 (28.6%)
• Non-Prescription (recommended) NSAIDS	5 (12.2%)	11 (22.5%)	1 (4.8%)	3 (14.3%)
NSAIDS (combined prescribed and non-prescribed)	33 (80.5%)	26 (53.1%)	16 (76.2%)	8 (38.1%)
• Acetaminophen	26 (63.4%)	16 (32.7%)	12 (57.1%)	6 (28.6%)
• Muscle relaxants	3 (7.3%)	7 (14.3%)	2 (9.5%)	3 (14.3%)
• Opioids / Narcotics	9 (21.9%)	4 (8.2%)	6 (28.6%)	2 (9.5%)
• Pregabalin or Gabapentin	5 (12.2%)	6 (12.2%)	3 (14.3%)	4 (19.1%)
• Other (includes sedatives, antidepressants, anti-anxiety, Voltaren gel, capsaicin cream, antibiotics, anti-rheumatics etc.)	13 (31.7%)	11 (22.5%)	5 (23.8%)	6 (28.6%)
Referrals to an outside distant facility	11 (26.8%)	11 (22.4%)	8 (38.1%)	6 (28.6%)
• Physiotherapy	7 (12.5%)	2 (4.1%)	4 (19.1%)	0 (0.0%)
• Medical specialists (orthopedic, rheumatology, neurosurgery)	9 (21.9%)	9 (18.4%)	7 (33.4%)	6 (28.6%)

* Number of imaging referrals can exceed the number of patients imaged because a patient may receive multiple modalities. (Paired pre = 9+3+5 = 17; paired post = 6+1+3 + other 3 = 13).

ADLs = activities of daily living;
PROMs = patient-reported outcome measures;
PREMs = patient-reported experience measures.

The proportion of cases with a traumatic onset increased from 12.2% to 22.5% during the post-implementation period. Low back pain remained the most common complaint across both periods (63.4% pre- vs 59.2% post-), while cases involving neck pain (7.3% to 10.2%) and extremity pain (19.5% to 22.5%) both showed a slight increase. The proportion of patients with chronic pain (duration >3 months) more than doubled, from 19.5% to 40.8%. Pain intensity was reported in approximately 20% of charts in both periods. Most patients presented with a single episode of MSK care (78.1% pre- vs. 81.6% post-) and were seen less than three times by medical staff (MDs or nurses) in both time periods. Interestingly, fewer second episodes of MSK care were noted post-implementation (21.9% vs. 12.2%).

Imaging Utilization

Overall, imaging rate declined from 63.4% to 44.9% post-implementation. This included a reduction in plain film radiography (48.8% to 14.3%), CT scans (12.2% to 8.2%), and MRIs (19.5% to. 14.3%).

Patient Management

Non-Pharmacological Care

Recommendations (from MDs and nurses) for non-pharmacological interventions declined post-implementation, notably for patient education and self-care advice (43.3% to 10.2%), exercise prescriptions (14.6% to 4.1%). Recommendations for manual therapy remained low in both periods.

Pharmacological Care

There was a notable reduction in prescribed NSAIDs (68.3% to 30.6%, although the overall use of NSAIDs showed a lesser decrease from 80.5% to 53.1% when taking over-the-counter NSAIDs into account), acetaminophen (63.4% to 32.7%), and opioids (21.9% to 8.2%). Other medications (e.g., sedatives, antidepressants, anti-anxiety, Voltaren gel, and capsaicin cream) also decreased (31.7% to 22.5%). Conversely, prescriptions for muscle relaxants (7.3% to 14.3%) increased, while prescriptions for Pregabalin or Gabapentin remained unchanged (12.2%).

Referrals

Referrals to external distant facilities decreased from 26.8% to 22.4%. This included medical specialist referrals (21.9% to 18.4%), and physiotherapy referrals (12.5% to 4.1%). Additionally, six new referrals (12.2%) to the onsite WSCC (World Spine Care Canada) chiropractic clinic occurred in the post-implementation period.

Paired comparison of patients with charts included at both time points

Twenty-one patient charts (mean age 50.7 years, 76.2% females) were included in the pre- and post-implementation periods. (Table 1) Among these, the proportion of patients with a chronic complaint increased (38.1% to 52.4%), suggesting conditions transitioned from acute to chronic pain for some patients. Lumbar pain remained the most frequent complaint but declined slightly (61.9% to 52.4%), suggesting either symptom resolution or a change in complaint priority. Extremity complaints increased in the post-implementation period (19.1% to 28.6%), while the proportion of neck and thoracic complaints remained stable. Most patients had only one episode of care across periods (71.4%).

Imaging Utilization

Among patients seen at both time points, imaging ordering (plain film, CT, MRI) decreased in the post-implementation period (61.9% to 47.6%).

Non-Pharmacological Care

Interestingly, fewer patients received patient education and self-care advice (38.1% to 4.8%) or exercise prescriptions (19% vs. 4.8%) from MDs, nurses and nurse practitioners. Referrals for massage remained unchanged (4.8%), while a few referrals (23.8%) were made to the onsite chiropractic clinic.

Pharmacological Care

A decline in the overall prescription of NSAIDS (81% to 38.1%), opioids (28.6% to 9.5%), and acetaminophen (57.1% to 28.6%) was noted post-implementation.

Discussion

In this exploratory retrospective pre–post chart review, after introducing an onsite GSCI-aligned chiropractic service, we observed lower imaging and reduced prescribing of NSAIDs, acetaminophen, and opioids. These associative changes align with prior reports of more guide-

line-concordant care when non-pharmacological options are integrated into primary care teams.[41-43]

Consistent with broader spine care populations,[44] most patients presenting to the Cross Lake Nursing Station identified as female, in their early 50s, reporting non-traumatic low back or neck pain. Across both time periods, most individuals sought care for a single episode and were seen fewer than three times by medical staff, suggesting that MSK complaints were generally managed within a short care window.

Imaging ordered by medical staff declined post-implementation, though rates remained a high considering serious pathology (e.g., cancer, infection) or specific pathology (e.g., spinal canal stenosis, compression fracture)[37, 45, 46] are estimated to be the causes of spinal pain in less than 1% and 10% in the primary care setting, respectively.[47,48,49] While trauma and extremity presentations were relatively more frequent post-implementation, not all such cases warrant imaging; the reduction may reflect increased comfort with non-pharmacological care pathways. Because red-flag documentation was unavailable, appropriateness could not be assessed and should be a focus of future quality improvement study.

While reductions in NSAIDs, acetaminophen, and opioids are consistent with greater availability of non-pharmacological care and staff education[41,42,43], the increased use of muscle relaxants in the post-implementation period warrants monitoring given mixed evidence[50,51]. Notably, gabapentinoid prescriptions remained unchanged, despite limited benefit for back pain with or without sciatica[52-55], and increasing concerns of misuse[56]. We avoid causal inference with these data but note these as pragmatic practice signals. Due to limitations in the available data, co-prescription of opioids and gabapentinoids could not be determined, and suggests an important gap given the increased risk of opioid-related mortality associated with such combinations.[57] Across Manitoba, rising overdose deaths from opioids[58,59] highlights the need for a more holistic approach to pain management specific to substance use interventions and as a public health priority[60]. Despite the evidence against opioid prescription as a first-line treatment for acute or chronic spine pain[61-63], and the ongoing opioid crisis across North America[64], pharmacological options are often more readily accessible than non-pharmacological alternatives, leading to their continued use[65].

Non-pharmacological care and role transition

Charted MDs/nurse delivery of education/exercise declined, possibly reflecting task re-distribution to the on-site chiropractic service. An unpublished report prepared for our funders (Oct 2023–May 2025) describes chiropractic care provided to 232 unique patients at Cross Lake Nursing Station during the post-implementation period (October 2023-May 2025), totaling 1384 patient visits.[66] The report documents high rates of education/exercise within chiropractic encounters, suggesting complementary roles, with approximately 80% of patients receiving education and rehabilitation/ exercise interventions, a proportion much higher than observed nationally and internationally.[67,68] However, the implementation window of the project extends beyond our study period (our Results include six WSCC referrals Oct 2023–Aug 2024). Together, our findings[39,40] support growing recommendations to integrate non-pharmacological care into interdisciplinary teams for a full range of evidence based spinal pain interventions rather than an add-on service to improve patient outcomes.[12-14] Consistent, harmonized documentation would support interprofessional communication, improve visibility of non-pharmacological care across providers, ensuring continuity and consistency of care.

Referrals to external services including physiotherapy and specialist care also slightly declined post-implementation. This trend may be attributed to the increased access to the newly introduced chiropractic service, which received a modest number of new referrals during the study period. Notably, several referrals were still pending at the time of data abstraction, suggesting that the full impact of the service may not yet be captured. The unpublished report indicates that nearly one fifth (18.2%) of the 232 unique patients had been referred to the WSC Canada clinic by either Cross Lake Nursing Station MDs (7.3%), a registered nurse (7.7%) or the staff (3.2%).[66]

Equity and Culture

Despite the documented changes in care processes, few patient charts included patient-reported outcome or experience measures (PROMs/PREMs).[69] While these tools can help monitor MSK care quality,[70-72] they are often grounded in Western biomedical frameworks that may fail to capture Indigenous perspectives of health, including physical, emotional, and spiritual healing and community well-being[32]. In particular, emotional and spiritual

dimensions of pain, often rooted in the intergenerational experience of colonization and the ongoing experiences of systemic racism, can profoundly affect the healthcare experiences of Indigenous persons in Canada and requires culturally responsive approaches to assessment and care.[73,74]

Systemic inequities in the Canadian healthcare system—including racism, implicit bias, and harmful stereotypes contribute to the disproportionate burden of chronic MSK conditions among Indigenous populations.[75-79] These inequities are exacerbated by limited access to primary and specialized pain services in remote communities, as well as financial barriers and as a result, there is often over-reliance on pharmaceuticals, including opioids, as first-line treatment.[78,79]

Expanding access to culturally safe, non-pharmacological therapies requires integrating Indigenous healing practices such as land-based healing, traditional medicine, and the active involvement of Elders and Knowledge Keepers into care pathways.[76] Other holistic approaches, such as chiropractic care, also merit consideration as a first-line intervention. Holistic practices are not peripheral but central to Indigenous worldviews on health and should be embedded within primary care systems.[80,81]

Culturally safe care involves respectful engagement that recognizes and strives to address power imbalances inherent in the healthcare system.[81] For Indigenous peoples, this means comprehensive care models that incorporates family, community traditions, ceremonies (e.g., smudging, sweats, talking circles), and protocols which are all elements central to healing.[82-84] Integrating traditional healing practices with multidisciplinary models for managing chronic pain may improve outcomes by aligning care with cultural values and lived experiences of patients.[75] Importantly, traditional medicine and conventional treatments need not be mutually exclusive, as their integration can support more holistic, person-centered care.[76,81,85]

To ensure that culturally responsive care is consistently delivered, there is a need to co-develop culturally safe care standards with Elders, traditional healers, and community members.[85] Such standards should inform provider licensing, education, and ongoing evaluation in primary care fields, including chiropractic.[86]

In parallel, investments in training and certifying local Indigenous health workers, including nurse practitioners, physician assistants, and providers of manual therapy and mental health therapies, can strengthen cultural competence and foster trust.[87,88] These individuals often share languages, values, and community ties, and are more likely to remain in their roles over time.

Finally, reducing reliance on short-term fly-in health providers is essential for improving relational continuity and cultural safety. Increasing the number of full-time community-based medical and allied health professionals such as chiropractors, can help establish sustainable, community-embedded care.[89-91]

Strengths and limitations

Few studies have documented routine MSK care delivery in remote Indigenous communities in Canada. The present study offers valuable preliminary insights into how the introduction of a culturally responsive spine care model may influence clinical practices in underserved Indigenous communities. However, several limitations must be acknowledged including convenience sampling from paper charts; potential selection/measurement bias (including inconsistent pain chronicity and red-flag capture); short post window (10 months); 43% overlap of patients across periods; small sample precluding inferential testing. Findings are preliminary and hypothesis-generating. Finally, the sparse and variable quality of clinical documentation restricted our ability to assess the appropriateness of care, such as whether imaging was warranted based on red flags, or higher-risk medications (e.g., opioids and gabapentinoids) were prescribed concurrently.[56]

Implications for practice and future research

This study contributes to the limited body of literature describing routine MSK care in northern Indigenous communities and provides preliminary evidence that integrating the GSCI model may influence clinical practice patterns towards evidence-based guideline congruent care. Customizing this model to align with the cultural, spiritual, and social contexts of the local community is essential for sustainability and community acceptance.[29] Future research should aim to incorporate longitudinal and mixed-methods designs to better understand outcomes over time, include culturally relevant PROMs/PREMs to capture patients' lived experiences, and partner with communities in co-designing services that reflect their values and preferences.[92] Quasi-experimental or im-

plementation studies could further evaluate the impact of the GSCI model on care quality, safety, and patient outcomes in underserved settings.

Conclusion

This exploratory study suggests that implementing a culturally sensitive chiropractic service based on the GSCI model was associated with reduced imaging and lower prescribing of several common MSK medications in a remote Indigenous community. Larger, longitudinal, mixed-methods evaluations with standardized documentation and culturally relevant PROMs/PREMs are warranted.

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Abbreviations: GSCI: Global Spine care Initiative; LBP: Low Back Pain; NSAIDs: non-steroidal anti-inflammatory drugs; PREM: Patients Reported Experience Measures; PROMs: Patient Reported Outcome Measures; WSC: World Spine Care; WSCC: World Spine Care Canada.

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Appendix 1.

Chart review: pre- and post-implementation data collection tool

Community: Pimicikamak **Clinic: Cross Lake First Nation Nursing Station, Manitoba, Canada**

Today's Date _____

Purpose: The purpose of this chart review is to help determine the type of care provided to people presenting to the local primary clinic with a complaint of back or neck pain in the past year. Please review the charts of each person in the household.

Instructions: Please select three (3) consecutive files each month between DATE and DATE, up to a total of 50 patient files.

For each of the 50 files you have selected, please answer the following questions: Use a separate sheet for each file.

Tool: This form was adapted from the Global Spine Care Initiative (GSCI) spine care pathway/FlashCards and prior use in Low Middle-Income Countries by team members. Information to be collected includes baseline demographics (age, gender), reason for consultation (back, neck pain), care delivered (pharmaceutical and non-pharmaceutical), number of spine pain episodes, use of patient health questionnaires, imaging, treating clinicians, and referrals.

Obtained patient consent Y N

Cross Lake Nursing Station File number:_____

ID # assigned by GSCI _____

1. Age (years): _____

2. Sex
   a. Male
   b. Female
   c. Other

3. Did this patient attend this clinic for:
   a. neck pain
   b. thoracic pain
   c. lumbar pain
   d. extremity pain
   e. Not reported

4. For the most recent episode of **spine pain or extremity pain**, what was its duration:
   a. Acute (< 3 months)
   b. Chronic pain (≥ 3 months)
   c. Not reported

5. What was the pain intensity?
   a. Minimal (1-1/10)
   b. Mild (2 to 4/10)
   c. Moderate (5 to 7/10)
   d. Severe (8 to 10/10)
   e. Not reported

6. Is the patient able to work or do his/her usual activities?
   a. Y b. N

7. For the most recent episode of **spine pain**, was the onset:
   a. Traumatic b. Non-traumatic

8. Was diagnostic imaging ordered?
   a. Y b. N

9. If the answered is 'yes' to Q8, please indicate the type of **imaging ordered in the past 12 months** (either at the clinic or elsewhere):

9.1. X rays a. Taken at: Local facility b. Distant facility: Thompson or Norway house
c. Winnipeg d. By: Plane

9.2. CT Scan a. Taken at: Local facility b. Distant facility: Thompson or Norway house
c. Winnipeg d. By: Plane

9.3. MRI a. Taken at: Local facility b. Distant facility: Thompson or Norway house
c. Winnipeg d. By: Plane

9.4. Abdominal U/S a. Taken at: Local facility b. Distant facility: Thompson or Norway house
c. Winnipeg d. By: Plane

9.5. Bone Scan a. Taken at: Local facility b. Distant facility: Thompson or Norway house
c. Winnipeg d. By: Plane

10. If this adult attended for neck and/or back pain, was/is this adult being treated for that neck or back pain at this clinic: a. Y b. N

If No, skip to Q. 14

11. If this adult was/is being treated, was/is this adult being treated with the following:

a. Medications: Prescribed or delivered by: _____

1. NSAID
2. Acetaminophen
3. Muscle relaxants
4. Opioids/Narcotics Type/Name _____
   Were opioid medication prescribed for back/neck pain
5. Other: (specify) _____
6. Was any medication delivered by injection/intravenously?
7. Non-prescribed or illegal substances? a. Y b. N c. Not reported

If yes list these medications: _____

b. Massage of the spine Delivered by: _____ This information is not in the chart

c. Manipulation of the spine Delivered by: _____ This information is not in the chart

d. Home or group exercises Delivered by: _____ This information is not in the chart

e. Education (neck/back) Delivered by: _____ This information is not in the chart

f. Advice on self-care Delivered by: _____ This information is not in the chart

g. Corset, back brace, assistive device Delivered by: _____ This information is not in the chart

12. Over the last 12 months, total number of treatment visits this patient received for each episode of care for spine/extremity pain?

a. Episode 1 (if applicable) _____

b. Episode 2 (if applicable) _____

c. Most Recent Episode _____

13. How many treatment visits in total did this patient have for their neck/back pain? _____
This information is not in the chart

14. Was the patient referred to someone else beyond the primary care clinic? a. Y b. N
This information is not in the chart

If yes, please specify:

a. Physiotherapy (PT)
b. Orthopedic surgeon
c. Neurosurgeon
d. Emergency room
e. Other

15. History of addiction to opioids? a. Y b. N

16. Any adverse events due to opioids? a. Y b. N

If you have any additional comments, please use the space below

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Well-being in Australian chiropractors and chiropractic students: factors influencing burnout and job satisfaction

Zoe Ryan, BPsychSc(Hons)[1]
Matt Fernandez, BSpSc, MChiro. PhD[1]
Katie de Luca, BAppSci(Ex&SpSci), MChiro, PhD[1]
Aron Downie, BSc, MChiro, MPhil, PhD[2]
David T McNaughton, MChiro, MRes, PhD[1]

Background: *Chiropractors face workplace stressors that affect well-being, burnout and job satisfaction. The well-being of chiropractors and students in Australia is yet to be examined.*

Methods: *From September 2024 to January 2025, Australian chiropractors and students completed a well-being survey. Measures included burnout, anxiety, depression, job satisfaction, substance use, suicidal ideation and job demands/resources. Multivariable regression models assessed factors associated with burnout and job satisfaction.*

Le bien-être des chiropraticiens australiens et des étudiants en chiropratique : les facteurs influençant l'épuisement professionnel et la satisfaction au travail

Contexte: *Les chiropraticiens font face à des facteurs de stress au travail qui affectent leur bien-être, leur épuisement professionnel et leur satisfaction au travail. Le bien-être des chiropraticiens et des étudiants en Australie n'a pas encore été examiné.*

Méthodes: *De septembre 2024 à janvier 2025, des chiropraticiens et des étudiants australiens ont complété une enquête sur le bien-être. Les mesures comprenaient l'épuisement professionnel, l'anxiété, la dépression, la satisfaction au travail, l'utilisation de substances, les idées suicidaires et les exigences/ressources liées au travail. Des modèles de régression multivariée ont évalué les facteurs associés à l'épuisement professionnel et à la satisfaction au travail.*

[1] School of Health, Medical and Applied Sciences, Central Queensland University, Brisbane, Australia
[2] Department of Chiropractic, Macquarie University, Sydney, Australia

Corresponding author: David McNaughton, School of Health, Medical and Applied Sciences, Central Queensland University, Brisbane, Australia
E-mail: d.mcnaughton@cqu.edu.au
Tel: (07) 3228 4846

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Results: *Of 200 respondents, 38% reported burnout and nearly 80% reported job satisfaction. Early-career chiropractors reported lower job satisfaction and higher burnout. Higher depression (β=0.26 [0.15-0.36]) and anxiety (β=0.03 [0.00-0.06]) scores were associated with burnout. Job satisfaction was associated with lower depression (OR=.60 [0.39-0.93]), more resources (OR=2.98 [1.39-6.39]) and greater workload control (OR=2.03 [1.14-3.62]).*

Conclusion: *Preliminary results suggest the need for well-being screening and interventions for at-risk groups, including students, early career chiropractors and those experiencing elevated anxiety and depression.*

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KEY WORDS: anxiety, burnout, chiropractic student, chiropractor, depression, job resources and demands, job satisfaction, well-being

Résultats: *Parmi 200 répondants, 38 % ont signalé un épuisement professionnel et près de 80 % ont déclaré être satisfaits au travail. Les chiropraticiens en début de carrière ont signalé une satisfaction au travail plus faible et un épuisement professionnel plus élevé. Des scores de dépression plus élevés (β=0,26 [0,15-0,36]) et d'anxiété (β=0,03 [0,00-0,06]) étaient associés à l'épuisement professionnel. La satisfaction au travail était associée à une dépression plus faible (OR=0,60 [0,39-0,93]), à plus de ressources (OR=2,98 [1,39-6,39]) et à un meilleur contrôle de la charge de travail (OR=2,03 [1,14-3,62]).*

Conclusion: *Les résultats préliminaires suggèrent la nécessité de dépistage du bien-être et d'interventions pour les groupes à risque, notamment les étudiants, les chiropraticiens en début de carrière et ceux éprouvant une anxiété et une dépression élevées.*

(JCCA. 2025;69(4):365-378)

MOTS CLÉS : anxieté, épuisement professionnel, étudiant en chiropratique, chiropraticien, dépression, ressources et exigences professionnelles, satisfaction au travail, bien-être

Introduction

The COVID-19 pandemic highlighted the importance of maintaining a healthy and functioning healthcare workforce to withstand pressures in an ever-changing environment.[1] The healthcare environment places employees at a high risk for stress, burnout, and psychological distress, with the challenges of sustained clinical work, constantly changing work environments and repeated exposure to patients' issues.[1–3] Chiropractors, like other healthcare professionals, address complex client issues and offer physical and emotional support to their patients.

The Australian chiropractic profession has a registered workforce of over 6,000 accounting for an estimated 21.3 million patient consultations per year.[4,5] Although research on chiropractors' well-being is in its infancy, U.S. studies have identified isolation, professional competition and student debt as stressors that can impact chiropractors' well-being.[6,7] Additionally, individual factors such as fewer years in practice, younger age, and female gender have been linked to reduced chiropractor well-being.[6]

Workplace well-being is commonly operationalised using measures of burnout, job satisfaction, and psychological functioning (e.g. depression and anxiety levels).[8] Burnout is considered a psychological syndrome due to a prolonged state of chronic job-related stress.[9,10] It is estimated that burnout may develop in 20 to 80% of healthcare workers, and it is reported across all stages of their careers.[3,11] Burnout in healthcare workers impacts the individual and their patients, with higher levels of burnout associated with increased medical errors and lower patient outcomes.[3] Literature on burnout in chiropractors is scarce, with no published papers researching Australian chiropractors and burnout, reiterating the importance of this research.

Complementary to burnout is the concept of job satisfaction. Since work consumes a significant portion of a person's time, job satisfaction has a profound impact on psychological functioning, health, and overall well-being.[12,13] Additionally, reduced job satisfaction is associated with a decline in the quality of patient care, decreased

worker productivity, increased employee absenteeism, and a greater intention to leave the profession or retire early.[14,15] Job satisfaction is an individual's affective response to various aspects of their job that are important to them, and low job satisfaction is associated with higher symptoms of burnout, anxiety and depression.[12] Considering the link between poor job satisfaction and burnout, as well as its implications for patients and the broader healthcare system, it is imperative to investigate job satisfaction among Australian chiropractors.

An individual's risk of developing burnout is not solely determined by workplace conditions. Responses to stressful situations vary across individuals, with reduced psychological functioning increasing an individual's vulnerability to stressors.[16] Anxiety and depression, common psychological conditions, are extensively connected with burnout in the literature.[16,17]

Like healthcare workers, students in health professions face significant stressors, particularly during teaching terms and placements, which add to academic and financial strain.[10] For example, medical students face well-documented challenges with stress, burnout and psychological distress, with factors such as academic studies, relationships and financial difficulties impacting their well-being.[17,18] Research on chiropractic student well-being is limited; however, a survey of 121 chiropractic students across four European colleges reported burnout and stress levels similar to those of medical students.[19] These findings underscore the importance of including students in this study, as addressing their well-being is essential for the sustainability of Australia's chiropractic workforce.

Burnout and job satisfaction are essential components of well-being that have been extensively studied in other healthcare professions; however, there has been limited investigation in the Australian chiropractic context. In alignment with a global effort to understand the mental health and well-being of the chiropractic workforce using an internationally comparable survey, the current study piloted the implementation of the National Chiropractic Health Survey. The specific aims of this pilot study are to: (1) determine preliminary estimates of Australian chiropractors and chiropractic students, burnout, job satisfaction, socio-demographic factors, psychological functioning and drug and alcohol use, and (2) determine the preliminary association between a) burnout and b) job satisfaction with sociodemographic, psychological and job resources and demands in the Australian chiropractic profession.

Methods

Procedure

This pilot study encompassed a cross-sectional online survey conducted between September 2024 and January 2025. All registered Australian chiropractors and chiropractic students aged 18 and above were eligible to participate in a survey exploring factors related to work and wellbeing via an online link. National Chiropractic Associations, existing networks, and professional associations distributed the survey to Australian chiropractic members. It was also distributed to members on their websites and other communication channels (e.g., newsletters and social media). The study was approved by the CQUniversity Human Research Ethics Committee, approval number 0000025018.

Measures

The National Chiropractic Health Survey (NCHS), initially developed for the Canadian Medical Association and successfully applied to Canadian chiropractors in 2023, was adapted for an Australian setting.[20] The survey captured demographic information and psychological, behavioural, and occupational indicators relevant to the Australian chiropractic industry. This survey measured factors relating to burnout and job satisfaction in Australian chiropractors and students. In this survey, all questions were optional, with the only required answers being those that involved navigation (e.g. would you like to skip this section?). For the present study, career stage choices were collapsed into two categories: chiropractic students (including chiropractic students, graduate school students, and clinical residents) and registered chiropractors (currently practising chiropractic, on leave from practice, paused practice, but not retired).

Burnout

Burnout was measured using the Stanford Professional Fulfilment Index (PFI), which consists of 16 questions rated on a 5-point rating scale (0- Not at all true; 4- completely true) with three subscales. The PFI burnout score is calculated by averaging the individual item scores within the work exhaustion (WE) and interpersonal disengagement (ID) sub-scales. The WE subscale (4 items) meas-

ured feelings of physical and emotional exhaustion with questions such as 'How often during the past few weeks have you felt emotionally exhausted at work or school?' The ID subscale (6 items) assessed detachment and reduced empathy, with questions including 'How often during the past few weeks have you felt less empathetic with your patients?' Following standard guidelines, mean scores were calculated for each subscale to produce total WE and ID scores. A total burnout score was calculated as the mean of all 10 items. A cutoff level of 1.33 was used to establish PFI burnout. The reliability of the PFI has been established with test-retest reliability estimates of 0.80 for work exhaustion ($\alpha = 0.86$), 0.71 for interpersonal disengagement ($\alpha = 0.92$), and 0.80 for overall burnout ($\alpha = 0.92$). PFI measures have been shown to correlate highly with the Maslach Burnout Inventory (MBI), the closest equivalent burnout measurement tool ($r \geq 0.50$) [21]. In the current study, Cronbach's alpha for internal consistency was $\alpha = 0.93$ for WE, $\alpha = 0.93$ for ID, and $\alpha = 0.94$ for overall burnout.

Job Satisfaction

Job satisfaction was measured by one item: 'Overall, I am satisfied with my current job or training position,' rated on a 5-point Likert scale from 0 (strongly disagree) to 4 (strongly agree). Given that most chiropractors and students reported satisfaction (agree or strongly agree), job satisfaction was coded as a binary variable (1 = satisfied, 0 = neutral/disagreed), allowing for meaningful analysis of the skewed distribution toward higher satisfaction. Single-item measures of job satisfaction are widely used to capture an individual's overall satisfaction with their job, avoiding the complexity of multi-component scales that may not reflect an individual's priorities.[12,22,23] A single-item measure of job satisfaction shows concurrent validity with multiple-item job satisfaction scales ($r = .82$) and a reliability estimate of .90 (comparable to multiple-item job satisfaction measures of $\alpha = .92$).[22]

Anxiety

Anxiety symptoms were measured using the 7-item General Anxiety Disorder screening tool (GAD-7). Participants were asked, 'How often have you been bothered by the following over the past two (2) weeks?' followed by seven items relating to anxiety symptoms (e.g. 'Feeling nervous, anxious, or on edge'). Four options ranged from nearly every day (score of 3) to not at all (score of 0). The results of each question were totalled (ranging from 0 to 21), with higher scores indicating higher anxiety symptoms. Internal consistency of the GAD-7 in the general population is acceptable ($\alpha = 0.89$).[24] The GAD-7 demonstrates construct validity, with intercorrelations comparable to those found in other studies, including the PHQ-2 ($r = 0.64$) and the Rosenberg Self-Esteem Scale ($r = -0.43$).[24] Cronbach's alpha for internal consistency was $\alpha = 0.91$.

Depression

Depression symptoms were measured using the Patient Health Questionnaire -2 (PHQ-2). Participants were asked, 'Over the last 2 weeks, how often have you been bothered by the following problems?' This was followed by two statements: 'little interest or pleasure in doing things', and 'feeling down, depressed, or hopeless.' Respondents chose from 4 options ranging from nearly every day (score of 3) to not at all (score of 0). The results of each question were totalled (ranging from 0 to 6), with higher scores indicating higher levels of depressive symptoms. Criterion validity has been demonstrated for the PHQ-2 by assessing it against the mental health professional (MHP).[25] The PHQ-2 has demonstrated a pooled sensitivity of 100% and 76% and a specificity of 77% and 87% in different samples and is therefore effective for identifying individuals who may be at risk for depression.[26] Cronbach's alpha for internal consistency was $\alpha = 0.84$.

Suicidal ideation

Respondents were asked a screening question about suicidal ideation: 'Have you had thoughts of suicide in the last 12 months?', choosing from 'yes', 'no', and 'prefer not to answer'. Respondents who selected 'yes' screened positively for suicidal ideation. All other responses screened 'no' for suicidal ideation. Before answering questions regarding suicidal ideation and drug and alcohol use, participants were reminded that the survey was anonymous and voluntary. Participants were encouraged to seek support from a general practitioner or emergency services. Contact numbers for two mental health helpline services were provided to participants (Beyond Blue and Lifeline).

Alcohol and Drug Use

Questions regarding the use of alcohol were asked on a 5-point Likert scale from 0 (never) to 4 (daily or almost daily) with an option of 'I prefer not to answer'. Respondents were asked: 'In the past year, how many times have you used the following substances for non medical reasons? Alcohol(for men, five or more standard drinks in a day; for women, four or more standard drinks in a day). Note: A drink is one can/bottle of beer or wine cooler, one glass of wine, one cocktail, or one shot of liquor.'

Drug Use

Questions regarding the use of drugs were asked on a 5-point Likert scale from 0 (never) to 4 (daily or almost daily) with an option of 'I prefer not to answer'. Respondents were asked: 'In the past year, how many times have you used the following substances for non-medical reasons? (stimulants, tobacco products, cannabis (recreational), opioids (unauthorised), and others).' Although medicinal cannabis is legal with a prescription in Australia, recreational use of cannabis is illegal in most Australian states and territories.

Job Demands and Resources

Respondents were asked to rate their satisfaction with efficiency and resources on a 4-point Likert scale (very dissatisfied to satisfied). Higher scores indicated higher satisfaction. To calculate hours of work, chiropractors reported the number of hours per week spent on patient care, administrative tasks, and other duties/responsibilities. Students indicated the number of hours per week they usually spend on coursework, training, education and other duties. Control over workload was measured on a 5-point Likert scale (poor to optimal), with higher scores indicating greater control over workload.

Analysis

Sample size estimates were based on the total number of chiropractors in Australia in 2024 (n = 6526) and chiropractic students (n = 1601).[27] Using an online sample size calculator, we chose a 95% confidence level, 0.5 standard deviation, and a margin error of 5%. The sample size for a fully powered survey would be 363 chiropractors and 310 chiropractic students.

Study data were collected and managed using the REDCap electronic data capture platform hosted at Central Queensland University (CQUniversity).[28,29] Data were analysed using STATAv17 (StataCorp LLC, College Station, TX). Due to the low sample size of chiropractic students, analyses were conducted using the full sample, with stratified results by career stage (chiropractor vs. chiropractic student) provided in Appendices 1 and 2.

Descriptive statistics (mean, standard deviation, frequency distributions) for all key variables (burnout, job satisfaction, anxiety, depression, suicidal ideation, demands and resources) were generated and presented by two groups (chiropractors and chiropractic students). Multiple chi-square tests were conducted to determine the association between categorical demographic variables and the dependent variables. T tests were used to determine differences between the two groups of chiropractors and students for continuous data. Analysis of Variance (ANOVA) tests were used to determine associations between continuous dependent variables.

To determine the relationship between burnout or job satisfaction with psychological and job-related demands, two separate statistical models were conducted. A single multivariable linear regression model was conducted with burnout as the dependent variable and psychological functioning, and job resources and demands as the independent variables. A separate multivariable logistic regression model was conducted with job satisfaction as the dependent variable and psychological functioning, and job resources and demands as the independent variables. Covariates nested within the additional multivariable models included age, gender, and career stage (chiropractor vs. student). Both statistical models were bootstrapped with 1,000 resamples to produce robust estimates of the standard errors and confidence intervals.

Results

Descriptive Statistics

Two hundred and four responses were recorded; four were excluded due to incomplete data. The final sample comprised 152 registered chiropractors and 48 chiropractic students, representing 2.5% of the Australian chiropractic population. Table 1 presents the demographics of the participants and a summary of study variables stratified by chiropractors and chiropractic students.

This sample of chiropractors closely reflected the Australian chiropractic profession; however, with a higher proportion of females (54.5%) compared to the AHPRA

2023-24 data (42%).[5] Students from chiropractic educational institutions participated from the states and territories of New South Wales (NSW), Queensland (QLD), Victoria (VIC), and Western Australia (WA), but no responses were received from South Australia (SA). (There are no chiropractic educational institutions currently in Tasmania (TAS), the Australian Capital Territory (ACT) and the Northern Territory (NT)). One chiropractor identified as Aboriginal or Torres Strait Islander (0.7%), consistent with national data. Thirty-nine individuals reported one or more disabilities, including mental health conditions ($n = 18$), neurodevelopmental disorders ($n = 15$), chronic conditions ($n = 10$), and others such as hearing and mobility impairments.

Using the PFI cut-off >1.33[21,30,31] to indicate burnout, 76 individuals (38%) in the sample were classified as burnt out, including 26 chiropractic students (54.17%) and 50 chiropractors (32.9%). By career stage, 47% of chiropractors who had been practising for less than 5 years were classified as burnt out, 40% who had been in the field between 6 and 20 years were burnt out, and 16% of chiropractors who had been practising for over 21 years were classified as burnt out.

Most participants reported satisfaction with their job or training; however, 41 (20.6%) were neutral or dissatisfied. While only 12% of chiropractors who had been practising for over 21 years were dissatisfied with their jobs, 34% who were practising for less than 5 years reported job dissatisfaction. Depressive and anxiety symptom scores were negatively skewed, with 83 participants (41.5%) reporting no symptoms of depression. A score of > 3 indicated possible depression, with 12.5% participants overall screening positive.[25] Clinically significant anxiety, defined by a GAD-7 score >10, was reported by 21% of the sample.[24] In total, 24 participants (12.5%) reported experiencing thoughts of suicide in the past 12 months, including seven students and 17 practising chiropractors. Substance misuse over the past 12 months revealed 120 individuals (61.2%) exceeding recommended alcohol intake, 20 (10.3%) using other drugs, 19 (9.7%) using cannabis, 14 (7.5%) using tobacco, and 13 (6.6%) using stimulants. One individual reported opioid use.

Table 1.
Demographics of the sample: practising chiropractors versus chiropractic students.

Characteristic	Full sample ($N = 200$)	Career Stage		Difference
		Chiropractor ($n = 152$)	Chiropractic Student ($n = 48$)	
Gender *n (%)*				
Male	90 (45.5)	67 (44.1)	23 (50.0)	$X_2(1) = 0.50, p = .480$
Female	108 (54.5)	85 (55.9)	23 (50.0)	
Age *n (%)*				
<31	70 (35.4)	34 (22.5)	36 (76.6)	$X_2(4) = 50.98, p < .001$
31-50	80 (40.4)	71 (47.0)	9 (19.1)	
>51	48 (24.2)	46 (30.5)	2 (4.3)	
Disability *n (%)*				
Yes	39 (19.5)	29 (19.1)	10 (20.8)	$X_2(1) = 0.07, p = .789$
State *n (%)*				
NSW	74 (37.0)	56 (36.8)	18 (37.5)	$X_2(7) = 16.06, p = .025$
QLD	63 (31.5)	43 (28.3)	20 (41.7)	
VIC	25 (12.5)	24 (15.8)	1 (2.1)	
SA	9 (4.5)	9 (5.9)	0 (0)	
ACT	3 (1.5)	3 (2.0)	0 (0)	
NT	1 (0.5)	1 (0.7)	0 (0)	
WA	22 (11.0)	13 (8.6)	9 (18.8)	
TAS	3 (1.5)	3 (2.0)	0 (0)	

Characteristic	Full sample (N = 200)	Career Stage		Difference
		Chiropractor (n = 152)	Chiropractic Student (n = 48)	
Length in Career Stage				
<5 years	32 (21.3)	32 (21.3)		
6 – 20 years	60 (40.0)	60 (40.0)		
>20 years	58 (38.7)	58 (38.7)		
Practice Location *n (%)*				
Urban/Suburban	117 (78.0)	117 (78.0)		
Small Town/Rural	30 (20.0)	30 (20.0)		
Geographically isolated/ remote	2 (1.3)	2 (1.3)		
Telehealth	1 (0.7)	1 (0.7)		
Aboriginal or Torres Strait Islander *n (%)*	1 (0.5)	1 (0.7)	0 (0)	$X_2(1) = 0.317, p = .573$
Job Satisfaction *n (%)*				
No	41 (20.6)	32 (21.1)	9 (19.1)	$X_2(1) = 0.08, p = .778$
Suicidal Ideation *n(%)*				
Yes	24 (12.5)	17 (11.5)	7 (15.9)	$X_2(1) = 0.61, p = .436$
Alcohol Use[1,2] *n (%)*				
Yes	120 (61.2)	93 (62.0)	27 (58.7)	$X_2(1) = 0.16, p = .687$
Stimulants Use[2] *n (%)*				
Yes	13 (6.6)	8 (5.3)	5 (10.9)	$X_2(1) = 1.74, p = .187$
Tobacco use[2] *n (%)*				
Yes	14 (7.5)	9 (6.4)	5 (10.9)	$X_2(1) = 1.26, p = .262$
Cannabis Use[2] *n (%)*				
Yes	19 (9.7)	12 (8.1)	7 (15.2)	$X_2(1) = 2.05, p = .152$
Opioids Use[2] *n (%)*				
Yes	1 (0.5)	1 (0.7)	0(0.0)	$X_2(1) = 0.31, p = .577$
Other Drug Use[2] *n(%)*				
Yes	20 (10.3)	14 (9.4)	6 (13.0)	$X_2(1) = 0.51, p = .476$
Burnout[3] M[4](SD[5])	1.21 (0.89)	1.11 (0.91)	1.51 (0.76)	$T(198) = 2.78$, $p = .006$
WE[6] M(SD)	1.65 (1.12)	1.41 (1.05)	2.40 (1.00)	$T(198) = 5.48$, $p < .001$
ID[7] M(SD)	0.89 (0.85)	0.89 (0.88)	0.91 (0.76)	$T(196) = -0.32$, $p = .753$
Depression[8] M(SD)	1.35 (1.59)	1.21 (1.54)	1.77 (1.69)	$T(198) = 2.14$, $p = .033$
Anxiety[9] M(SD)	6.69 (5.60)	6.15 (5.59)	8.42 (5.35)	$T(198) = 2.48$, $p = .014$
Total work hours[10] M(SD)	40.71 (17.56)	36.83 (13.75)	52.99 (22.26)	$T(198) = 6.03$, $p < .001$
Control over workload M(SD)[11]	2.46 (1.06)	2.64 (1.02)	1.87 (0.98)	$T(195) = -4.56$, $p < .001$

Characteristic	Full sample (N = 200)	Career Stage		Difference
		Chiropractor (n = 152)	Chiropractic Student (n = 48)	
Resources[12] M(SD)	1.95 (0.75)	2.01 (0.76)	1.71 (0.68)	T (179) = -2.33, p = .021

[1]For men, five or more drinks in a day; for women, four or more drinks in a day, [2]Over the last 12 months, [3]Burnout: Professional Fulfillment (PFI) Scale (0-4 range: higher scores reflective of higher burnout), [4]mean, [5]standard deviation, [6]Work Exhaustion (PFI sub-scale) (0-4 scale: higher scores reflective of higher work exhaustion), [7]Interpersonal Disengagement (PFI sub-scale) (0-4 range: higher score reflective of higher interpersonal disengagement), [8] Depression: Patient Health Questionnaire-2(PHQ-2) (0-6 range: higher score reflective of higher depression symptoms), [9]Anxiety: General Anxiety Disorder-7 (GAD-7) (0-21 range: higher scores reflective of more anxiety symptoms), [10]Total hours of patient care, administrative tasks, course work, training, other duties, [11]1-5 range: higher scores reflective higher work control, [12]1-4 range: higher scores reflective of higher satisfaction with efficiency and resources.

Between Group Differences

Job satisfaction ($X2$ (1) = 0.08, p = .778) and suicidal ideation ($X2$ (1) = 0.61, p = .436), and drug and alcohol use did not statistically significantly differ between chiropractors and students. Chiropractic students had higher overall burnout scores compared to chiropractors (T(198) = 2.78, p = .006). While interpersonal disengagement scores did not differ (T(196) = -0.32, p = .753), work exhaustion scores were higher for chiropractic students (T(198) = 5.48, p < .001). Chiropractic students also had higher depression scores compared to chiropractors, and students showed higher anxiety scores compared to chiropractors. Students reported higher hours of work per week, less control over their workload and less satisfaction with efficiency and resources.

Preliminary Burnout Estimates

A multivariable linear regression model (Table 2) was conducted to examine whether depression, anxiety, suicidal ideation, job demands and resources were preliminarily associated with levels of burnout in Australian chiropractors and chiropractic students. The adjusted statistical model was statistically significant, F(10, 171) = 234.74, p < .001, explaining 59% of the variance in burnout (R^2adj= 0.59). Higher depression and higher anxiety scores were associated with higher rates of burnout and sustained in the adjusted statistical model.

Table 2.
Multivariable linear regression models: burnout.

Variable	Unadjusted Model		Adjusted Model	
	β (SE)	95% CI	β (SE)	95% CI
Depression	0.25*** (0.05)	[0.14, 0.35]	0.26*** (0.05)	[0.15, 0.36]
Anxiety	0.04*** (0.01)	[0.01, 0.06]	0.03* (0.02)	[0.00, 0.06]
Suicidal Ideation	-0.01 (0.22)	[-0.41, 0.44]	0.05 (0.22)	[-0.38, 0.48]
Total Hours	0.00 (0.00)	[-0.00, 0.01]	0.00 (0.00)	[-0.00, 0.01]
Workload Control	-0.11* (0.05)	[-0.21, -0.01]	-0.09 (0.05)	[-0.20, -0.01]
Resources	-0.09 (0.06)	[-0.21, 0.03]	-0.09 (0.06)	[0.22, 0.03]

β: unstandardised regression coefficients; SE: bootstrapped standard errors, CI = confidence interval [lower, upper]; *p < .05. **p < .01. ***p < .001. Adjusted model includes the covariates age, gender, and career stage.

Preliminary Job Satisfaction Estimates

A multivariable logistic regression model was conducted to preliminarily examine whether depression, anxiety, suicidal ideation, job demands and resources were associated with job satisfaction (0 = not satisfied, 1 = satisfied) in Australian chiropractors and students. Table 3 presents the unadjusted and adjusted statistical models. The adjusted logistic regression model was statistically significant ($\chi 2$ (10) = 58.84, $p < .001$), with McFadden's pseudo $R^2 = 0.35$. The variable efficiency and resources significantly contributed to the adjusted model (OR = 2.98, 95% CI [1.39, 6.39], $p = .005$), as did control over workload (OR = 2.03, 95% CI [1.14, 3.62], $p = .016$). The adjusted statistical model revealed a statistically significant association between depression and job satisfaction (OR = .60, 95% CI [0.39, 0.93], $p = .022$), indicating that individuals with higher levels of depression were less likely to report satisfaction with their jobs or training. The adjusted model identified no statistically significant association between anxiety, suicidal ideation, and total hours of work.

Table 3.
Multivariable logistic regression models: Job satisfaction

	Unadjusted Model		Adjusted Model	
Variable	OR (SE)	95% CI	OR (SE)	95% CI
Depression	0.64* (0.14)	[0.42, 0.97]	0.60* (0.13)	[0.39, 0.93]
Anxiety	0.95 (0.06)	[0.84, 1.08]	0.94 (0.06)	[0.83, 1.08]
Suicidal Ideation	1.83 (1.54)	[0.35, 9.55]	2.82 (2.62)	[0.46, 17.42]
Total Hours	1.01 (0.02)	[0.98, 1.04]	0.99 (0.02)	[0.96, 1.03]
Workload Control	1.82* (0.50)	[1.07, 3.10]	2.03* (0.60)	[1.14, 3.62]
Resources	2.98** (1.12)	[1.43, 6.21]	2.98** (1.16)	[1.39, 6.39]

OR = odds ratio; SE = Standard Error; CI = confidence interval; $^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$. Adjusted model includes the covariates age, gender, and career stage.

Post-Hoc Sensitivity analysis

To investigate the difference between the student and clinician samples, both linear and logistic regression models were conducted in each sub-sample. For burnout, when results were stratified by chiropractor and student, chiropractors exhibited a statistically significant relationship with depression and burnout but not anxiety. In chiropractic students, no statistically significant results were found between any variables and burnout. For job satisfaction, when results were stratified by career stage, a statistically significant relationship was found between job satisfaction and the predictors depression and efficiency and resources. No statistically significant relationships were found between any of the predictors and job satisfaction in the student sample. This sensitivity analysis should be interpreted with caution due to the preliminary nature of these results and the smaller student sample.

Discussion

This study examined the well-being of Australian chiropractors and students, aiming to establish preliminary levels of burnout and job satisfaction within the Australian chiropractic profession. It offered insights into the psychological functioning, substance use, burnout and job satisfaction levels of those in the industry. The findings offer novel insights into the deployment of the National Chiropractic Mental Health Survey in an Australian setting and further reveal how socio-demographic factors and the chiropractic clinical work environment influence the well-being of Australian chiropractors.

Despite the relevance and importance of this study to the global chiropractic community[6], our Australian response rate did not reflect this need and future research should carefully consider how to improve this. This survey has seen much higher response rates internationally

despite similar communication plans being developed and implemented in Australia. The Australian chiropractic landscape reflects a fragmented professional association, compared to Canada or Denmark, where these associations represent >85% of the profession. Future research requires a more coordinated communication plan between stakeholders, educational institutions and professional bodies to engage chiropractors and chiropractic students in the importance of this work and professional sustainability.

Burnout levels among Australian chiropractors are comparable to those in other healthcare fields. During COVID-19, 29.5% of 320 Australian healthcare workers screened positive for burnout using the Professional Fulfilment Index (PFI), which was lower than 32.9% in our chiropractic sample.[11] Partridge *et al*.'s literature review of burnout in the international chiropractic field identifies several chiropractic-specific factors contributing to burnout that may also be relevant for the Australian chiropractic community.[6] These included working in acute settings, having a limited scope of practice, work-related injuries, business and administrative duties, and a negative public perception. Notwithstanding the small sample size, preliminary estimates suggest that chiropractic students may face an even higher risk of burnout, with over half classified as burnt out, similar to high-risk student groups such as medical and dental students.[32] In addition to the stressors of studying in a health-related field, chiropractic students in Australia may experience internal conflict about their professional identity due to the divergent viewpoints regarding the identity, scope, and future of chiropractic practice.[33,34] Whilst the profession progresses towards evidence-based care and prioritises research, there are still attempts to retain traditional chiropractic philosophy.[33,34] Discrepancies within the profession's approach to care can lead to confusion for students and early career chiropractors regarding their own professional practice and role identity.[35] In appreciation of the complexity of these issues, researchers should consider exploring whether burnout may be influenced by cognitive dissonance resulting from the conflicting ideologies and divisions within the profession.[34]

Job satisfaction among chiropractors and students was generally high, consistent with that of Australian doctors who report job satisfaction levels exceeding 80%.[36] As with physicians, early-career chiropractors may also experience greater dissatisfaction and burnout due to inexperience, reduced workload control, or increased interpersonal conflicts.[14] The preliminary results indicate that many aspects of chiropractic practice are fulfilling and enjoyable, such as reducing patient pain and work variety.[37] However, this study identified at-risk groups, such as early-career chiropractors and students, where interventions and further research could be directed.

The well-being of Australian chiropractors and students was further explored by measuring psychological functioning alongside contributing factors such as drug use and socio-demographic factors. Continuing the trend of decreased well-being, students reported lower psychological functioning compared to chiropractors. Anxiety was more prevalent than depression, with levels aligning with findings in other healthcare students, who report higher mental health concerns than normative data.[10,11] In this sample, 12.5% of individuals reported suicidal thoughts in the past 12 months, comparable to the 10% of Australian healthcare workers reporting thoughts of suicide or self-harm during the pandemic.[38] Additionally, this study highlighted that a notable proportion of Australian chiropractors and students reported using alcohol and other substances in a way that contradicts health recommendations, raising concerns for patient safety.[39]

This study suggests a link between psychological functioning and burnout in Australian chiropractors. Higher depressive and anxiety symptoms were preliminarily associated with higher burnout scores for chiropractors. This aligns with existing research showing a bidirectional relationship between depression and burnout, where burnout is also a strong predictor of depression.[11] While the two constructs are highly correlated, and it is agreed that they share overlapping symptoms, they remain distinct. Theoretically, burnout primarily affects work-related domains, whereas depression is more pervasive.[3,17] However, real-world experiences are more complex. For example, researchers have found that many individuals who attribute feelings of burnout to their jobs also attribute their feelings of depression to their work.[16] As an explanation for this overlap, depression, given its pervasive nature, can impact all aspects of life, including work, increasing one's risk for burnout.[40] As this is a cross-sectional study, it remains unclear whether individuals attributed their depression and anxiety symptoms to their work or the sequence in which they occurred. Despite

their complex interrelation requiring further study, higher depressive and anxiety symptoms remain a risk factor for burnout in the Australian chiropractic profession.

This study identified that psychological functioning was also associated with job satisfaction, with higher depressive symptoms predicting lower job satisfaction, consistent with previous research.[12] Low anxiety was not associated with job satisfaction in this sample; however, previous literature has indicated a conflicting impact of anxiety on job satisfaction, with some findings indicating a relationship between the two,[12] while others do not.[41] This further highlights the multifaceted nature of job satisfaction, which is influenced by numerous factors.[42,43]

The role of job demands and resources on well-being in the chiropractic profession was highlighted in this study. The JD-R model provides a valuable framework for examining these influences. This study evaluated the resources and demands of chiropractors, examining their impact on burnout and job satisfaction.[9] The job demand of higher total hours worked was found to be preliminarily associated with burnout. Job resources appeared more influential in whether chiropractors are satisfied with their job, with both efficiency and resources and control over workload associated with job satisfaction. These findings emphasise the role that job demands and resources have on experiences of burnout and job satisfaction. The impact of workload on burnout is well-documented, with the relationship being strongest when job control is low, highlighting the protective role of control over workload against burnout.[44,45] For chiropractors in particular, job-specific demands such as physical workload, role ambiguity/conflict and public perception[7] may further amplify stressors that health professionals may generally experience.

Further research on job demands and resources specific to chiropractors and students will have important implications for interventions. For example, introducing programs that promote efficiency and reduce excessive workloads has effectively lowered burnout in similar professions.[6] While many chiropractors, particularly those in private practice, benefit from autonomy, flexibility and workload control, these advantages may be less accessible to those employed by larger companies.[37] Further, providing unified support to students entering a potentially conflicting workforce may assist early career chiropractors to develop their professional identity and evaluate and navigate conflicting ideologies in their workplace. Individually focused strategies that increase personal resources, such as mindfulness and relaxation techniques, have been shown to be effective in reducing anxiety, depression and burnout,[10] as have organisational-based strategies which focus on reducing work hours and accessing peer support.[46]

Strengths and limitations

This study provides valuable initial insights into the factors associated with burnout and job satisfaction among Australian chiropractors and chiropractic students. Still, its findings should be interpreted in light of several limitations. The sample size includes only 2.2% of Australian chiropractors and chiropractic students, which limits generalisability. Online surveys, although convenient, exclude potential participants who lack electronic devices. The study's cross-sectional design limits the ability to draw causal inferences. While relationships between variables were identified, their directionality is not clear. Longitudinal studies could clarify whether these relationships are causal and interdependent. Further, reliance on self-reported data introduces potential biases, such as recall bias, selection bias (e.g., participants struggling with well-being may have been more likely to participate) and underreporting of undesirable behaviours due to social desirability. However, the survey's anonymity likely mitigated these issues. Regardless, it is clear from the results that there are many chiropractors and chiropractic students experiencing symptoms of burnout, depression, anxiety, suicidal ideation and misuse of drugs and alcohol, justifying further investigation of this population.

Conclusion

This study offers preliminary insights into the well-being of Australian chiropractors and students, with a focus on burnout and job satisfaction. The findings of this study suggest that burnout levels in Australian chiropractors are comparable to those of other healthcare professionals, with students at an even greater risk. Levels of reduced psychological functioning were comparable to those of other healthcare professions. Higher depression and anxiety scores were preliminarily associated with higher levels of burnout, and higher depression predicted lower job satisfaction scores. The results of this study should

promote investment from chiropractic educational institutions, government and industry bodies to invest in further research to identify the risk of burnout, job satisfaction and wellbeing, to ensure a healthy and stable chiropractic profession.

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Contributions

Conceptualisation: DM; Methodology: DM, ZR, AD; Analysis: ZR, DM; Data Curation: ZR, DM, AD; Writing – Original Draft Preparation: ZR, DM; Writing – Review & Editing: ZR, DM, MF, KdL, AD.

Data Sharing

Access to de-identified data may be provided on reasonable request. Requests are subject to the establishment of appropriate data governance, and the approval of an independent and recognised human research ethics committee. Requests must be made in writing to ZR.

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Appendix 1.
Adjusted Multivariable Linear Regression Model: Burnout (student vs. chiropractor)

	Chiropractic Student		Chiropractor	
Variable	β (SE)	95% CI	β (SE)	95% CI
Depression	0.14 (0.15)	[-0.16, 0.44]	0.25*** (0.0)	[0.12, 0.38]
Anxiety	0.04 (0.04)	[-0.04, 0.13]	0.03 (0.02)	[-0.00, 0.06]
Suicidal Ideation	-0.12 (0.40)	[-0.91, 0.66]	0.13 (0.29)	[-0.43, 0.69]
Total Hours	0.00 (0.01)	[-0.01, -0.02]	0.01 (0.00)	[-0.00, 0.01]
Workload Control	-0.27 (0.23)	[-0.72, 0.18]	-0.07 (0.06)	[-0.18, 0.05]
Resources	0.01 (0.22)	[-0.43, 0.44]	-0.14 (0.07)	[-0.29, 0.00]

β: unstandardised regression coefficients; SE: bootstrapped standard errors, CI = confidence interval [lower, upper]; ***$p < .001$. Note: Adjusted model includes the covariates age and gender.

Appendix 2.
Multivariable logistic regression analyses: Job satisfaction (student vs. chiropractor)

	Chiropractic Student		Chiropractor	
Variable	OR (SE)	95% CI	OR (SE)	95% CI
Depression	0.82 (0.90)	[0.10, 7.10]	0.52* (0.14)	[0.31, 0.89]
Anxiety	0.91 (0.34)	[0.43, 1.91]	0.95 (0.07)	[0.82, 1.11]
Suicidal Ideation	0.02 (4.24)	[0.4, 4.0]	3.22 (3.17)	[0.47, 22.10]
Total Hours	1.24 (0.17)	[0.95, 1.61]	0.96 (0.02)	[0.92, 1.01]
Workload Control	93.24 (277.68)	[0.27, 31959.45]	1.50 (0.46)	[0.82, 2.75]
Resources	637.50 (2868.43)	[0.09, 4310049]	2.95** (1.21)	[1.32, 6.59]

OR = odds ratio; SE = Standard Error; CI = confidence interval; *$p < .05$. **$p < .01$. Adjusted model includes the covariates age, gender, and career stage. Note: due to model complexity and the smaller sample of the student population, including covariates age and gender was not feasible.

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Editorial

JCCA December 2025 Sports Chiropractic Special Issue: 17th Edition

Mohsen Kazemi, RN, DC, FRCCSS(C), FCCPOR(C), MSc, PhD[1]
Assistant Editor

(JCCA. 2025; 69(4):379-380)

KEY WORDS: sports, chiropractic, editorial

Éditorial
JCCA Décembre 2025 – Numéro spécial de la chiropratique sportive : 17e édition

MOTS CLÉS : sports, chiropratique, éditorial

Chiropractic sports science in Canada continues to move forward with purpose, clarity, and rising influence. Each year, we see our profession become more deeply embedded in athlete development, performance systems, and collaborative sport-medicine environments. This JCCA Sports Issue reflects that momentum and celebrates the clinicians, researchers, and educators who are shaping the next chapter of chiropractic in sport.

The papers in this issue highlight both the complexity of athletic injuries and the strength of evidence-informed chiropractic care. From a graded return-to-cycling protocol for chronic coccydynia, to the rehabilitation of a multiligament knee injury in a young football athlete, we see how precise assessment and thoughtful progression can restore hope and function.

The integration of PRP and stem-cell therapy for a partial UCL tear demonstrates how chiropractors are adapting to emerging regenerative technologies while maintaining the core principles of functional rehabilitation. The management of an L5–S1 disc protrusion in an elite speed skater reminds us of the delicate balance between performance and protection at the highest levels of sport. And the case of a schwannoma presenting as chronic calf pain reinforces the critical role of diagnostic vigilance in everyday practice.

This issue is further strengthened by the 2025 RCCSS(C) Conference Proceedings and Scientific Poster Competition abstracts, showcasing the passion and innovation of the next generation of chiropractic sport scientists. Their work inspires confidence that our profession's research culture will continue to grow in both depth and impact.

[1] Canadian Memorial Chiropractic College

Corresponding author: Mohsen Kazemi, 6100 Leslie Street, Toronto, ON M2H 3J1
E-mail: mkazemi@cmcc.ca
Tel: 416-277-3994

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As clinicians and scholars, we are privileged to serve athletes who pursue excellence with relentless determination. Our role is to match their commitment—with rigorous thinking, skilful care, and a willingness to keep pushing the boundaries of what chiropractic can contribute to sport.

I am grateful for the authors, reviewers, and researchers who make this issue possible. Together, we are advancing a profession that stands ready to support healthier, stronger, and more resilient athletes across Canada

Sincerely,

Mohsen Kazemi, RN, DC, FRCCSS(C), FCCPOR(C), MSc, PhD, Acupunture

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Return to cycling protocol after chronic coccydynia: a case report

Melissa Hamilton, MSc, DC, CSCS, FRCCSS(C)[1]
Kristen Mangos, BSc (Hons), DC, RCCSS(C) Resident[1,2]

Objective: *To outline a successful return to cycling protocol in a patient recovering from chronic coccydynia.*

Case Presentation: *A 34-year-old female recreational cyclist suffered chronic coccydynia for one year. She received a cortisone shot that provided relief until she had a hysterectomy, which then intensified the pain. She was referred to a pelvic floor physiotherapist where she was discharged after one visit due to no pelvic abnormalities. She then sought chiropractic care where she went through a return to cycling protocol based around coccydynia rehabilitation and pain management. The patient was able to return to cycling after 22 weeks of chiropractic care.*

Le retour au protocole de cyclisme après une coccydynie chronique: un rapport de cas

Objectifs: *Pour établir un protocole de retour au cyclisme réussi chez un patient en convalescence d'une coccydynie chronique.*

Présentation de cas: *Une cycliste récréative de 34 ans a souffert d'une coccydynie chronique pendant un an. Elle a reçu une injection de cortisone qui a apporté un soulagement jusqu'à ce qu'elle subisse une hystérectomie, ce qui a ensuite intensifié la douleur. Elle a été référée à une physiothérapeute du plancher pelvien où elle a été libérée après une visite en raison de l'absence d'anomalies pelviennes. Elle a ensuite eu des soins chiropratiques où elle a suivi un protocole de retour au cyclisme axé sur la réhabilitation de la coccydynie et la gestion de la douleur. La patiente a pu reprendre le cyclisme après 22 semaines de soins chiropratiques.*

[1] Royal College of Chiropractic Sports Sciences (Canada)
[2] Canadian Memorial Chiropractic College, Toronto, ON

Corresponding author: Melissa Hamilton, 212 Frederick Court, Tavistock ON N0B2R0
Tel: 289-927-5990
Email: melisshams01@gmail.com

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Summary: *Coccydynia is a painful condition that has no universally accepted treatment or guidelines for management. As such, there are no return-to-sport protocols for individuals who have developed coccydynia in sports. Here we present an evidence-based protocol that can assist practitioners in the management of chronic coccydynia.*

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KEY WORDS: chronic pain, coccydynia, cycling , rehabilitation, return to sport, chiropractic

Résumé: *La coccydynie est une condition douloureuse qui n'a pas de traitement ou de directives de gestion universellement acceptés. En tant que tel, il n'existe pas de protocoles de retour au sport pour les personnes ayant développé une coccygodynie dans le cadre du sport. Voici un protocole basé sur des donnée probantes qui peut aider les praticiens dans la gestion de la coccydynie chronique.*

(JCCA. 2025;69(4):381-395)

MOTS CLÉS : douleur chronique, coccydynie, cyclisme, réhabilitation, retour au sport, chiropratique

Introduction

The term coccydynia refers to pain located around the sacrococcygeal region.[1] The coccyx is located at the bottom of the spinal column, and it consists of three to five vertebrae located below the sacrum.[2,3] It is connected to the sacrum by a fibrocartilaginous joint called the sacrococcygeal joint.[2,3] This joint allows limited coccygeal movement, specifically with slight forward bending when in a seated position.[2,3] The anterior surface of the coccyx is the attachment site for pelvic floor muscles such as levator ani, iliococcygeus, coccygeus, and pubococcygeus.[2,3] Anatomical studies show that distally, the psoas fascia is continuous with the pelvic floor.[4] The posterior surface of the coccyx is the attachment site for the gluteus maximus.[2,3] The coccyx connects to the anterior and posterior sacrococcygeal ligaments, which continue between the anterior and posterior longitudinal ligaments.[2,3] The sacrotuberous and sacrospinous ligaments also connect to the coccyx on either side.[2,3] The coccyx also is connected to the anococcygeal raphe which is a structure that extends from the anus to the distal end of the coccyx.[2] It helps to stabilize the anus within the pelvic floor.[2] The coccyx is innervated by the coccygeal nerve, which is composed of the coccygeal plexus, and is responsible for receiving sensation from the coccyx region.[5] It is also innervated by the ganglion impar, located anterior to the coccyx, which represents the terminal end of the paravertebral chain of the sympathetic nervous system.[5] It is responsible for nociception and sympathetic innervation of the perineal region.[5] Of clinical relevance, nerve blocks in both these areas have been used to successfully treat coccydynia.[5]

The development of coccydynia is multifactorial and may include traumatic, idiopathic, infectious or tumor-related causes.[1] Coccydynia mainly affects females which has been attributed to the more posterior location of the sacrum and coccyx and the characteristics of the ischial tuberosities.[6-9] This anatomy leaves a female coccyx more exposed and susceptible to acute trauma such as childbirth or falls and repetitive microtrauma such as prolonged sitting or cycling.[10] Researchers have hypothesized that coccydynia is a dynamic condition rather than static.[11-13] Coccygeal translation or angular motion has been found in 69% of patients that present with coccydynia as seen in dynamic standing and seated radiographs.[14] Coccygeal mobility has been categorized into four types: 1) Luxation; posterior subluxation of the jutting out tip of the coccyx with sitting, 2) Hypermobility; direct seating axial pressure leading to coccygeal flexion over 25 degrees, 3) Immobile; less than 5 degrees of coccygeal flexion on sitting, and 4) normal; coccygeal mobility of 5-25 degrees on dynamic radiography.[14] Luxation-type coccydynia is thought to occur primarily in obese individuals due to restricted sagittal pelvic rotation leading to protrusion, retroversion, excessive pressure on the tip of the coccyx, and increased intra-pelvic pressure during sitting.[14,15] Whereas, the hypermobility type is thought to be more common in thin individuals.[14] Another potential cause of coccydynia is the intra-coccygeal articulations which are known to contain variants of intervertebral discs.[12] Degenerative changes in these discs have been implicated

as a cause of pain in 41% of idiopathic and 44% of traumatic coccydynia.[12] Mild cases of coccydynia can improve spontaneously, persistent cases have been shown to resolve with conservative care including NSAIDs, injections, lifestyle management, manual therapy, and rehabilitation exercises.[16] Those who fail conservative care may then resort to surgery.[16]

Cycling involves sustained pressure on the saddle which directly compresses the perineal region.[17] Discomfort with sitting on a bicycle saddle is one of the most common complaints among cyclists and it can be associated with numbness, nodules, chafing, sexual dysfunction, urethritis, and coccydynia.[10,17] Females may be at higher risk of developing pain in the saddle as researchers have shown that they experience less pressure reduction than males when switching from the top-hand position to the lower-hand position.[17] Females typically have a lower center-of-mass in the upper body, resulting in a reduced ability to offload weight onto the handlebars in the lower-hand position.[17] Bike saddle designs have evolved to improve comfort and reduce the likelihood of saddle-related pathologies; however, the prevalence of saddle-related issues remains high in female cyclists.[18] A 2023 study by Harrison and Edy reported that 37% of female cyclists suffer from saddle-related pain, 33% experience chafing, 27% have skin irritation, and 20% of recreational cyclists report infections linked to cycling.[18] The prevalence of coccydynia in female cyclists is currently unknown. Currently, knowledge about coccydynia in sports is sparse, and minimal research exists to help guide practitioners on managing this condition in athletes.[16] The basic protocols of rest, ice, coccyx cushions, and gentle exercises may be helpful for symptom relief in the general population, but they are not adequate for proper management and prevention of recurrence when coccydynia was developed in sports. Here we present a 34-year-old female cyclist who developed chronic coccydynia from repetitive and prolonged sitting on a bike saddle. The purpose of this case report is to outline a successful return to cycling protocol after experiencing chronic coccydynia. The return to cycling protocol was developed after evaluating anatomy, coccydynia pathology, and cycling biomechanics within the literature.

Case Presentation

The information from this case report is based on clinical documentation obtained during the patient's history and physical exam by a chiropractor and pelvic floor physiotherapist.

History

A 34-year-old female presented to our chiropractic office in September 2024 with chronic coccydynia, which she believed started from prolonged sitting on a bike seat, as this was when she first noticed symptoms in August 2023. She reported being a recreational athlete who participated in road cycling and taught indoor stationary cycling classes. She noted that she would spend five or more hours on a bike weekly, with each session averaging forty-five minutes to two hours. With both road cycling and indoor stationary cycling she would clip into the bike. Her road bike was a Cannondale Synapse 3 endurance road bike; her indoor cycling bike brand was not noted. She reported that she had a bike fitting done when she bought her bike. She reported that she would wear normal workout shorts during her indoor cycling sessions, and when she would use her road bike, she would use 3D padded cycling shorts.

The patient also thought that her pain might be linked to her most recent pregnancy in October 2021. She reported having three pregnancies, all of which were vaginal births without complications. She experienced second-degree tearing with her firstborn, but no tearing with her second or third births. Her third pregnancy was described as a difficult pregnancy. She reported experiencing symptoms consistent with gestational diabetes, but her doctors did not diagnose her. She was carrying excess amniotic fluid, and the baby was larger than her previous children, weighing nine pounds at birth. At the time of her assessment, she did not report any other pelvic floor complaints such as urinary or fecal incontinence, pain with sexual intercourse or regular pain with bowel movements.

She reported her pain increased in intensity and frequency around January of 2024 which she attributed to having an increase in teaching hours at the spin studio alongside her own training. She described the pain as a constant sharp pain with direct pressure on the area with sitting. The pain would subside a few minutes after standing but would be the worst during the transition from sitting to standing. Her pain would be at its worst in the evening after repetitive sitting to standing throughout the day, and laying down in bed on her back to sleep

would cause sharp pains. She reported no associated pain in the low back, hip or groin and no radiation or referral pains. The severity and frequency of the pain prompted her to seek medical attention. Her family physician sent her for X-rays that returned unremarkable (Figure 1). The X-rays showed that she had type 2 curvature of the coccyx by the classification first proposed by Postacchini and Massobrio and since modified by Nathan which classifies into six types.[19, 20] Seated X-rays were not taken. She was then referred to a rheumatologist, which took three to four months to have that appointment. Her family doctor prescribed naproxen, an anti-inflammatory medication, to manage the pain while waiting for the appointment. She reported that the pain medication helped, but the pain would always return after the medication wore off. She saw two rheumatologists in total. The first rheumatologist thought that she had a cyst that needed to be drained, which was proven to be incorrect. She was then sent to a different rheumatologist for a second option. The second rheumatologist explained that her coccyx was inflamed and recommended a cortisone shot. The doctor injected the area with a cortisone shot in May 2024 which provided temporary relief until shortly after her surgery in June 2024.

Due to a large benign tumor (polyp) causing cramping, excessive bleeding, and heavy bleeding, she had a full hysterectomy in June 2024 entailing the removal of her uterus and cervix, while leaving her ovaries. She reported surgery was laparoscopic and vaginally assisted, with only three small incisions made. Recovery from the surgery was about six weeks long and she reported that the pain started to return around three weeks post-surgery. She reported that the coccydynia pain was significantly worse post-surgery, her pain was more constant and felt higher in intensity. She reported that post-surgery, when she would transition from sitting to standing the pain would linger for up to thirty minutes. She would be in pain while walking around, compared to prior to surgery the pain would dissipate immediately upon standing. She reported that after the surgery, she had some constipation issues. She started to put a large focus on diet to ensure regular bowel movements because if she was constipated, she noticed the tailbone pain with walking and standing as well as sitting. Whereas, with regular bowel movements,

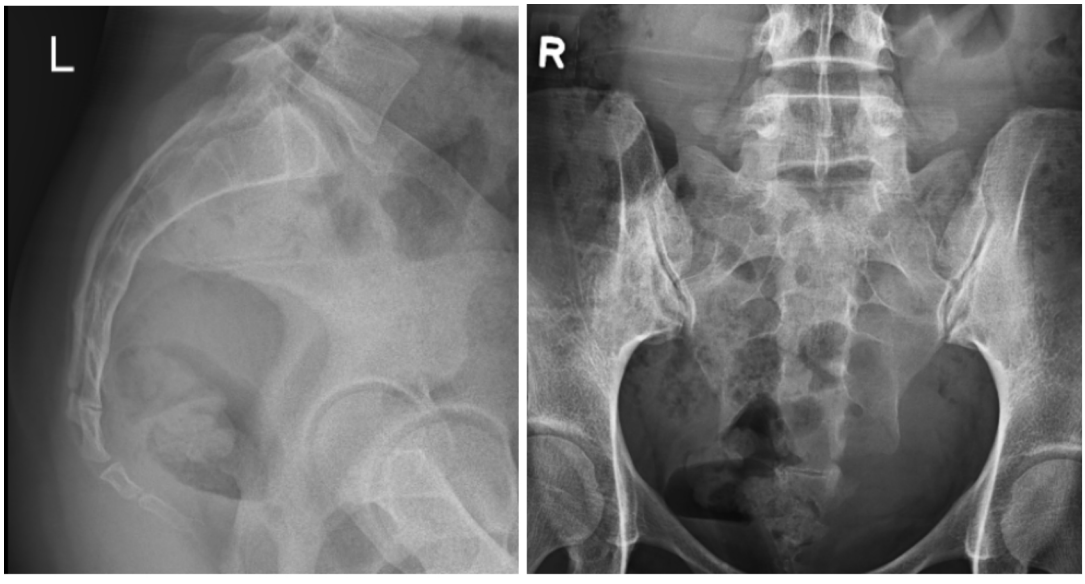

Figure 1.
On the left is a lateral view of the coccyx. On the right is an anterior-posterior view of the coccyx. All X-rays were read as normal. The patient was deemed to have a type 2 curvature by the classification first proposed by Postacchini and Massobrio and since modified by Nathan which classifies into six types.[19]

the pain was only experienced with sitting, however, it was still the worst it had ever been. She also noticed that she would get more pain with repetitive hip flexion. At this point, she decided to pursue conservative care for management.

Upon initial chiropractic assessment, she rated her pain on a numeric rating scale (NRS) to be between 4-8/10. Her Oswestry score was 34% indicating moderate disability. She rated on a visual analog scale (VAS) that the problem bothers her extremely, 10/10. She rated on a VAS that she is extremely motivated to correct the problem, 10/10. She reported feelings of frustration and fear that she will have to continue to take medications and have repetitive injections or have surgery. She also reported being fearful that she would not be able to return to cycling. Her main goals were to be able to sit through her son's hockey game without pain and to return to cycling.

She reported that leading up to the onset of her symptoms, and during the past year while living with the pain, she maintained a healthy lifestyle. She reported working out about five or six days a week with a mixture of cardio and strength training while maintaining a well-balanced diet with no dietary restrictions. She reported that after the onset of symptoms she avoided any movements that required pressure on her coccyx, including sit ups and minimal lower body strengthening. She reported that she is a non-smoker and would have an average of three or four drinks per month. She did not report any underlying health conditions or regularly take medications besides the anti-inflammatories prescribed for her coccydynia. Stress levels were reported to be medium due to having three children while working a full-time job, however, she reported that she has a supportive partner and family help. She reported that her sleep could be better but is now improving as her youngest is now sleeping through the night most of the time. Family history revealed that her father suffered from prostate cancer. The only previous injury reported was entrapment of the lateral cutaneous nerve of the thigh in her left hip two years ago that she received chiropractic treatment that focused on soft tissue release of the left iliopsoas muscle, with no recurrence of symptoms since. Menstrual cycle history revealed the age of menarche as twelve years old, and she reported that her cycle was regular, however, she could not recall the length of her cycle. She reported that she was on birth control for two years but discontinued in 2013. She went on birth control because of pregnancy prevention and acne control. She reported that she suffered from severe cramping and bleeding during her menstrual cycle, which she attributed to the tumor growing, which was the reason for her hysterectomy.

Chiropractic examination

Chiropractic examination was completed six days before the pelvic floor physiotherapy examination. Range of motion testing for the lumbar spine was within normal physiological limits. Hip range of motion testing revealed active left hip extension was limited by approximately 50% with no pain, passive left hip extension was pain free and within normal physiological limits with a spring like end feel. All other ranges were within normal physiological limits. Left hip extension strength was graded 4/5 and right was 5/5. Orthopedic testing for the lumbar spine showed a positive lumbar Kemps test on the right for discomfort in the low back but did not reproduce the chief complaint. Neural tension testing for sciatic, femoral and obturator nerves were unremarkable. Sacro-iliac joint provocative testing was unremarkable. Thomas test showed elevation of the thigh on the left, indicating shortening of the iliopsoas. Palpation revealed tenderness with pressure on the external surface of the coccyx, more so on the left side, that recreated the chief complaint. Muscle palpation revealed mild tenderness at the left gluteus maximus attachment on the sacrum and coccyx, but this did not fully recreate the chief complaint. There was also moderate tenderness with palpation of the iliopsoas on the left hip, but this did not recreate the chief complaint. The pain was recreated by doing a sit-up action from lying supine to sitting upright, as well as sitting. She has some mild pain recreated with rolling over and going from side-lying to sitting upright. All other orthopedic testing, including palpation of the hamstrings, adductors, and other hip flexors, was unremarkable. At the time of assessment, the patient was not evaluated in the cycling position or while seated on the saddle. Based on the functional findings, we may expect to see a posterior pelvic shift in attempt to offload the perineal region leading to excessive lumbar flexion and pelvic rocking due to muscular imbalances in the hip flexors and extensors.[21, 22] The diagnosis was chronic hypermobility of the coccyx that is aggravated by coccygeal flexion. Differential diagnoses included pelvic floor muscle spasm, luxation of the coccyx, discogenic

pain from the lumbar spine or intra-coccygeal articulations, and chronic pain syndrome. A referral was made to the pelvic floor physiotherapist to rule out pelvic floor contributions.

Pelvic floor physiotherapy examination

Observation revealed mild descent of the perineum with no visible prolapse. Visible contraction showed a strong contraction and ability to lift the perineum. External palpation revealed mild tenderness over both the left and right abdominal scars and tenderness over the coccyx, more on the left side, with a posterior to anterior pressure applied. More adhesion was noted around the umbilical scar but presented with less tenderness. Internal palpation revealed mild tenderness at the left iliococcygeus muscle with no reproduction of coccyx pain with any palpation of pelvic floor musculature. There was no pain with vaginal coccyx palpation when an anterior to posterior pressure was applied. Pelvic floor muscle strength with contract-relax testing was graded 4/5 with no pain. Connection to diaphragmatic breathing was unremarkable.

Pelvic floor physiotherapy treatment plan

The treatment plan was to refer for chiropractic treatment as it was deemed there was no pelvic floor involvement. A home exercise program was given to complete silicone cupping around abdominal scars, ice the tailbone as needed, and roll the gluteus maximus with a lacrosse ball, and a discussion of pelvic floor strengthening progression was given. No further pelvic floor physiotherapy appointments were made.

Chiropractic treatment plan

The full treatment plan can be found in Table 1. The chiropractor refrained from taking another set of X-rays to include seated X-rays as they felt it was unethical to expose the patient to more radiation. Considering rehabilitation programs should mainly be driven off clinical findings, and not imaging findings, the chiropractor designed a rehabilitation program based off clinical findings that matched cycling compensation patterns found in the literature.[21-37] The main clinical findings to determine diagnosis were: 1) reproduction of the chief complaint with posterior-to-anterior pressure on the coccyx, but not with anterior-to-posterior pressure; 2) reproduction of the chief complaint during a sit-to-stand motion; and 3) X-ray evidence of a type 2 coccyx, which is the most susceptible to hypermobility.[19,20] The diagnosis was chronic hypermobility of the coccyx that is aggravated by coccygeal flexion. The patient had been dealing with coccydynia for a year, and she failed conservative treatments that would normally have coccydynia resolved in four to 12 weeks.[38] Therefore, the treatment plan was expected to be almost double the amount of time. It was designed with progressive overload techniques and was split into five different phases, each phased was expected to last anywhere from four to six weeks using a linear periodization model.[39,40] The goal of the program was to progressively load the coccyx over time to decrease pain, increase stability and ultimately have the patient return to cycling.

The first phase was the "early rehab phase" which was planned to be three to four weeks long. The main goal of this phase was to decrease pain, build tolerance to sitting on soft surfaces, and to start activating the pelvic floor, core, and gluteus maximus as separate entities. Treatment included low-level laser therapy (LLLT) over the sacrum and coccyx, spinal mobilization to the lumbar and sacroiliac regions, and soft tissue to the gluteus maximus and psoas muscles on the left. The treatment frequency was once per week. Rehabilitation exercises included pelvic tilts, quadruped bodyweight single-leg hip extension, abdominal breathing, and bracing alongside pelvic floor relaxation and contraction. Sitting progressions included using the coccyx cushion to sit on all surfaces for the first week. Each week the patient was advised to try and sit for three to five minutes without the cushion on soft surfaces only and to try and increase this time each week. Milestones for progression were no pain with sitting on a soft surface for 15 minutes and no pain with rolling over, sidelying to sitting up. The patient was able to progress after four weeks.

The second phase was the "mid-rehab phase" which was planned to be four to six weeks in length. The goals of this phase were to decrease pain, start to build strength of the pelvic floor, core, and gluteus maximus as separate entities, and to build tolerance to sitting on soft surfaces for longer periods of time. Treatment was the same as the "early rehab phase" and the frequency started at once per week for two weeks, then went to once every two weeks. Rehabilitation exercises included pelvic tilt progressions with pelvic floor and gluteus maximus activation, resisted quadruped bodyweight single-leg hip extension, and dead

bugs with isometric hip flexion. Cycling was avoided until the patient was able to better tolerate sitting. Sitting progressions included using a coccyx cushion for sitting on soft surfaces after at least 15 minutes and trying to increase time without by three to five minutes each week. Milestones for progression were no pain with sitting on a soft surface for 30 minutes and no sharp pain or increase in pain with going from sitting to standing or from supine to sitting up. The patient was able to progress after four weeks.

The third phase was the "late rehab phase" which was planned to be four to eight weeks in length. The goals of this phase were to decrease pain, strengthen the pelvic floor, core, and gluteus maximus in double-leg functional movements, and build tolerance to sitting on hard surfaces. Treatment was the same as the previous two phases, but the frequency was once every two weeks. Rehabilitation exercises included weighted pelvic tilt bridges, Romanian deadlifts, goblet squats, and planks. Cycling was introduced in this phase using a recumbent bike, short sessions to start that were gradually progressed in length and bike resistance. Sitting progressions included using the coccyx cushion on hard surfaces once symptoms began, with trying to increase by three to five minutes each week. Milestones to progress included no pain with sitting on soft surfaces for more than an hour and no pain with sitting on hard surfaces for 15 minutes. The patient was able to progress after 4 weeks.

The fourth phase was "physical preparation for return to sport" and this phase was expected to last four to eight weeks. The goals of this phase were to continue to decrease pain, strengthen the pelvic floor, core, and gluteus maximus in single-leg functional movements, and to build tolerance to sitting on harder surfaces. Treatment was the same as the previous phases and frequency was once every two to three weeks. Rehabilitation exercises included single-leg bridges, single-leg deadlifts, gluteal dominant high step-ups, plank with resisted single-leg hip flexion, and side planks with hip abduction and adduction variations. Cycling was continued in this phase with the introduction of a regular bike seat on an indoor stationary bike. The patient was advised to start to build a tolerance to sitting on a stationary bike seat with very light resistance on the pedal stroke. Once they felt the onset of discomfort, they were advised to add a gel cushion and continue. Once the discomfort started again, they switched to the recumbent bike. Overall time spent total on the different bike surfaces, and total resistance on the bike both started low and gradually increased each week. Sitting progressions included using the coccyx cushion for sitting on hard surfaces after 15 minutes when the onset of symptoms started. Each week they were advised to try and go another three to five minutes longer without the cushion. Milestones to progress included no pain with sitting on a hard surface for 30 minutes and no pain with sitting on a bike seat for a total of 15 minutes. The patient was able to progress after four weeks. At this point, they were able to sit on hard surfaces with no issues and they were able to sit on a bike seat for a total of 15 minutes, with only getting pain with going in and out of the saddle on the bike seat.

The final phase was the "return to sport transition" which was expected to last six to eight weeks. The goals of this phase were to continue to decrease pain, to work on power and endurance of single-leg functional movements while still engaging pelvic floor, core, and gluteus maximus, and to build a tolerance to sitting on a bike seat. Treatment remained the same and the frequency lowered to once every three to four weeks. Rehabilitation exercises included elevated shoulders and feet single leg bridges, walking swing lunges, weighted gluteal dominant high step-ups, and mountain climbers. The tempo in this phase was changed to add more of an explosive emphasis during the concentric phase to mimic a powerful bike pedal stroke. Sitting progressions included only using the coccyx cushion when sitting on hard surfaces, if necessary, using a gel cushion or 4D padded bike shorts as needed, and slowly progressing to no longer needing the cushion on the bike seat and using 3D padded shorts. Cycling progressed to stationary bike only, slowly increasing time spent on the bike and resistance added each week. Once 60 minutes on the stationary bike was tolerated, the patient was advised that they could return to cycling on a road bike. They were advised to get their bike properly fitted and have the specialists help find the appropriate bike seat. The patient did not report what new type of bike seat was chosen but did report that they had purchased a new one. Milestones to be cleared for back to sport were no pain with sitting on a hard surface for an hour or more, no pain with sitting on a bike seat for 30 minutes or more total with no added cushion, and no pain from going to a sit to stand on the bike seat. These milestones were to be

hit using 3D padded bike shorts. The patient was able to return to sport after six weeks. Her Oswestry score was 2% indicating very minimal disability. She continues to be able to participate in sport with minimal issues, she will receive chiropractic treatment as needed when she feels some discomfort in the area. This will tend to happen intermittently after longer rides, which happens once every six to eight weeks on average, however her pain levels have not returned to a level that interferes with her sport or activities of daily living.

Discussion

Cycling involves a complex interplay of muscle recruitment patterns and joint mechanics, particularly in the lower body. The cycling motion can be divided into three phases: the propulsive or power phase (downstroke), the pulling or recovery phase (upstroke), and the pushing phase, where the foot is pushed forward at the top dead center of the pedal stroke.[25] The coactivation of agonist and antagonist muscles, such as the psoas major (PM) and gluteus maximus (GM), is key in optimizing power transfer while protecting major joints from injury.[25] Interestingly, greater muscle-specific hypertrophy of PM compared to rectus femoris or sartorius has been demonstrated in competitive cyclists compared to untrained men.[26,27] Although PM has been well established as a hip flexor in the literature, it also has other roles such as a flexor of the lumbar spine on the pelvis[28], a lateral flexor of the lumbar spine[29], a stabilizer of the lumbar spine[30-33], and a stabilizer of the hip[34-37]. All of the proposed actions of PM are of consideration during the motion of cycling.[26-28, 34-37] The PM is the only muscle that connects the lumbar spine to the lower limbs and is an important contributor to both trunk, pelvis and lower limb biomechanics.[26,27]

The GM also plays a crucial role in force generation, pelvic stabilization, and efficient power transfer during cycling.[21,25] The GM is most active during the pushing phase of the pedal revolution, with its range of action occurring between 340° and 130° of the cycle.[21,25] During this phase, the GM generates net hip extension torque, delivering energy to the entire limb, then subsequently transferred to the crank via net ankle torque, facilitating the propulsion of the bike.[21,25] At higher cycling intensities, the GM demonstrates the greatest increase in activation compared to other lower limb muscles, highlighting its role as the primary initiator of force.[21,25] With higher intensity, the body adopts a more forward-leaning position to generate maximal power output.[21] This forward position involves greater lumbar and elbow flexion, and significant changes in thoracic lean angle, however the hip joint angle remains the same.[21] The increased forward lean lengthens the GM, enabling it to produce greater force.[21] Increased GM activity may also aid in stabilizing the pelvis, ensuring efficient force transfer across the hip joint and reducing strain on surrounding structures.[21]

Increased lumbar flexion posture is not only adopted at higher intensities but also as a compensatory mechanism in the presence of muscular imbalances and limited hip range of motion (ROM).[21] Common compensations observed with restricted hip ROM include pelvic rocking, excessive lumbar flexion, and lateral knee deviation, all of which can disrupt proper biomechanics and contribute to discomfort or injury.[22] These same compensatory patterns could be attributed to the PM, given the actions of PM on the trunk and lower limb.[28-37] Additionally, in the case of saddle discomfort, riders will shift their weight posteriorly onto the ischial tuberosities to reduce pressure on the perineum, leading to increased lumbopelvic flexion.[22] This posture, along with pelvic rocking, may result in greater pressure on the coccyx.[22] The female sex is at higher risk to pelvic-related pain secondary to these compensation patterns due to the posterior location of the sacrum and coccyx and the characteristics of the ischial tuberosities.[6-9] Depending on the coccyx orientation, these compensations may put the coccyx at higher risk of luxation, hypermobility or damage to the intra-coccygeal articulations and discs, with the type two coccyx orientation being the most susceptible.[14,15,19,20]

Currently, rehabilitation protocols for chronic coccydynia are sparse within the literature. This may be due to most cases of coccydynia resolving within weeks to months with or without conservative treatment, but for some patients, the pain can become chronic and debilitating.[16] The documented conservative treatments are relatively simple and they are sufficient in most cases.[16] These include coccygeal or donut cushions for sitting, modifying sitting postures, heat or cold therapy, and nonsteroidal anti-inflammatory drugs (NSAIDs).[16] The only physiotherapy exercise that has been reported to show benefit is pelvic floor physiotherapy focusing on the relaxation of the pelvic floor when pelvic floor muscle spasms have been identified as a contributing factor.[16] For chronic coccy-

dynia, injections of local anesthetic with steroids around the coccyx are used for both diagnostic and therapeutic purposes.[16] These injections are often used to help identify patients who might benefit from a coccygectomy.[16]

This case outlines a rehabilitation protocol for chronic coccydynia that aims to increase the stabilization of the coccyx through exercise. Based on the anatomy of the coccyx and the patient's presentation upon physical exam, it was hypothesized that the patient's lack of hip extension on her left side and the observed shortening of the PM on her left side may be a sign of weakness and compensation of the muscles stabilizing the pelvic region. Considering her pelvic floor examination was unremarkable, it was again hypothesized based on anatomical review that weakness in the left GM may be a driving factor. Considering the contributions of the PM to the biomechanics of cycling[26,27] and the fascial connections to the pelvic floor[4], it was again hypothesized that the PM and the GM may synergistically work together to help stabilize the coccyx during cycling and other methods of physical activity. Based on the information above, if there was weakness in the left GM, a compensatory pattern would be to increase lumbar flexion and pelvic rocking.[21,22] Lumbar flexion is an action of PM and pelvic rocking could be in part to increased lateral flexion through contraction of the ipsilateral PM.[28,29] Hypothetically, this compensatory pattern and the increase in force production of the PM can pull up on the pelvic floor at the same time as the seat presses on the coccyx without the GM being able to adequately work as an antagonist to this action. These biomechanical compensations may increase mechanical stress on the coccyx and contribute to symptom provocation during cycling. The rehabilitation exercises were prescribed to retrain the movement patterns on the hip. The main goal was to increase the strength of the hip extensors, particularly the GM, while synergistically activating the pelvic floor and PM. The resistance, repetitions and tempo were progressed to work on power and endurance, similar to the demands of the sport of cycling.[25] The design of the protocol was similar to other rehabilitation protocols which aim to increase the dynamic stability of the lumbar spine[41], cervical spine[42], shoulder[43], and more.

Summary

Coccydynia is a condition that can significantly impact daily activities and athletic performance, yet it remains underexplored in the context of athletic populations, particularly female cyclists. Here, we presented the case of a 34-year-old female with chronic coccydynia, likely due to dynamic instability of the pelvis and coccyx, along with other contributing factors, such as previous pregnancies. In this patient, notable muscle imbalances were found between GM and PM with associated restricted hip extension. Her pain was attributed to cycling as the onset was first noted while sitting on a bike seat, it did not start near the date of her pregnancy deliveries, and her pelvic floor musculature was deemed unremarkable. Cycling requires precise biomechanics and coordinated muscle recruitment to optimize performance and minimize injury risk.[25-27] Key pelvic stabilizers, such as the GM and PM, play a critical role in transferring forces from the trunk to the lower limbs, propelling the bike forward effectively.[21,25-27] Compensatory cycling patterns can expose the perineal region to increased compressive forces which can lead to instability of the coccyx, especially in females, who are at higher risk for the development of coccydynia due to the wider ischial tuberosities and more posterior location of the sacrum and coccyx.[6-9,21,22] This case report outlines a successful rehabilitation protocol that aimed to increase the dynamic stability of the pelvis and coccyx using progressive overload techniques.

Limitations

The authors recognize that there are limitations to this case report such as poor interrater reliability and validity of certain assessment techniques used. A proper biomechanical evaluation by the patient cycling would have added to the strength of this case report and unfortunately was not conducted. The evaluation of cycling mechanics was solely completed through review of the literature, and it was hypothesized that the patient had compensatory patterns based off clinical findings off the bike. As with all case reports, there is an inherent limitation in that the findings cannot be broadly generalized. Rather, their purpose is to highlight observations and to encourage further research in the field, which is the intended aim of this report. Another limitation is the lack of a control group therefore it is difficult to conclude that the improvements seen were because of the rehabilitation program, or of natural history. Considering the length of time the patient had the coccydynia and the relief provided with steroid injections; the next medical step would have been

surgery. It was the patient's choice to refrain from surgery and seek a second opinion on how to manage the condition conservatively. There was also a lack of confirmation of a hypermobile coccyx through sit to stand radiographs, which would be considered the gold standard, although repeating radiographs to confirm this is not recommended due to unnecessary radiation exposure.

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Table 1.
Detailed outline of the return to cycling protocol after chronic coccydynia used over a total of 22 weeks.

	Early Rehab
Goals of phase	Desensitization of pain Start to work on activation of pelvic floor, core and gluteus maximus as separate entities Build tolerance to sitting on soft surfaces
Approximate timeline progression	3-4 weeks
Functional milestone progressions	No pain with sitting on soft surfaces for 15 minutes No pain with rolling over, side-laying to sitting up
Manual therapy and modalities Frequency of treatment	LLLT over Sacrum/coccyx Spinal mobilization and Manipulation – Lumbar and Sacroiliac regions Soft tissue therapy Left gluteus maximus and psoas 1x per week

	Early Rehab
Rehab exercises Frequency/reps/sets/rest	Pelvic tilts: working on pulling up with the pelvic floor and relaxing the gluteal muscles in the posterior tilt position Quadruped body weight single leg hip extension: working on gluteus maximus activation without lumbar extension Abdominal breathing and bracing with pelvic floor relaxation/contraction Sets: 2-3 to be done 1-2x per day Reps: 6-8 with Tempo: 3-1-3-1 Rest: 30-60 seconds
Sitting Progressions	To use a coccyx cushion for sitting to relieve pressure on the tailbone on all surfaces Each week, sit for 3-5 extra minutes on a soft surface without cushion (couch, chair)

	Mid Rehab
Goals of phase	Desensitization of pain Start to build muscles of pelvic floor, core and gluteus maximus as separate entities Build tolerance to siting on soft surfaces
Approximate timeline progression	4-6 weeks
Functional milestone progressions	No pain with sitting on soft surfaces for 30 minutes No sharp pains with going from sit to stand or from supine lying to sitting up
Manual therapy and modalities Frequency of treatment	LLLT over Sacrum/coccyx Spinal mobilization and Manipulation – Lumbar and Sacroiliac regions Soft tissue therapy Left gluteus maximus and psoas 1x per week for 2 weeks 1x every 2 weeks
Rehab exercises Frequency/reps/sets/rest	Pelvic tilts: working on pulling up with the pelvic floor and relaxing the gluteal muscles in the posterior tilt position Quadruped body weight single leg hip extension: working on gluteus maximus activation – add resistance each week Dead bug isometric holds (pushing hand into knee): increase strain on hip flexors with pelvic floor relaxation/contraction Sets: 3 one time every 2 days (1 day of rest) Reps: 10-15 with Tempo: 3-1-3-1 Rest: 60-90 Sec
Sitting Progressions	To use a coccyx cushion for sitting to relieve pressure on the tailbone on most surfaces – start to add it on soft surfaces after 15 minutes Each week, sit for 3-5 extra minutes on a soft surface without cushion (couch, chair)

	Late Rehab
Goals of phase	Desensitization of pain Start to strengthen pelvic floor, core and gluteus maximus in double leg functional movements Build tolerance to siting on harder surfaces
Approximate timeline progression	4-8 weeks
Functional milestone progressions	No pain with sitting on soft surfaces for 60+ minutes No pain with sitting on hard surface for 15 minutes
Manual therapy and modalities Frequency of treatment	LLLT over Sacrum/coccyx Spinal mobilization and Manipulation – Lumbar and Sacroiliac regions Soft tissue therapy Left gluteus maximus and psoas 1x every 2 weeks
Rehab exercises Frequency/reps/sets/rest	Pelvic tilt bridges: working on pulling up with the pelvic floor into a pelvic tilt, while relaxing the gluteal muscles, then contracting the gluteal muscles to rise into a bridge – add weight to hips each week for the first 3 weeks – then increase ROM by elevating shoulders and/or feet Romanian deadlifts: engage pelvic floor and core at top – hinge – relax pelvic floor and reengage at bottom – lift Goblet squats: engage pelvic floor and core at top – hinge – relax pelvic floor and reengage at bottom – lift Planks: Focus on maintaining core, pelvic floor and gluteal engagement through breath Sets: 4 sets every 2-3 days (1-2 days of rest) Reps: 10-15 for the first 4 weeks with a Tempo: 3-1-3-1 For planks start with 30 seconds – increase time each week 10-15 reps for the last few weeks with a Tempo: 3-1-1-1 temp (increase speed on concentric phase) Rest: 60-90sec Begin to use Recumbent bike: Begin with short sessions (10-15 minutes), low resistance, and a comfortable saddle (use a padded or wide saddle). Increase cycling time/resistance gradually (start with 20 minutes, then 30 minutes, and so on) as tolerated.
Sitting Progressions	To use a coccyx cushion for sitting to relieve pressure on the tailbone on hard surfaces – start to add it once symptoms begin Each week try and go another 3-5 minutes without it on hard surfaces

	Physical Preparation for return to sport
Goals of phase	Desensitization to pain Start to strengthen pelvic floor, core and gluteus maximus in single leg functional movements Build tolerance to siting on harder surfaces
Approximate timeline progression	4-8 weeks
Functional milestone progressions	No pain with sitting on hard surface for 30 minutes No pain with sitting on a bike seat for 15 minutes total
Manual therapy and modalities Frequency of treatment	LLLT over Sacrum/coccyx Spinal mobilization and Manipulation – Lumbar and Sacroiliac regions Soft tissue therapy Left gluteus maximus and psoas 1x every 2-3 weeks
Rehab exercises Frequency/reps/sets/rest	Single leg bridges: working on pulling up with the pelvic floor and maintaining pelvic contraction while in single leg bridge – each week add weight to hips Single leg deadlifts: engage pelvic floor and core throughout movement – avoid opening through hips Glute dominant High step ups: engage pelvic floor and core throughout movement – maintain vertical shin and focus on pushing through centre of foot (maintain tripod contact) Plank with resisted single leg hip flexion (hold at peak hip flexion) & Side planks with hip abduction/adduction: Focus on maintaining core/pelvic floor engagement as leg moves Sets: 3 sets every 2-3 days (1-2 days of rest) Reps: 10-15 for the first 4 weeks with a Tempo: 3-1-3-1 Rest: 60-90sec Start to build tolerance to sitting on stationary bike seat – very light resistance for a few minutes as tolerated then switch and continue to use Recumbent bike: Begin with short sessions (10-15 minutes), low resistance, Try and use no cushion on seat Increase cycling time/resistance gradually (start with 20 minutes, then 30 minutes, and so on) as tolerated. Gradually increase time spent on stationary bike seat
Sitting Progressions	To use a coccyx cushion for sitting to relieve pressure on the tailbone on hard surfaces – start to add if needed after 15 minutes Each week try and go another 3-5 minutes without it on hard surfaces To use a gel cushion on bike seat OR padded bike shorts as needed on stationary bike

	Return to sport transition
Goals of phase	Desensitization to pain Start to work on power and endurance of single leg functional movements Build tolerance to sitting on a bike seat
Approximate timeline progression	6-8 weeks
Functional milestone progressions	No pain with sitting on hard surface for 60+ minutes No pain with sitting on a bike seat for 30+ minutes total without cushion No pain with going from sit to stand on bike seat
Manual therapy and modalities Frequency of treatment	LLLT over Sacrum/coccyx Spinal mobilization and Manipulation – Lumbar and Sacroiliac regions Soft tissue therapy Left gluteus maximus and psoas 1x every 2-4 weeks
Rehab exercises Frequency/reps/sets/rest	Elevated Single leg bridge: elevate both shoulders and feet to maximum ROM Walking swing lunges: each week increase weight High step ups: increase weight each week Weighted glute dominant high step ups: engage pelvic floor and core throughout movement – maintain vertical shin focus on pushing through centre of foot (maintain tripod contact) Mountain climbers: Increase time each week (start with 30 second intervals) Sets: 3 sets every 2-3 days (1-2 days of rest) Reps: 10-15 for the first 4 weeks with a Tempo: 3-1-1-1 Rest: 60-120 sec To start on Stationary bike: Begin with short sessions (total of 10-15 minutes seated), low resistance and in and out of saddle as needed Increase cycling time/resistance gradually (start with 20 minutes, then 30 minutes, and so on) as tolerated. Once 60 minutes is tolerated on stationary bike can progress to outdoor cycling. Switching between seated and standing positions on bike as needed. Ensure proper fitting on bike – advised to speak to bike fitting specialists to adjust seat as needed
Sitting Progressions	Try and sit on hard surfaces without coccyx cushion – only use as needed To use a gel cushion on bike seat OR padded bike shorts Slowly progress to no longer needing cushion on bike seat with time

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Multiligament knee injury and dislocation in a 17-year old football player: clinical focus on rehabilitation exercise and return to sport

Noah Lane, BSc (Hons.), DC, RCCSS(C) Resident[1]
George Austin Rees, BSc, DC, RCCSS(C) Resident[2]
Kevin D'Angelo, BSc (Hons.), DC, FRCCSS(C)[3]

Objective: *To highlight the rehabilitation exercises of a football player following surgical reconstruction of a multi-ligament knee injury (MLKI) with vascular compromise.*

Case Presentation: *A 17-year-old male high school football player sustained a traumatic MLKI requiring immediate limb saving surgery and subsequent tissue repair. Post-operatively, he engaged in an interdisciplinary phased and structured rehabilitation program with an emphasis on progressive loading, neuromuscular control and return-to-sport (RTS) readiness. At eight months post-op the athlete returned to a United States prepatory school where he transitioned to an external strength and conditioning program.*

Une lésion multiligamentaire et une luxation du genou chez un joueur de football de 17 ans : un focus clinique sur l'exercice de réhabilitation et le retour au sport.

Objectifs: *Pour mettre en évidence les exercices de réhabilitation d'un joueur de football à la suite d'une reconstruction chirurgicale d'une lésion multiligamentaire du genou avec un compromis vasculaire.*

Présentation de cas: *Un joueur de football au lycée âgé de 17 ans a subi une lésion multiligamentaire du genou traumatique nécessitant une chirurgie immédiate pour sauver le membre et une réparation tissulaire subséquente. Après l'opération, il a participé à un programme de réhabilitation structuré et interdisciplinaire en plusieurs phases, mettant l'accent sur le chargement progressif, le contrôle neuromusculaire et la préparation au retour au sport (RTS). À huit mois après l'opération, l'athlète est retourné dans une école préparatoire aux États-Unis où il a intégré un programme externe de force et de conditionnement.*

[1] Department of Graduate Studies, Canadian Memorial Chiropractic College
[2] Graduate Student, Sport Sciences RCCSS(C) SSRP Program
[3] FRCCSS(C), Private Practice

Corresponding author: Noah Lane, Canadian Memorial Chiropractic College, 6100 Leslie Street, Toronto, ON, M2H 3J1
Tel: 416-482-2340
Email: nlane.dc@gmail.com

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Summary: *This case report illustrates the complexities and value of an interdisciplinary and individualized rehabilitation program in the early stages of MLKI recovery. Outcomes were positive through eight months, but there were limitations related to the continuity of care that prevented long-term follow up.*

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KEY WORDS: multiligament-knee-injury, rehabilitation, return-to-sport, sports medicine, chiropractic

Résumé: *Ce rapport de cas illustre les complexités et la valeur d'un programme de réhabilitation interdisciplinaire et individualisé dans les premières étapes de la récupération après une lésion multiligamentaire du genou. Les résultats étaient positifs pendant huit mois, mais il y avait des limitations liées à la continuité des soins qui ont empêché un suivi à long terme.*

(JCCA. 2025;69(4):396-413)

MOTS CLÉS : lésion multiligamentaire du genou, réhabilitation, retour au sport, médecine du sport, chiropratique

Introduction

The knee is a complex joint within the body and is often associated with several pathologies that present in chiropractic offices and clinics. These acute injuries are most commonly experienced in sport-related environments, often only resulting in short-term management, and rarely require any surgical intervention.[1] Conversely, more serious injuries of the lower limb, such as acute MLKIs or acute knee dislocations (KDs), rarely present within traditional chiropractic settings. MLKIs are defined as complete injury to two or more of the four major ligaments of the knee: the anterior cruciate ligament (ACL), posterior cruciate ligament (PCL), medial collateral ligament (MCL)/posteromedial corner (PMC), and lateral collateral ligament (LCL)/posterolateral corner (PLC)[2], or acute KDs. As a result of the complexity and rarity of MLKIs, management may present a challenge to clinicians. However, with the growing involvement of chiropractors in sports medicine and the on-field care of amateur and professional athletes, exposure to more extreme injuries to the knee complex will become more prevalent. Therefore, it is essential that when these situations do present into practice, those within the profession have the clinical tools necessary to implement effective and timely patient care.

Acute knee dislocations are considered medical emergencies due to the potential of vascular and neurological compromise to the lower limb that can result in long-term disability. MLKIs are often associated with KDs and neurovascular injury, typically affecting the popliteal artery (PA) and the common peroneal nerve (CPN).[1] However, based on the timing, mechanism of injury, and high likelihood of spontaneous reduction, the knee may or may not be in a dislocated position, which can mask the potential dangers of this pathology and delay appropriate treatment.[2] This is of concern because approximately 40% of MLKIs and KDs have some degree of CPN palsy or vascular injury.[1] MLKIs involving dislocation – with or without vascular injury – require close monitoring, timely reduction, and often surgical management to preserve leg function. This necessitates proper triage from the attending clinician to determine the need for immediate orthopaedic intervention, as surgical treatment has been shown to lead to better outcomes than non-operative care.[1]

Although surgical considerations for MLKIs with associated vascular compromise is outside the scope of chiropractic practice, there is an important on-field role to potentially recognize, stabilize, and refer these patients accordingly. While there is currently no standardized treatment algorithm for MLKIs, and no consensus regarding the optimal timing of surgery, reconstruction versus repair, graft choice, and pre-operative rehabilitation[1], chiropractors working in sport can become an essential part of the health care team with regards to pre-rehabilitation for future reconstructive surgeries, post-surgical rehabilitation, return to sport training, and patient education. Our initiative in this paper is to highlight a case of a post-surgical MLKI with vascular compromise that presented to a sports specialist chiropractor. A brief literature

review outlining the clinical relevance of this pathology in the scope of conservative management will be provided to help identify barriers and goals when rehabilitating a complicated orthopaedic knee injury. In addition, this case report will highlight the paucity within the literature regarding the lack of specificity within current rehabilitation protocols with respect to the class of MLKIs with neurovascular compromise.

Case Presentation

A 17-year-old male wide receiver, competing in an elite college preparatory football program in the United States of America, sustained a severe and limb-threatening lower extremity injury while attempting to catch a pass in a game. Upon landing, his left knee went into hyperextension while experiencing a torsional force, resulting in a comminuted tibial plateau fracture and tibio-femoral joint dislocation. Some of the involved soft tissue injuries included complete tears to the PCL and both popliteus and biceps femoris tendons, a radial tear to the medial meniscus and partial tears to the LCL, gastrocnemius proximal heads and patellar tendon. After the on-field injury, he was rushed to a local emergency department where he underwent emergency fasciotomies (medial and lateral) to salvage his lower limb as he had developed injury and ischemia to the PA that required a left PA endarterectomy and patch angioplasty. At the time, no ligamentous reconstruction was performed. Radiographs following the left knee reduction and first surgeries are found in Figures 1 and 2. Two months after the initial injury, he returned to

Figure 1.
Lateral radiograph post left knee reduction and angioplasty. The arrow in this image is highlighting the tibial plateau fracture still evident following the emergency knee reduction and angioplasty.

Figure 2.
Anterior-posterior radiograph post-left knee reduction and angioplasty.

his permanent residence in Canada, where he underwent a secondary multiligament reconstructive knee surgery to repair the PCL, medial meniscus and PLC of his left knee (Figures 3 and 4). Immediately following reconstruction, he was given an initial rehabilitation protocol from his surgeon to complete (Table 1). At six weeks post-operative, he was referred to a sports specialist chiropractor for consultation and rehabilitation at the recommendation of his surgeon. In addition to helping facilitate a return to full range of motion (ROM) and strength in the surgical knee, the surgeon requested a focused strength and conditioning program to help the patient get back to his performance goals in a timely manner. The primary goal of the patient was to return to football at a high level, with aspirations of playing NCAA Division I.

A multimodal plan of conservative care was designed that included exercise, manual therapies, joint mobilizations and therapeutic modalities (microcurrent, transcutaneous electrical nerve stimulation [TENS], electroacupuncture) to help facilitate and optimize tissue healing and are highlighted specifically in stages 3-5 of Table 1 with relevant clinical findings (> 6 weeks post-operative care). These were included to meet the targets of the post-surgical rehabilitation plan and address the signifi-

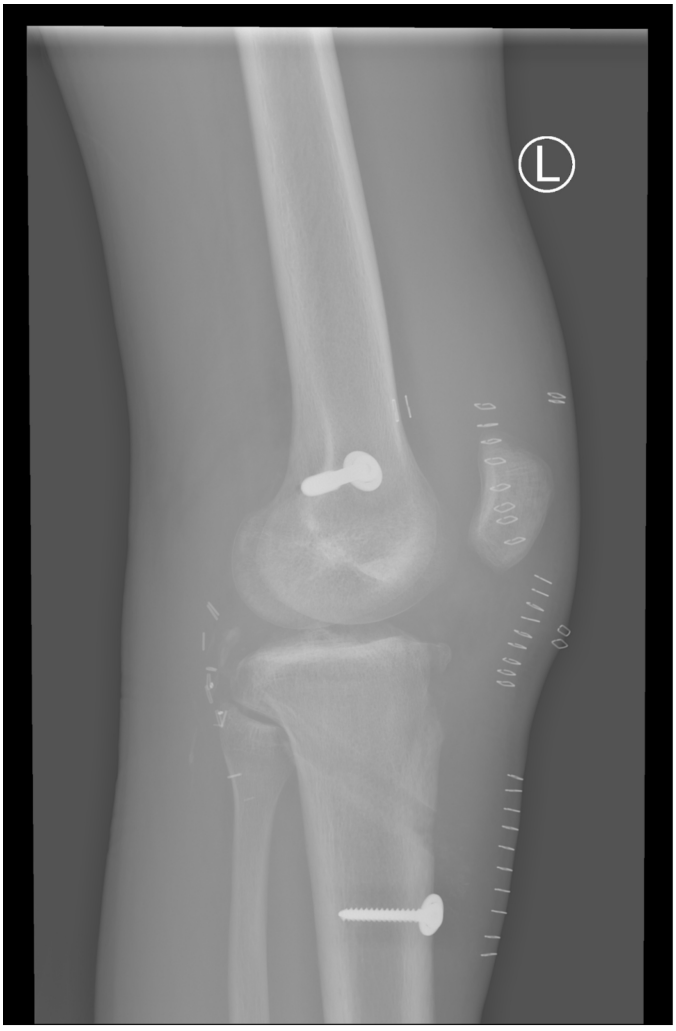

Figure 3.
Lateral radiograph post left knee multiligament reconstruction.

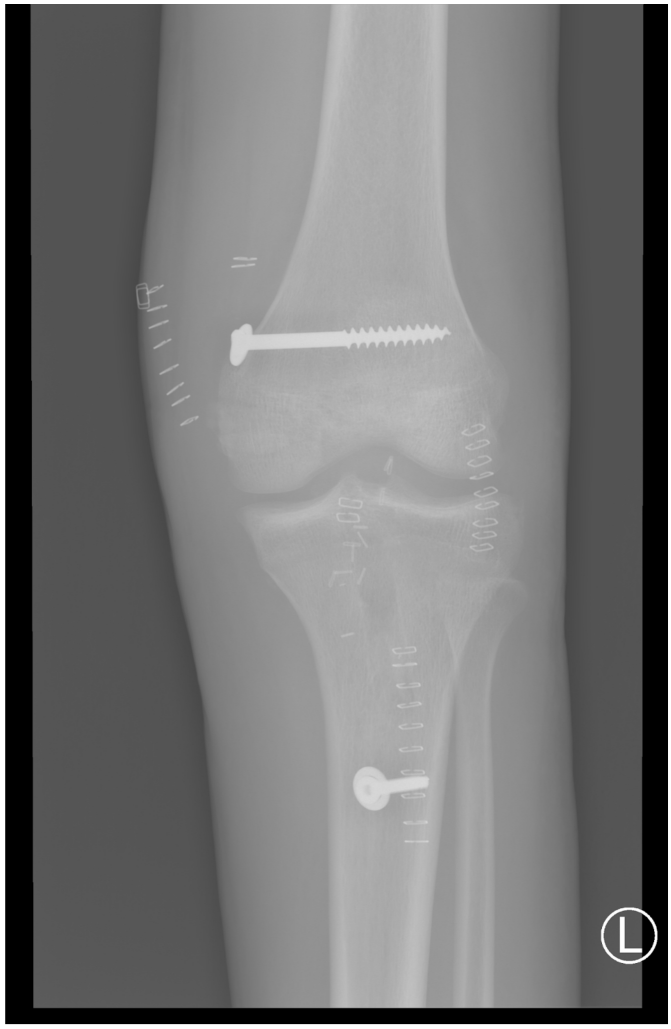

Figure 4.
Anterior-posterior radiograph post left knee multiligament reconstruction.

cant scarring left from the emergency fasciotomies and arterial repair. In stage 3 (weeks 6-12) the goals were to reduce pain and swelling, work towards full knee ROM, improve muscle strength and control while being mindful to protect the surgical grafts. Manual soft tissue therapies began in this stage involving the muscles of the lower extremity and scar tissue mobilization was prioritized for full patellar and tibiofemoral joint ROM. Modalities such as neuromuscular electrical stimulation (NMES) and electroacupuncture (low frequency stimulation, 2-4 Hz)[3] were used to help facilitate quadriceps activation. Instrument assisted soft tissue therapy, cross friction soft tissue therapy and high frequency electroacupuncture (210-270 Hz) were used to aid in scar mobility.[4] During this stage, the patient was seen twice a week where all of the passive treatment was completed prior to ending in the gym with exercise.

The goals of stage 4 (3-6 months) progressed to full patellar and tibiofemoral joint ROM and increasing strength and control of the lower extremity. Closed chain exercise and proprioception training was initiated at month 3 as detailed in Table 1. Many of the manual therapy techniques and modalities previously mentioned in weeks 6-12 were used here to maintain ROM and function of the lower limb.

During stage 5 (>6 months) goals were aimed to optimize knee ROM and strength while initiating a return to sport program. Whole body (compound) movements were utilized here to help integrate the affected left lower limb in more functional athletic movements and demands. In addition to Table 1 outlining the surgeon's recommendations with the detailed treatment therapies, Table 2 outlines the supplementary strength and conditioning program that was initiated.

Although there were several components in this plan of care, the purpose of this case is to highlight the complexity of the decision-making in MLKIs within the context of rehabilitation exercise. As such, the discussion will draw on how a clinician must evaluate several variables to optimize knee healing in the context of exercise program design in a high-performance athlete. Some of the variables that will be discussed are timelines for healing, functional anatomy of the knee, what movements are prioritized, and novel approaches to augment clinical outcomes.

Table 1.

Surgeon instructed post-operative physical therapy following multiligament reconstruction

Weeks 0-3. Goals: Decrease pain and swelling, protect surgical grafts, optimize early range of motion, initiate early muscle activation and strength

Category	**Protocol Details**
Weight Bearing	Touch weight bearing
ROM Goals	0-70° (prone)
Stability Precautions	No varus/valgus stress Protect posterior tibial sag
Bracing	ROM brace Locked at 0-70° flexion
Patellar Mobilizations:	Patellar Mobilizations: Multi-angle (cranial/caudal/medial/lateral glides) Positions: 0° , 30° , 60°

Category	Protocol Details
Local Modalities	Ice – 20 min every 2 hours Therapeutic ultrasound Interferential current/TENS – 20 min with therapy
Neuromuscular Electrical Stimulation (NMES)	Left quadriceps (full extension) – 20 min every 2 days
Strengthening	Quad sets (with NMES) Straight leg raises (SLR) – if full extension is achieved

Weeks 3-6. Goals: Reduce pain and swelling, protect surgical grafts, optimize early range of motion, initiate early muscle activation and strength

Category	Protocol Details
Weight Bearing	Partial weight bearing (25-30%) if full extension is achieved in brace
ROM Goals	0-90° (prone)
Stability Precautions	No varus/valgus stress Protect posterior tibial sag
Bracing	ROM brace Locked at 0-90° flexion
Patellar Mobilizations	Multi-angle (cranial/caudal/medial/lateral glides) Positions: 0° , 3° , 60°
Local Modalities	Ice – 20 min every 4 hours Therapeutic ultrasound Local scar massage Interferential current/TENS – 20 min with therapy
Muscle Stimulation (NMES)	Quads (full extension) – 20 min every 2 days
Strengthening	Quad sets (with NMES) Straight leg raises (SLR) – if full extension is achieved

Weeks 6-12. Goals: Reduce pain and swelling, protect surgical grafts, work towards full knee range of motion, regain muscle strength and control

Category	Protocol Details
Weight Bearing	Partial weight bearing, transitioning to weight bearing as tolerated over 2 weeks (protected in ROM brace)
ROM Goals	0-115° (transition to supine)
Stability Precautions	No varus/valgus stress

Category	Protocol Details
Case Clinical Findings: VAS PROM	Week 6: VAS 6/10 Week 12: VAS 2/10 Week 6: Extension 0°; Flexion 90° Week 12: Extension 0°; Flexion 135°
Bracing	ROM brace Unlocked while ambulating
Manual Therapies	Soft tissue therapy: directed towards the lower extremity (gluteals, quadriceps, hamstrings, gastrocnemius, soleus, extensor and peroneal muscles) Scar mobilization/treatment: • Instrument assisted soft tissue therapy • Cross friction • Electroacupucture (high frequency stimulation 210-270 Hz) Patellar Mobilizations: • Multi-angle (cranial/caudal/medial/lateral glides) • Unrestricted ROM
Local Modalities	Ice – post-therapy Electroacupuncture (low frequency stimulation, 2-4 Hz) directed towards the left quadriceps, hamstrings, peroneals
Muscle Stimulation (NMES)	Quads (full extension) – 20 min every 2 days Quads (30-0° closed chain) – 8-12 weeks
Strengthening	Quad sets (with NMES) Straight leg raises (SLR) – if full extension is achieved Open chain quads (no resistance) – 60-30° Closed chain quads – no deep flexion >60° (8-12 weeks) Open chain hamstring (eccentric, no resistance) – 60-10° (8 weeks) Hip abduction – standing, gravity eliminated
Proprioceptive Exercises	8-12 weeks
Cardio/Endurance	Stationary bike (no fixation of the distal chain)

3-6 months. Goals: Work towards full knee range of motion, regain muscle strength and control.

Category	Protocol Details
Weight Bearing	As tolerated
ROM Goals	Full ROM No varus/valgus stress
Case Clinical Findings: VAS PROM	6 months: VAS 1/10 6 months: Extension 0°; Flexion 150°
Bracing	Custom ACL/PCL brace
Local Modalities	Ice – post-therapy (as needed) Electroacupuncture (low frequency stimulation, 2-4 Hz) directed towards the left quadriceps, hamstrings, peroneals
Manual Therapies	Soft tissue therapy: directed towards the lower extremity (gluteals, quadriceps, hamstrings, gastrocnemius, soleus, extensor and peroneal muscles) Scar mobilization/treatment: • Instrument assisted soft tissue therapy • Cross friction • Electroacupucture (high frequency stimulation 210-270 Hz) Patellar Mobilizations: • Multi-angle (cranial/caudal/medial/lateral glides) Unrestricted ROM
Muscle Stimulation (NMES)	Quads (30-0° closed chain): ¼ squat holds
Stretching	ITB stretching – not for PCL/LCL
Strengthening	Open chain quads (no resistance) – 90-30° Open chain quads (light resistance <10 lbs) – 90-30° Closed chain quads – no deep flexion >60° Open chain hamstrings (eccentric, <10 lbs) – 60-10° Open chain hamstrings (eccentric, <10 lbs) – 90-10° Hip abduction (standing) – gravity eliminated
Proprioceptive Exercises	Single leg balance, ¼ to full Y-balance reaches
Cardio/Endurance	Stationary bike (no fixation of distal chain)

After 6 months. Goals: Work towards full knee range of motion, work towards full muscle strength and control, initiate a return to play program

Category	**Protocol Details**
Weight Bearing	As tolerated
ROM Goals	Full ROM
Bracing	Custom ACL/PCL brace
Local Modalities (as needed, varied per session)	Ice – post-therapy Electroacupuncture (low frequency stimulation, 2-4 Hz)
Stretching	ITB Stretching – not for PCL/LCL
Manual Therapies	Soft tissue therapy: directed towards the lower extremity (gluteals, adductor magnus, iliopsoas, quadriceps, hamstrings, gastrocnemius, soleus, extensor and peroneal muscles)
Strengthening	Closed chain quads – no deep flexion >60° Open chain hamstrings (eccentric, <25 lbs) – 60-10° Open chain hamstrings (eccentric, <25 lbs) – 90-10° Hip abduction (standing) – gravity eliminated Hip abduction (side-lying) *Table 5a: Initiated at 6 months
Proprioceptive Exercises	*Table 5a: Initiated at 6 months
Cardio/Endurance	Stationary bike (no fixation of distal chain) Pilates
Return to Sport Progression (surgeon criteria)	Running – 6 months Cutting/pivoting – 6-8 months Sports – <1 year
Restrictions (surgeon criteria)	No stationary bike/spin with distal chain fixed (until >6 months) No spin/bike with free flywheel (until > 4 months) No open chain hamstring (first 6 weeks) No plyometrics (until 8-12 months) No sports (until 1 year) No yoga (if not previously a sport/hobby until >1 year)

ROM: range of motion; Deg: degrees; TENS: Transcutaneous electrical nerve stimulation; NMES: Neuromuscular electrical stimulation; SLR: straight leg raise; ACL: anterior cruciate ligament; PCL: posterior cruciate ligament; LCL: lateral collateral ligament; MCL: medial collateral ligament; ITB: iliotibial band; Lbs: pounds; PNF: proprioceptive neuromuscular facilitation; KB: kettlebell; DB: dumbbell; BFR: blood flow restriction; CW: clockwise; CCW: counterclockwise; RDL: Romanian deadlift; 2L: two legs; 1L: one leg; KD: knee dislocation

Table 2.
Strength and conditioning protocol (>6 months)

Mobility Work

Exercise	Sets	Reps	Weight
Askling Extender's (patient laying supine, stabilizing thigh at 90 degrees hip & knee flexion, perform slow knee extensions until the point before pain)	3	12	N/a
Prone assisted knee flexion holds	2	3-4	N/a
Hip flexor split-stance proprioceptive neuromuscular facilitation (PNF) holds	2	3-4	N/a
Cat-camels	2	10-15	N/a
Hip 90/90 PNF holds	2	4-5	N/a
Scar/patellar mobilizations	N/a	3 minutes	N/a
Isometric 2-leg/single-leg hamstring bridge holds	3	4-5	N/a

*Pick minimum of 4 off of mobility/neuromuscular list

Neuromuscular Control

Exercise	Sets	Reps	Weight
Single Leg balance +/- BOSU, Wobble board	3	60 seconds	N/a
Single leg clock squats	10	1/leg	N/a
Y-balance reaches	3	10	N/a
Kettlebell Arm Bars	2	12	>10 lbs
Front Plank Shoulder Taps	3	10-12	N/a
McGill Modified Curl Up	3	15	N/a
Dead Bug	3	20	N/a

Workout A

Exercise	Sets	Reps	Weight
Goblet Squat KB/DB +/- BFR therapy	3	15	>45 lbs
Eccentric SL hamstring curls 3:1 T	3	12	Ankle weight
2L or SL glute bridge	3	10	N/a
DB/KB carry (reps as steps/side)	3	15	>10 lbs
Bear Crawl (reps as steps/side)	3	15	N/a
2L (SL) Hamstring curl on ball	3	12	N/a
DB/KB squat to single arm press	3	10	>15 lbs
Eccentric (3:1) lateral step down	3	12	>15 lbs

Workout B

Exercise	Sets	Reps	Weight
DB Chest Press on ball	3	15	>30 lbs
Inverted (TRX/bar) row	3	15	3:1 tempo
Step Ups (front/lateral)	3	10	>10 lbs
Stir-the-pot on ball	3	15	CW/CCW
KB swing (modify for knee pain)	3	15-20	>20 lbs
BOSU Squat Holds +/- BFR	3	12	>15 lbs
Kickstand or 2L elevated heel squat	3	20	Light weight
SL RDL +/- KB	3	12	~10 lbs

Workout C

Exercise	Sets	Reps	Weight
Front or Back Squat +/- BFR	3	15	>bar weight
Bird dog single arm row	3	12	>10 lbs
Static lunge (front/lateral/back) BFR	2	12	>bodyweight
Deadlift (Conventional or RDL)	3	10	>bar weight
Eccentric heel raises (drops)	3	12-15	3:1 tempo
Monster walks	3	15-20	N/a
Push up-plus on BOSU	3	15	N/a
Plank track on bench (front/sides)	3	45 seconds	N/a

Plyometrics and Cardiovascular Training

Exercise	Sets	Reps	Weight
Line jumping (2L>SL): front/back/side	2	30s	N/a
Cariocas, figure 8's, ladder drills			N/a
Box jumps	3	10-12	N/a
Stationary bike			N/a
Skipping (2L and SL)	3	1 minute	N/a

ROM: range of motion; Deg: degrees; TENS: Transcutaneous electrical nerve stimulation; NMES: Neuromuscular electrical stimulation; SLR: straight leg raise; ACL: anterior cruciate ligrament; PCL: posterior cruciate ligament; LCL: lateral collateral ligament; MCL: medial collateral ligament; ITB: iliotibial band; Lbs: pounds; PNF: proprioceptive neuromuscular facilitation; KB: kettlebell; DB: dumbbell; BFR: blood flow restriction; CW: clockwise; CCW: counterclockwise; RDL: Romanian deadlift; 2L: two legs; 1L: one leg; KD: knee dislocation

Discussion

Clinical presentation

The disruption of the primary and secondary stabilizers of the knee through various mechanisms of injury results in varying presentations and patterns of MLKIs. These injuries typically occur via high-energy mechanisms, and ultimately require a thorough physical exam to assess the extent of injury and determine the presence of secondary complications such as arterial or nerve involvement.[2] While 50% of KDs spontaneously reduce, it is crucial to identify KDs and have them reduced in order to mitigate morbidity. Moreover, it is recommended to assess patients presenting with MLKIs using the Adult Trauma Life Support principles, a trauma care method focused on treating the greatest threat to life first, and initiating the indicated treatment without a definitive diagnosis, or detailed history.[5] After following such procedures and principles, it is paramount to assess the neurovascular system to identify possible associated vascular or nerve injury. Data has shown that delayed treatment of vascular injury increases the probability of compartment syndrome and/or amputation by 20%.[2] Clinical examination of the vascular status of the limb alone using pedal pulse is often not sufficient or reliable enough to identify subtle vascular injury, and it is recommended to proceed with further examinations such as the ankle brachial pressure index (ABI) and potential referral for an arteriogram. This emphasizes the importance of appropriate triage and assessment of MLKIs to prevent further complications. In the case presented, the on-field medical team was able to execute the appropriate steps needed to rush the patient to the hospital. Evaluation in the emergency department determined significant vascular compromise in the injured limb, which ultimately led to a medial and lateral fasciotomy, a left popliteal artery endarterectomy, and patch angioplasty to help save his leg.

Imaging

In addition to a comprehensive physical examination, diagnostic imaging is required to assess the direction of dislocations, integrity of bones, and other signs pointing to the extent of injury and location. Radiographs are the first line in assessment, followed by magnetic resonance imaging (MRI) to assist in the diagnosis of MLKIs and creation of a specific treatment and rehabilitation plan.[6] The MRI aids in evaluating meniscal involvement, intraosseous contusions, possible fractures, capsule tears, specific ligament involvement, and determining the amount of graft that would possibly be needed for reconstruction[6]. The selective use of arteriography is shown to be a safe and prudent practice following knee dislocation. Arterial examination should include palpation and ABI evaluation of the dorsal pedis and posterior tibial arteries. ABI scores of <0.9 have been shown to have a sensitivity, specificity and positive predictive value of 100% for identifying vascular injuries in KDs.[7] Asymmetry in pulses, or an ABI below 0.9 in the injured limb would warrant immediate referral for an arteriogram.[1] In the absence of these findings, patients should be admitted for careful observation[6]. In the case presented, the severity of the injury required all the aforementioned diagnostic imaging to help triage intervention and aid in the management of the lower extremity ischemia.

Sports chiropractors are well positioned to manage the immediate triage of these injuries during on-field management, as their advanced training in musculoskeletal diagnosis and emergency care allows for rapid assessment, stabilization, and decision-making in high pressure environments. Understanding the role of imaging in MLKIs improves a clinician's ability to recognize or confirm clinical red flags, identify cases requiring immediate intervention and referral to ensure prompt and appropriate care. Additionally, the utilization of imaging provides clinicians with an accurate diagnosis that will drive clinical decision making during the rehabilitation process. Given the confirmed injuries to the tibial plateau, meniscus, PCL and PLC, many factors needed to be considered in terms of when and how to prioritize loading in the knee. These details can be found in tables 1 and 2, and will be discussed more in the following sections.

Functional anatomy of the knee joint

The knee joint relies on a combination of different passive and dynamic stabilizers to maintain joint congruency and function. The four primary stabilizing ligaments include the ACL and PCL, which help control anterior and posterior translation, respectively, while providing critical proprioceptive input.[8,9] The MCL stabilizes against valgus forces, and the LCL resists varus stress and assists in rotational control. Additional support is provided by the posterior oblique and arcuate ligaments, in addition to the dynamic stabilizers of the knee's such as the quadriceps,

hamstrings and pes anserine complex. The knees menisci further contribute to stability by providing improved joint congruency, load distribution and shock absorption.[10]

The MCL, which is a key medial stabilizer, consists of three layers: superficial, deep, and capsular.[11,12] Its primary function is to resist valgus stress and external rotation, with additional contributions from the semimembranosus, quadriceps and pes anserine muscles.[13] Similarly, the PCL and LCL work in conjunction to limit posterior translation and external rotation. The popliteofibular ligament and popliteus muscle play important roles in stabilizing the PLC, with the popliteus actively resisting external rotation forces.[14] While a PCL rupture can be functionally compensated for by secondary stabilizers like the quadriceps, damage to the PLC significantly increases instability, often requiring surgical intervention.[15,16]

Neurovascular structures within the knee, particularly the PA, tibial and CPN, are at high risk during severe knee trauma. The PA, constrained by the adductor magnus, is vulnerable to injury, with vascular compromise being a critical concern.[17] The CPN due to its superficial location over the fibular head is especially susceptible to traction and rupture in high-energy type dislocations, often resulting in poor recovery rates.[18] In this case, rupture of the PA required limb-saving surgery, with rehabilitation focused on restoring circulation and mitigating motor and sensory deficits[17-19] through the use of gentle ROM, electrical stimulation and neuromuscular re-education (Table 1).

Understanding the functional anatomy of the knee joint is crucial for clinicians in guiding rehabilitation and treatment decisions following MLKIs. Each ligament and stabilizing structure of the knee plays a specific role in controlling excessive movement in any given direction, being anterior, posterior, medial, lateral or rotational instability. Identifying the primary instability pattern, and the associated structures allows clinicians to tailor rehabilitation protocols to protect healing structures while promoting compensatory support from the secondary stabilizers. In cases of an injured PCL, the quadriceps complex and popliteofibular ligament can provide important posterior and rotational stability of the knee[15], influencing early rehabilitation exercises to help avoid any excessive posterior tibial translation. In complex cases where multiple structures are compromised, rehabilitation exercises must balance controlled loading to promote the healing of injured tissues while aiding in restoring strength, neuromuscular control and joint proprioception. This was particularly important in the case presented as complete tears occurred to the PCL and structures of the PLC. This was further made vulnerable by partial tears to supporting musculature of the knee joint. As a result, following the healing of the tibial fracture (6-8 weeks), early rehabilitation focused on regaining dynamic stability by encouraging muscular co-contraction without compromising joint congruency and graft integrity (Table 1: Weeks 6-12 and 3-6 months). By having a comprehensive understanding of the functional anatomy of the knee, it ensures a progressive return to function of the knee while minimizing the risk of any instability-related complications.

Rehabilitation for MLKI

MLKIs represent a large spectrum of injury pathology, evidently being less common than single ligament knee injuries. This provides a challenge in developing a consensus regarding diagnosis, and more importantly, management of these injuries. Post-operative rehabilitation and RTS protocols following multiligament knee reconstructions remain complex and individualized, specifically for high-level athletes.[20,21] Existing literature emphasizes the need for structured rehabilitation strategies that balance early mobility with the protection of reconstructed ligaments to optimize functional outcomes.[20,21] Key components of MLKI rehabilitation includes progressive weight-bearing, controlled ROM, neuromuscular re-education and gradual RTS.[20,21] There is however, significant variability in rehabilitation timelines, bracing suggestions/requirements, and specific criteria for reintegration into sport, further highlighting the continued challenges in standardizing care. The importance of early mobilization and challenges in establishing definitive protocols was highlighted by Monson *et al*.[20]

An initial period of restricted weight-bearing, controlled ROM exercises, and progressive strengthening were central to the rehabilitation plan of our patient, and incorporated elements highlighted in recent expert consensus statements[21], as well as the article by Monson *et al*.[20] Given his goal of competing in NCAA Division I football, the rehabilitation strategy was designed using current best practices and individualized considerations for the patient's return to high-performance sport (see Tables 1-2).

The findings from Monson *et al*. suggest early mobilization improves stability, ROM and functional outcomes when compared to prolonged immobilization.[20] The overall rehabilitation strategy focused on progressing from weight bearing restrictions and ROM limitations, to dynamic strengthening and proprioceptive exercises, in line with current evidence advocating for early mobility for functional recovery. These steps were necessary for early fracture healing and allowing sufficient time to protect the PCL graft and other compromised passive tissues of the knee joint. Additionally, the use of a custom ACL/PCL brace for protection during high-impact activities was mandated, consistent with expert consensus recommendations to brace for the first 18 months to safeguard the knee during the rehabilitation process[21]. For this patient, progression through rehabilitation stages was guided by defined criteria including minimum ROM milestones (Table 1). The patient met early phase targets within the expected timeframes, however delayed neuromuscular activation due to nerve involvement slightly prolonged the transition into dynamic loading and closed chain strengthening. Throughout the rehabilitation program, adherence to the brace was maintained and stage progression was carefully monitored to ensure graft protection and gradual functional improvements.

For this patient, RTS was staged with running anticipated at 6 months, cutting and pivoting at 6-8 months, and full participation in sport expected within 1 year from the injury date. These milestones reflect the best practices outlined in the literature, but have been tailored to the patient's specific needs and goals.[20, 21]

Stages and pacing for rehabilitation

The rehabilitation process in MLKIs is complex due to the nature of tissue damage, the need for careful protection of reconstructed ligaments, and the risk of complications including stiffness, instability, and muscle atrophy. Rehabilitation in these cases must be carefully paced to avoid exacerbating underlying issues while promoting healing and recovery.

The patient's vascular repairs and fasciotomies provide a unique aspect to the overall management. Typical fasciotomy incisions must extend along the full length of the affected segment of the limb which is necessary for thorough exploration of the affected musculature, as well as the major arteries and nerves in the area. In the rehabilitation of fasciotomies, typically a structured phase-based approach is important to optimize recovery and return function.[22] The outlined rehabilitation framework aligns with the recovery timeline of the patient in this case report, placing emphasis on early protection, progressive mobility, and gradual strengthening. Acutely post-operatively, PRICE principles play a role in minimizing swelling and post-operative complications. As healing continues, early ROM and soft tissue mobilizations can help maintain joint function, facilitating an easier transition to controlled resistance training, and proprioceptive and neuromuscular training in later stages.[22] Given the angioplasty and status of the PA, the surgeons involved in the management were consulted prior to using blood flow restriction therapy (BFR) to the lower limb in later stages of rehabilitation exercise.

Early rehabilitation phases, specifically in elite athletes, should focus on the prevention of common complications after knee trauma, including but not limited to joint stiffness and muscle atrophy. As highlighted in the literature, immobilization after MLKIs may result in decreased ROM, impaired joint stability, and delay recovery of muscle function, all of which can prolong rehabilitation and affect the athletes RTS.[20] Early mobilization within a controlled environment is the preferred approach, as it can accelerate recovery of function, specifically joint stability, and ROM.[21-23] This approach was closely followed with our patient. While the initial timelines were guided by the surgeon, early mobilization was initiated within the parameters and controlled passive ROM exercises and neuromuscular activation strategies began as soon as soft tissue integrity and vascular status allowed (Table 1).

The acute phase of 0-6 weeks post-op has a primary focus on protecting reconstructed ligaments and mitigating further damage, while restoring early function. The patient in this case was initially placed in a ROM brace with restricted weight-bearing, typical in the early phase of MLKI recovery. This allowed the patient to regain joint mobility while minimizing the risk of tissue compromise. During this initial period, prone knee ROM exercises with quadriceps activation should be initiated.[20, 21] These exercises aim to prevent joint stiffness, especially with PCL reconstruction, and ensure early quadriceps activation to avoid muscle atrophy and improve muscle and gait re-education.[24]

During the acute or tissue protection phase of rehabilitation, pain should be maintained below a 3/10 to prevent excessive stress on the healing tissues. Progression can occur as the pain and inflammation subsides, but any increase in symptoms lasting longer than 12-24 hours may indicate a premature overload of the tissues.[25] For patients recovering from PCL reconstruction, it is crucial to consider positions that place increased biomechanical stress on the compromised ligament. Hyperextension of the knee should be restricted for the first six weeks, and hamstring exercises should be avoided until week eight. This precaution is necessary due to the posterior tibial translatory forces that are exerted by the hamstrings in the absence of quadriceps co-contraction at 30 degrees of flexion.[20, 24, 25] The patient in this case also concomitantly sustained damage to their PLC and suffered a comminuted tibial plateau fracture. Rehabilitation considerations for these injuries do not differ from strategies described above, with an emphasis placed on early mobilization and graded exposure to load.[26-28] For early-stage rehabilitation (weeks 0-8) strengthening of the lower limb was limited to open-chain lower limb exercises to protect the osseous healing of the tibial fracture (Table 1). Additionally, clinicians should be mindful of the anchoring materials used during surgery, as soft tissue repairs secured with sutures are more susceptible to failure under early stress.[24]

As the patient progresses to the intermediate phase of post-operative recovery (6-12 weeks), rehabilitation can increase in intensity. Weight bearing can be advanced, and ROM goals expand to allow more functional movements. Surgeon clearance for weight bearing allowed for progression to both closed chain movements, and partial to full weight bearing (Table 1). The patient should begin integrating closed-chain exercises to strengthen the quadriceps while preventing excessive ligament stress.[21] In addition, the use of custom ACL/PCL bracing during higher-impact activities is important for protection of the surgically repaired tissues when transitioning to weight-bearing activities.[21] This stage additionally includes incorporation of proprioceptive exercise to regain neuromuscular control and improve proper movement patterns when returning to sport.

Advanced weight-bearing is defined as movements requiring greater eccentric control or a range of motion beyond 45 degrees of knee flexion.[24] These movements can begin as early as six weeks post-operatively, provided the patient has been cleared to bear weight without assistive devices. At this stage, a graded approach to weight-bearing load should be implemented.[20, 21-24] Initially, closed chain loading of the lower limb should not exceed 45 degrees of knee flexion. Advanced weight bearing was cautiously approached due to the tibial plateau fracture, and was initiated at week 8 (Table 1). Flexion beyond this point increases load on the PCL and activates the posterior stabilizers of the knee, whereas the ACL remains relatively unloaded.[29] While closed-chain movement was introduced at week 8 the patient was limited to a maximum range of motion of >60° of knee flexion. Tolerability of range was emphasized during the initial introduction of lower limb closed-chain loading (Table 1). Despite the patient in this case having full strength (graded 5/5 with manual muscle testing) in all isometric knee ROM at this stage, it was advised by the surgeon to proceed cautiously and avoid high knee flexion angles until week 12 post-operative given the complexity of the injury (Table 1).

The final phase (6-12 months post-operative) of rehabilitation should focus on sport-specific movements including cutting, pivoting, and sprinting. When introducing these higher intensity movements, it is crucial to monitor for signs of instability and discomfort. Through this phase, strengthening exercises should target functional muscle groups to help support dynamic movements. Plyometrics and complex sport-specific drills are to be incorporated gradually depending on the patient's recovery and status. RTS most importantly shouldn't be rushed and at this stage, management should include assessments of the patient's ability to perform high demand tasks and activities[20]. The integration of sport-specific movements programming (Table 2) was initiated at 6 months. The program included the following components: resistance, neuromuscular, cardiovascular, and mobility training.

Currently, there is no defined or validated RTS protocol for MLKIs. However, ACL RTS testing includes a variety of objective measures, such as quadriceps and hamstring strength, single- and double-leg jumping performance, change of direction (COD) ability, and validated subjective questionnaires.[20, 30, 31] PCL RTS criteria share similarities with ACL RTS, as assessments focus on the athletes strength, endurance, and functional movement patterns to determine readiness for RTS. Limb function has been extensively studied in ACL injury literature,

where functional hopping tests and isokinetic strength assessments are commonly recommended for RTS evaluation.[32] Additionally, single-leg hopping for time and the crossover hop test are valuable for assessing lower limb functional performance.[33] Traditional RTS testing for ACL injuries is typically conducted at three, six, and nine months post-injury.[34] Given the complexity of MLKIs and the potential soft tissue involvement, Monson *et al*.[20] proposed RTS metric testing at four, seven, and 10 months to better account for recovery timelines. Unfortunately, the subject returned to their respective collegiate team prior to completing RTS testing. In this case, steps were taken to prepare the athlete for sport readiness and testing preparedness with rehabilitation emphasizing unilateral strength, landing mechanics, and neuromuscular control of the lower limb (Table 2). Although the athlete was lost to follow-up prior to RTS testing, the utility of a proficient rehabilitation plan can be measured by its capacity to return an athlete to sport, therefore, discussing the implications and limitations of RTS testing is warranted.

The use of criteria-based testing aims to objectively clear athletes for RTS while minimizing the risk of reinjury. With 50% of ACL injuries occurring during single-leg landing or COD tasks[35], emphasis should be placed on unilateral loading mechanics. However, the validity of isolated objective performance measures in determining RTS readiness should be critically examined. In athletes with ACL reconstruction, asymmetrical joint mechanics have been observed despite symmetrical performance in jumping and COD tasks.[36, 37] These findings highlight the potential value of biomechanical assessment as an alternative measure of sport readiness, rather than relying solely on traditional performance metrics. As previously mentioned, the RTS battery testing is designed to clear an athlete's RTS while mitigating reinjury risk.[31] King *et al*. investigated reinjury rates in athletes following ACL reconstruction, assessing leg strength index (LSI) in the hamstring and quadriceps, jump height and length, and COD times.[38] Despite the findings from Kyritis *et al*.[31], where failure to achieve an LSI >90% increased reinjury risk, King *et al*.[38] demonstrated that even when this threshold was met, biomechanical abnormalities during jumping and COD tasks could still persist at the time of RTS. This suggests that the current standard of measuring symmetry may not be a strong predictor of sport readiness or reinjury risk mitigation.[38]

Although LSI was similar between the reinjury and non-reinjury groups in the study by King *et al*.[38], notable biomechanical differences were observed. In the sagittal plane during the double-leg drop jump, the reinjury group exhibited increased knee flexion, longer ground contact times on the surgical side, and a shorter vertical distance from the center of mass (COM) to the ankle. Additionally, during the COD tasks, the reinjury group demonstrated a less posterior COM position in planned COD movements and reduced anterior pelvic tilt during unplanned COD tasks. It has been suggested that a less posterior COM position is a strategy to reduce knee extensor moment during jumping and deceleration[38-41], and to decrease knee valgus moment during COD[39]. Interestingly, the study found no significant difference in knee valgus angle between the reinjury and non-reinjury groups, which contradicts previous reports identifying it as a risk factor for ACL reinjury.[38] These findings highlight the importance of movement context in the later stages of rehabilitation. A high-level rehabilitation professional understands the nuances of movement and the biomechanical compensations that may allow an athlete to meet objectively symmetrical RTS criteria while still exhibiting underlying deficits. This perspective may play a key role in mitigating reinjury risk[38] and represents a more comprehensive approach to both RTS and, more importantly, performance.

Limitations

This case report describes the rehabilitation process of a single patient that recovered from an MLKI, and the ability to generalize the findings from this case to a broader population is inherently limited due to the nature of a case report. While the rehabilitation plan was detailed, the observations and outcomes here are specific to this unique patient's injury pattern, surgical management, and access to care. Furthermore, continuity of care was disrupted at eight months postoperatively when the athlete returned to the United States preparatory school and transitioned to a different strength and conditioning program. As a result, we were unable to comprehensively track the patient's progress through the full rehabilitation timeline including the final return-to-play phases and decisions. Notably, the patient was red-shirted for his first year following the injury, while not competing in official games that season, he preserved eligibility while still training with the team. This allowed for a continued conservative progression

and an extended recovery period, though the impact of this decision on long-term outcomes could not be fully assessed.

Follow-up appointments and treatments occurred periodically during school holidays, which limited the ability to document longitudinal functional outcomes in the late-stage rehabilitation process. Additionally, while there were efforts to incorporate a collaborative interdisciplinary approach to managing this patient, the change in care environments as well as providers meant that the later stage rehabilitation may not have followed the initially established plan of care which may have influenced the patients long-term recovery trajectory in ways that cannot be accounted for in the scope of this report.

Summary

This case highlights the continued challenges in MLKI rehabilitation, outlining the importance of individualized treatment plans that consider the patients recovery and their long-term functional goals. However, as highlighted in a recent consensus statement[21], studies vary significantly in their protocols and guidelines for specific MLKI injury patterns. While current protocols provide general guidance, significant variation in rehabilitation strategies and the lack of high-quality, large-scale evidence means more research is needed to refine protocols and improve outcomes for athletes returning to sport.

While the early stages of rehabilitation focus on protection of the surgical repairs, the latter stages of rehabilitation should focus on strength, conditioning, and normalizing biomechanics. It is also critical to evaluate the goals and expectations of the patient. This can become particularly challenging in high performance sport where timelines and expectations are scrutinized. With the limited body of RTS literature on MLKIs in athletes, this case provides value as it presents MLKI rehabilitation strategies implemented by a sports chiropractor past the stage of post-surgical protocol, with the objective of returning to a high-level contact sport.

In MLKIs, the level of tissue damage and reconstruction of multiple ligaments requires a cautious and structured rehabilitation approach. The patient in this case not only suffered ligament damage, but also a tibial fracture and arterial damage which further requires management of swelling, circulation and healing in his early stages of rehabilitation, and necessitate attention to limb health in managing swelling and promoting blood flow.

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Platelet-Rich Plasma (PRP)/stem-cell therapy for a partial torn ulnar collateral ligament in a professional football player: case report

Noah Lane, BSc (Hons.), DC, RCCSS(C) Resident[1]
George Austin Rees, BSc, DC, RCCSS(C) Resident[2]
Kevin D'Angelo, BSc (Hons.), DC, FRCCSS(C)[3]

Objective: *Present a unique case of non-operative management of a partial ulnar collateral ligament (UCL) tear where the athlete was able to return to performance-based training in a brief six-week period.*

Case Presentation: *A 29-year-old male running back presented to a sports specialist chiropractor for post-injection management of a grade 2 partial tear of the right UCL treated with ultrasound-guided platelet-rich plasma (PRP) and stem cell injections. Physical exam testing found limitations in elbow range of motion (ROM) as well as positive orthopedic tests confirming*

Plasma riche en plaquettes (PRP)/thérapie par cellules souches pour une déchirure partielle du ligament collatéral ulnaire chez un joueur de football canadien professionnel : rapport de cas

Objectifs: *Présenter un cas unique de gestion non chirurgicale d'une déchirure partielle du ligament collatéral ulnaire (LCU) où l'athlète a pu reprendre l'entraînement axé sur la performance en une brève période de six semaines.*

Présentation de cas: *Un homme de 29 ans, vétéran demi-arrière de la Ligue canadienne de football (LCF), s'est présenté à un chiropraticien spécialisé en sports pour la gestion après injection d'une déchirure partielle de grade 2 du LCU droit traitée par des injections de plasma riche en plaquettes (PRP) et de cellules souches guidées par ultrasons. Les tests d'examen physique ont révélé des limitations dans l'amplitude articulaire (AA) du coude ainsi que des tests orthopédiques positifs confirmant une lésion au ligament collatéral ulnaire*

[1] Department of Graduate Studies, Canadian Memorial Chiropractic College
[2] Graduate Student, Sport Sciences RCCSS(C) SSRP Program
[3] FRCCSS(C), Private practice

Corresponding author: Noah Lane, Canadian Memorial Chiropractic College, 6100 Leslie Street, Toronto, ON, M2H 3J1
Tel: 416-482-2340
Email: nlane.dc@gmail.com

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a UCL injury including the milking maneuver, and dynamic valgus stress test.

Summary: *Management consisted of multimodal chiropractic care including active release therapy (ART), electroacupuncture and rehabilitation exercises. This patient's improved strength and function without surgical intervention highlights the possible role of biologic injections as a form of non-operative management when combined with multimodal care to accelerate recovery from UCL injuries in elite athletes.*

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KEY WORDS: platelet-rich-plasma, stem-cell therapy, ulnar collateral ligament, sports medicine, chiropractic

(LCU), notamment la manœuvre de traite et le test de provocation en valgus dynamique.

Résumé: *La gestion consistait en des soins chiropratiques multimodaux, notamment l'active release therapy (ART), l'électroacupuncture et des exercices de réhabilitation. La force et la fonction améliorées de ce patient sans intervention chirurgicale soulignent le rôle possible des injections biologiques comme forme de gestion non opératoire lorsqu'elles sont combinées à des soins multimodaux pour accélérer la récupération des lésions du LCU chez les athlètes d'élite.*

(JCCA. 2025;69(4):414-424)

MOTS CLÉS : plasma riche en plaquettes, soin par cellules souches, ligament collatéral lulnaire, médecine sportive, chiropratique

Introduction

The role of the medial ulnar collateral ligament (UCL) in stabilizing valgus stress at the elbow is often stressed and is at an increased injury risk among elite athletes, commonly in baseball, football and tennis.[1] It has been reported that approximately 45% of athletes who sustain injuries to the UCL return to play the ensuing season as reported in the NCAA.[2] Although the degree of injury happens along a spectrum from low-grade partial tear, to tears in >1 location[3], athletes sustaining full-thickness tears of the UCL are primarily managed operatively to restore stability and return to play[1]. Post-operative recovery for full-thickness UCL tears has been reported to take a minimum of nine months away from sport, leading to many implications for these elite athletes.[1] Non-operative management for athletes with partial UCL tears remains a less invasive and enticing first-line treatment, with reported recovery taking between 12 to 14 weeks.

Common nonoperative protocols for these injuries involves chiropractic care with the option of platelet-rich plasma injections (PRP), and more recently mesenchymal stem cells (MSC). There has been an increased interest in the use of biologic injections for the augmentation of UCL healing.[4] These biologics include the use of PRP and MSC. It is proposed that haematologically derived and cytokine-rich PRP facilitates angiogenesis and endothelial cell growth, conjunctively increasing blood flow and accelerating healing as a result.[4] Stem cells can be derived from adult or embryonic sources. The stem cell of interest is the mesenchymal stem cell which, based on environmental conditions can differentiate into osteocytes, chondrocytes, adipocytes, and tenocytes.[4] In North America, the most likely stem cell intervention is a minimally manipulated preparation more appropriately termed connective tissue progenitor cells (CTPs). It is theorized that the mechanism in which MSC therapy promotes healing may be due to the presence of numerous growth factors in the solution.[4] The purpose of this case report is to detail the nonoperative management of a male professional running back with a partial UCL tear who began his return to performance in a matter of six weeks. This case will outline the possible roles of chiropractic care and injections in helping athletes with partial UCL tears return to sport without surgical intervention. Furthermore, this case highlights the paucity in the literature regarding emerging biologic interventions. Although these interventions are gaining popularity, there remains a lack of high-quality and large-scale research confirming their efficacy, safety and long-term outcomes in athletes. The absence of strong evidence complicates decision-making for sports clinicians and strength and conditioning professionals responsible for developing treatment and recovery plans.

Case Presentation

A 29-year-old running back sustained a right grade 2 proximal UCL tear when his arm was suddenly hyperextended while making a block. This diagnosis was confirmed via diagnostic ultrasound prior to the playoff season and the patient was able to finish playing the rest of the season while equipped with protective bracing, which included a combination of zinc oxide tape strapping for the UCL (base) with an external compression sleeve. After the season ended, he sought out a sports physician who administered ultrasound guided PRP and placental stem cell injections to the right UCL. Two weeks after receiving injections, the patient presented to a sports specialist chiropractor for rehabilitation and treatment with primary complaints of sharp pain with terminal elbow extension and wrist supination. The pain was very local to the medial elbow without referral or paresthesia. The pain was rated on a subjective pain scale (VAS) as a sharp 8/10 with terminal elbow extension and supination, and a dull 4/10 at rest. There was no previous trauma to his right elbow before the injury, and no other remarkable findings to the upper extremity. The patient reported that they had tried some light isometric exercises but had not been back to strength training since the injection. Additionally, he reported that his elbow was consistently sore when sleeping at night. Systems review was unremarkable and the patient was very eager to get back to off-season training as soon as possible.

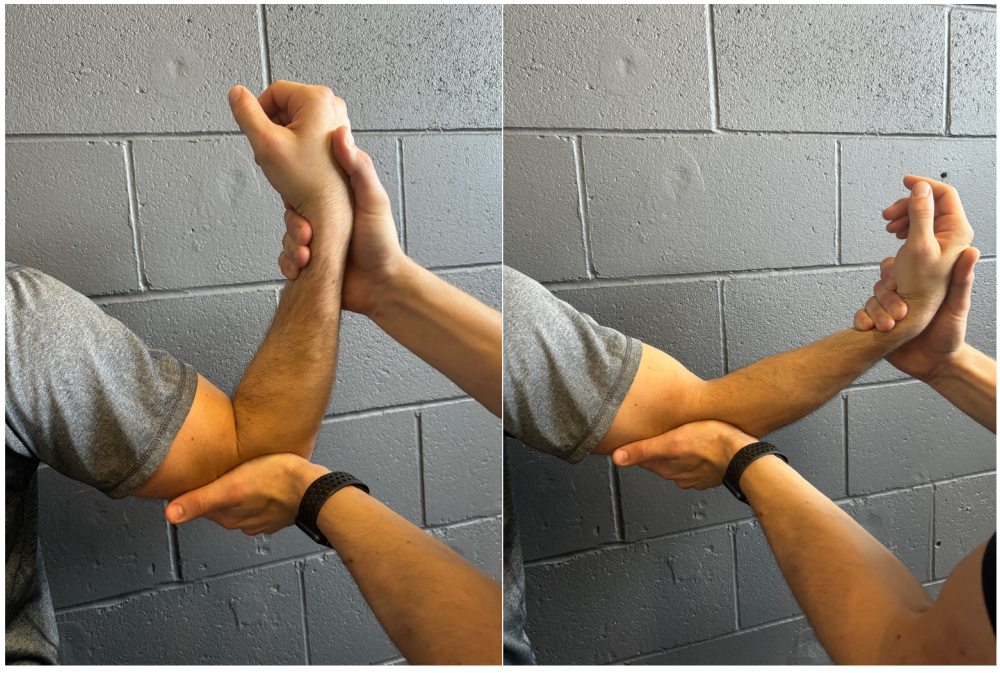

Figure 2.
Dynamic (or moving) valgus stress tests A valgus load is applied while flexing and extending the elbow.

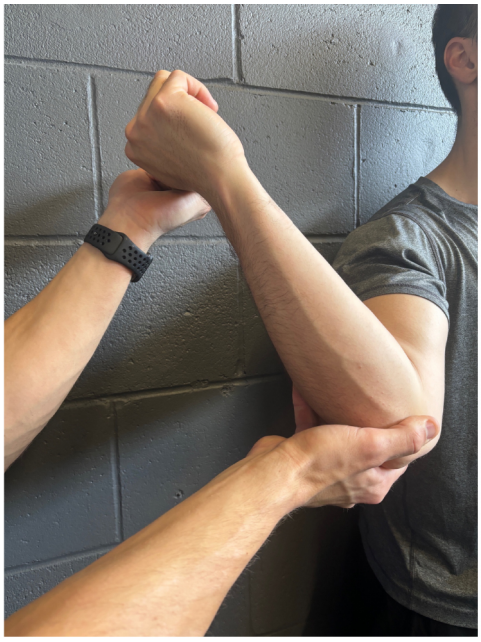

Figure 1.
Milking maneuver. The patient's thumb is pulled laterally with the shoulder & elbow flexed to 90 degrees and forearm supinated.

On physical examination, the patient presented with no discolouration, effusion or trophic changes in the right upper extremity. During palpation, the chief complaint was reproduced at the proximal and mid-body portion of the UCL. Range of motion testing using a manual goni-

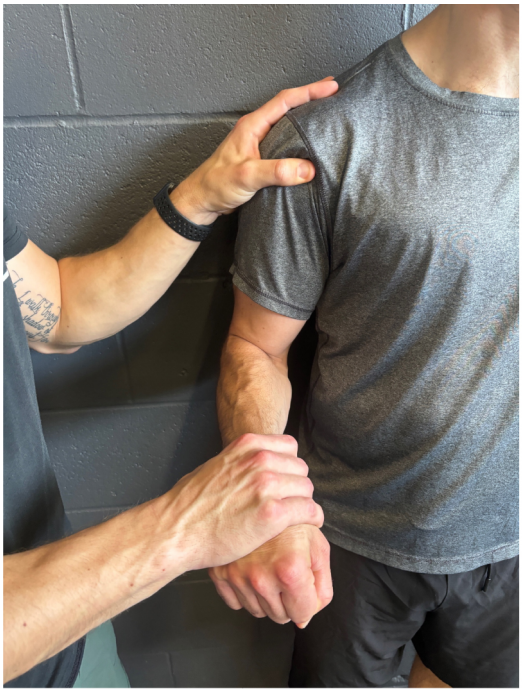

Figure 3.
Yergason's test. Patient externally rotates and supinates their arm against manual resistance from a 90-degree flexed and pronated position.

ometer[5] revealed passive supination and extension were painful at 8 degrees of elbow ROM, as well as pain at the medial elbow during end-range wrist flexion and pronation. There was pain produced over the medial elbow/UCL with active extension after 10 degrees of flexion and pain with active terminal elbow flexion. Resisted range of motion testing of the right elbow at 90 degrees of flexion found 3/5 strength in flexion, 4.5/5 strength in extension, 3/5 strength in pronation and 4.5/5 strength in supination.[6] Orthopedic testing revealed moderate discomfort with valgus stress to the right elbow with grade 1 laxity. Similarly, the milking maneuver (Figure 1), and the dynamic (or moving) valgus stress tests (Figure 2) both elicited grade 1 laxity with discomfort. These tests all reflect potential compromise to the anterior bundle of the UCL when there is no firm end point and reproduction of the patient's pain.[7]

Additionally, Yergason's test (Figure 3), produced medial right elbow pain with 3/5 strength. Palpation revealed hypertonic muscles of the right pronator teres, common flexor origin, distal biceps tendon and anconeus. Palpation of the right UCL, medial epicondyle, common flexor origin and both heads of pronator teres produced pain.

Management and outcome

A multimodal plan of management was started twice per week for the first two weeks, consisting of active release therapy (ART)®, Mulligan mobilizations with movement (MWM)®, contemporary medical electroacupuncture and rehabilitation exercise. ART was performed on the entire upper extremity with specific emphasis on the pronator teres, common flexor muscle origin, distal biceps tendon and anconeus. MWM was performed in all ranges to both the right glenohumeral joint and right elbow joint. The manual therapies incorporating both ART® and MWM® were utilized to help restore passive elbow ROM, normalize muscle tone, and increase blood flow and mechanical tension to the joint and surrounding connective tissues.[8,9] Medical electroacupuncture was administered using 0.22x50mm needles and an ES-130 stim unit to the motor points of pronator teres, flexor carpi ulnaris, flexor carpi radialis, flexor digitorum superficialis, biceps, common extensor origin and supinator. The parameters of the electrical stimulation included a varying intensity of low frequency stimulation (2-10 Hz) for 15-20 minutes. Early rehabilitation exercises are outlined in Table 1 which included wrist and elbow active ranges of motion with a green TheraBand® to patient tolerance, multi-angle wrist flexor and extensor exercises, TheraBand® or light dumbbell extensions at 90-degree elbow positioning, loaded closed chain high plank with active elbow supination/pronation and 90-90 isometric band holds. The purpose of exercise selection in the initial phase was to help improve neuromuscular coordination, modulate pain, and vary single and multi-joint loading scenarios in the upper extremity and torso. These strategies were modified from best current concepts in UCL reconstruction rehabilitation[5] with emphasis on accelerated loading and more advanced exercises due to the location, extent and stage of physiological healing.

Table 1.
Rehabilitation plan for partial proximal UCL tear – Stage 1 (Weeks 1-4 Post-Injection)

GOALS	• Pain modulation • Protect healing tissue • Prevent muscle atrophy	
REHABILITATION STRATEGIES	• Pain free isometrics locally at elbow • Continue loading pain-free ROM globally at adjacent joints: wrist, shoulder & scapula • Continue/progress with other full body strength and conditioning	
EXERCISES	**Sets & Reps**	**Notes**
Grip Strength Protocol a. Neutral wrist b. Flexed wrist c. Extended wrist	2 sets x 8-10 reps	• Performed with a grip ball • All sets and reps performed for each positioning (a, b & c)
Supine isometric tricep curl with TheraBand®	3 sets x 8-10 reps; 10 second hold each	• Green TheraBand (rated light strain from patient)
High plank with active elbow rotation (supination/pronation)	3 sets x 10 reps	• All reps should be pain free
Standing Shoulder external/internal rotation	3 x 12 reps	• Completed with heavy band on cable to fatigue
Shoulder 90-90 isometric external rotation with TheraBand®	2 x 10 reps; 10 second hold each	• Initialed with a green theraband and progressed to cable machine
Isometric barbell bench press with elbow positioned at 90°	3 x 8 reps; 12 second hold each	• Weight rack used to position barbell

During this initial plan of management, the patient had clearance to continue training from a sports physician while modifying upper body movements. These modifications included isometric loading parameters only when isolating elbow ROM, focus on closed-chain versus open-chain exercises for increased joint stability and relative light effort loading (<50% 1RM). These decisions were made to protect the healing UCL while trying to minimize disuse atrophy and arthrogenic inhibition in the surrounding tissues.[10] Due to his lack of pain, full ROM and improved strength after week 2, the patient was allowed to progress with more strenuous rehabilitation exercises and more formal strength, eccentric muscle capacity, and early power production at week 3 on. These exercises progressed over the six-week period where the athlete was under the care of the sports specialist chiropractor and are highlighted in Tables 2 and 3. An interesting finding in this case was the drastic change in elbow strength and perceived pain at week 3 compared to his initial examination where he was able to load the elbow with high strain movements with little to no pain or strength loss. His success with strength and conditioning continued to increase and he was back to full loading and performance testing in the offseason at six weeks. It is important to note the several variables and

Table 2.
Rehabilitation plan for partial proximal UCL tear – Stage 1(Weeks 4-6 Post-Injection)

GOALS	• Promote healing of repaired tissue • Regain and progress with muscular strength • Begin progressive overload principles • Continue with most stage 1 exercises	
REHABILITATION STRATEGIES	• Begin concentric/eccentric contractions where tolerated and at adjacent joints • Progress with both closed-chain and open-chain exercises for the upper extremity • Multi-joint coordination and strength production	
EXERCISES	**Sets and Reps**	**Notes**
Shoulder, elbow and wrist controlled articular rotations (CARS)	2 sets x 10 reps	
Bear crawl with isometric elbow extension	3 sets x 12 reps	• Progressed to full, multi-directional bear crawls
Single arm TheraBand® triceps extension (3010 tempo)	2-3 sets x 6-8 reps	• Progressed to higher load on cable machine
Multi-angle overhead TheraBand® isometrics with rhythmic stabilization	3 sets x 5 reps; 15 seconds of rhythmic stabilization	• Varying angles of shoulder abduction-external rotation
Supine triceps curls with dumbbells	3 sets x 10-12 reps	• 5-10lb dumbbells
Dumbbell hammer curls	3 x 12 reps	• 2020 tempo • 10 lbs dumbbells
Eccentric wrist curls (flexion/extension) with dumbbell	2 x 8 reps	• 3010 tempo • 10 lbs • elbow at 90°
Active supination/pronation with golf club	3 x 10 reps	• 3131 tempo • 2 sets with elbow bent; 1 set with elbow extended
Kettlebell arm bars	3 x 12 reps	• 30lb kettlebell bottom up
Isometric barbell bench press with elbow increasingly positioned >90°	3 x 8 reps; 12 second hold each	• Elbow increasingly positioned >90° with each set
Prone L Raises with dumbbells	3 x 8 reps	• 2-3lbs used

limitations with such findings in this particular case study which will be explored in the discussion. Nonetheless, this case highlights the need for sport-focused clinicians to be aware of a rapidly evolving field where biologic aids and advancement in regenerative medicine may augment the traditional timelines in some injuries.

Table 3.
Rehabilitation plan for partial proximal UCL tear – Stage 3 (weeks >6 post-injection)

GOALS	• Continue to increase strength, power and endurance of the upper extremity • Gradual return to post-season training and on-field drills • Re-test preseason (pre-injury) strength measures • Continue with most stage 2 exercises	
REHABILITATION STRATEGIES	• Increase muscle strength and endurance capacity • Reintroduce familiar in/off-season training exercises • Monitor for progress and accelerated RTP protocols	
EXERCISES	**Sets and Reps**	**Notes**
Eccentric floor press with dumbbells with external rotation	3 sets x 8-12 reps	• >110 lbs dumbbells • rep ranges to fatigue
Barbell bench press with releasers	3 sets x 8-10 reps	• 3110 tempo • Started week 5 at 135lbs • At week 8 at 400lbs
Eccentric pull ups with weight belt	3 sets x 8 reps	• 25lb weight belt
EZ bar triceps curls (skull crushers)	3 x 10 reps	• >90 lbs
Eccentric single-arm row with external rotation	4 x 8 reps	• >90 lbs

Discussion

Due to the UCL's primary role in resisting valgus stress at the elbow, athletes who participate in throwing sports are at an increased odds of sustaining injuries to the UCL.[11] In professional baseball, it has been reported that UCL injuries account for 10% of all injuries. The literature surrounding UCL injuries has focused on overhead or throwing athletes and the prevalence of these injuries in non-throwing athletes due to contact mechanisms has not been well developed. A 2019 study by Li *et al*.[11] compared the incidence, severity and outcomes of elbow UCL injuries in contact versus throwing athletes in the NCAA. Among 25 different sports across 5 seasons, men's football was reported as having the highest number of injuries, with 75% of injuries resulting from a contact mechanism of injury, primarily from a valgus load from blocking. Although football had the greatest number of injuries, injuries in throwing athletes were of greater severity and resulted in more time lost and a higher rate of surgery.[11] Although throwing athletes are more susceptible to UCL injuries via the throwing mechanism of injury, UCL injuries appear to be common in other sports due to contact mechanisms.

The rate of UCL reconstruction procedures have increased >300% from 2003 to 2014 without a consensus on an evidence-based treatment protocol for nonoperative management.[1] Surgical repair of the UCL has shown favourable outcomes for complete or partial tears, but typically requires between 10 to 16 months for a full recovery with additional risks of surgical complications such as fractures, inadequate healing, and nerve injuries.[12] With a typical season lasting 21 to 24 weeks, depending on the

timeline of injury, surgical repair of this patient's UCL would require them to miss anywhere from a few games to a full season, making nonoperative management of partial tears an attractive first-line treatment.[1] Conservative care is typically the first-line treatment at all levels of sport due to its non-invasive approach and established protocols for injury management. However, the method, expectations, and recovery timelines can vary depending on the athlete's level of competition. In adolescent athletes, conservative care is emphasized to prevent disruptions in development and minimize the risks associated with invasive procedures. Collegiate athletes often face a greater urgency to return to play, balancing the pressures of competition with the need to consider long-term health outcomes. For professional athletes, the focus is usually on the fastest and most effective recovery strategies, which may include a combination of conservative treatments and biologic interventions to expedite their return to peak performance. Although the athlete sought treatment in the offseason allowing a longer recovery period, there is great potential for biological injections with chiropractic care to improve timelines and expedite the return to play process. In this particular case, there was a significant increase in strength, ROM and lack of pain at six weeks which allowed an opportunity to resume performance-based training. It was at this point in the recovery period where almost all upper extremity loading was at pre-injury levels, such as consistently bench pressing 315 pounds for multiple repetitions. The bench press was a significant metric, apart from being a means to demonstrate overall load capacity of the elbow, it allowed direct comparison to pre-season and in-season testing levels. This is an atypical timeline to achieve such function with most partial UCL tears and presents an opportunity to study how variables such as biologic injections may help augment healing in combination with traditional care methods and will be discussed further in the paper.

There is a growing body of evidence showing positive outcomes with a conservative approach in certain cases of UCL injury.[12] As such, rehabilitation played an important role in this patient's recovery. A 2019 systematic review by Cascia *et al*.[12] highlighted the importance of a structured rehabilitation program in order to regain elbow stability and function. This athletes progress was monitored weekly and the rehabilitation program was modified to progress with the athlete's condition, aiding in a full recovery without surgical intervention. It is important for the primary sports clinician to monitor progress and rehabilitation on an individualized basis as healing is rarely linear. In this case, the functional abilities at three weeks post-injection were drastic. Given the numerous confounding variables and bias, much more research is needed to draw firm conclusions on best practices post-biologic injections and these injuries.

The UCL is predominantly avascular which may delay healing time and quality. Blood supply differs for the UCL, with the proximal portion of the UCL being well-vascularized, therefore, the location of the tear affects prognosis.[13] Distal UCL tears are more likely to require surgical intervention, while proximal tears may have success with non-operative management.[4,14] Recent research suggests that the use of MSC's provides tissues with important growth factors necessary for healing and tissue regeneration. An interesting aside should be mentioned, North American stem cell therapies use minimally modified solutions of stem cells. Bone marrow aspirate concentrate and adipose-derived are the most commonly used MSC formulations.[4,15] With placental and embryonic stem cell usage subject to additional ethical debate, adult bone marrow and adipose tissue remains a clinically available source.[15]

The yield from bone marrow aspirate reports a low concentration of stem cells.[16] Therefore, the effectiveness of MSC therapy is most likely due to the numerous growth factors found within the sample.[4]

Although outside the scope of this case report, from a re-injury standpoint, there may be beneficial considerations when deciding on the use of MSC as an adjunct to rehabilitation and/or surgery. Animal studies have histologically examined differences in healing. They have found an earlier increase in the concentration of Sharpey like fibres in the ACL's and patellar tendons (Patellar ligament) that were treated with MSC's. These fibres are more consistent with a ligamentous tissue, as they are seen predominantly in the areas where ligament begins to transition to bone.[17,18] Traditional ligament healing presents with the formation of dense fibrous scar tissue. Interestingly, the ACL's treated with MSC's had significantly higher failure loads and stiffness than controls at 8 weeks of healing.[17] Furthermore, from a clinical perspective, cost, risk, and benefit should be considered when suggesting the implementation of additional adjuncts of

therapy. Recent research on ACL healing in animal models with the combination of MSC's and PRP found indications of better osteointegration of the tendon graft versus control and PRP alone.[19] PRP is a relatively widely used therapy with a minimal risk profile[20], and PRP is an effective treatment adjunct for partial UCL tears[21]. There is evidence that PRP improves return to-play times and increases the rate of ligament reconstitution in high-level throwing athletes.[22,23] PRP has an excellent safety profile as it is prepared from autologous blood, making it innately safe. Pain and synovial reactions are common adverse reactions, with the rate of pain after a PRP injection not being higher than control injections.[24] While MSC therapy is less common, it is also regarded as safe for extra-articular administration.[24] Similar to PRP, common preparations of MSC's are autologous in nature. The most common side effect is pain and swelling at the site of the injection, with no serious adverse effects being observed.[25,27] In Ontario, neither PRP or MSC therapies are covered by public health. Presently, MSC's are not approved in Canada for the treatment of musculoskeletal pathologies.

The neurophysiological effect of manual therapy provides the rationale for the implementation of passive therapy within a conservative approach to a UCL tear's plan of management. Passive therapy can benefit the rehabilitation process by inhibiting pain via desensitization of pain receptors, decrease disability, and promote tissue healing.[28] Moreover, acupuncture can be an adjunct to further augment recovery by reducing pain and promoting recovery from exercise induced delayed onset muscle soreness.[29] There may be an additional benefit to the administration of acupuncture to induce vasodilation by stimulating both calcitonin gene-related peptide (CGRP) and nitric oxide (NO). Inducing vasodilation in the periphery can be beneficial in promoting healing.[30] In context to this case, there are several variables that may have rendered success in strength and reduced pain at both the three and six-week marks. With respect to ligament and connective tissue healing, these timelines correspond to the late proliferative and early remodelling phases of the healing process. Both manual therapies and modalities such as acupuncture play a role in biophysical stimulation of the tissues. They can promote blood flow and aid with the expansion of the extracellular matrix and collagen synthesis while also providing mechanical tension to enhance the integrity and density of collagen. At the same time, biologics such as PRP and stem cells have the potential to further augment the same phases of healing and potentially do so at a faster rate.[31] Although these processes can aid in healing, these known actions in tissue remodelling are not as potent before six weeks. With respect to the early success at week three, the peripheral and central neural adaptations to resistance training in allowing more force generation were more likely the main contributor.[32] In contrast, the marked success at the six-week mark is more difficult to explain as both neural and physiological adaptations to exercise and cellular processes augmenting tissue remodeling are both possible.

Limitations

There are several limitations that affect the generalizability and applicability of this case report. Notably, an MRI was not performed for the initial diagnosis of the UCL injury, limiting the accuracy of the initial clinical assessment. While musculoskeletal ultrasound has demonstrated sensitivity ranging from 0.86-1.00 for conditions such as UCL tears, the variability in imaging sensitivity may have impacted the accuracy of diagnoses in this athlete, potentially influencing treatment decisions and outcomes.[33] Furthermore, although follow-up imaging was reportedly performed after stem-cell and PRP treatment, we were unable to obtain or review these images or imaging reports. The lack of access to the imaging and reports restricts our ability to objectively evaluate the impact of the patients structured rehabilitation program in the athlete's recovery. Additionally, we were unable to receive specific details surrounding the stem cell treatment, more specifically, the type of stem cells used, whether they were autologous or externally sourced, or the dosage administered, all of which could have a significant impact on the treatment outcomes.

Regarding the orthopaedic tests used, the dynamic valgus stress test is currently considered the gold standard for diagnosing UCL injuries. It has demonstrated excellent sensitivity (1.00) and strong specificity (0.75), and has been shown to produced greater elongation of the UCL compared to static testing.[34] This test provides biomechanical evidence supporting its validity as an examination technique for UCL injuries. However, additional limitations are present for the other provocative tests used, such as the milking maneuver, which – while helpful in reproducing symptoms- lacks specificity and may

be confounded by other elbow pathologies.[35] MRI with articular contrast is still required to confirm UCL tears due to its superior sensitivity and specificity.[36] Lastly, Yergason's test, although commonly used for diagnosing biceps or SLAP lesions, lacks relevance in confirming UCL injuries, as its sensitivity (0.43) and specificity (0.79) for biceps pathologies do not provide adequate diagnostic utility for UCL-specific injuries.[37]

Summary

To our knowledge, this is the first case report which examines the use of PRP and MSC in a non-operative UCL intervention. Given the difference in repetitive strain and overall demand of the medial elbow in non-throwing athletes, PRP and MSC may be valuable adjuncts to the non-operative management of incomplete UCL tears in this athletic population. In professional sports, time is of the essence and stress is placed on the medical team to get an athlete back to play as fast as possible. Further research is needed to determine the benefits of combination therapy using traditional rehabilitation, PRP, and MSC on ligament healing time, return to performance, and to help inform sports clinicians on optimal rehabilitation strategies to help athletes return to play efficiently. Although there is significant bias with a single case report and multiple variables in such an intervention, the radical improvement in strength and functional parameters just three to four weeks after injection is notable and warrants more exploration in larger study populations.

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Chiropractic management of L5-S1 disc protrusion in an elite speed skater: a case report

Yeewon Chong, BChiroSc, MChiro, ICSC[1]
Henry Pollard, BSc, DC, Grad Dip AppSc, MSportSc, PhD, ICSSD[2]

Objective: *To describe clinical outcomes and return-to-play following multimodal chiropractic management of an elite speed skater with acute L5-S1 disc protrusion and S1 radiculopathy.*

Clinical Features: *A 20-year-old male elite speed skater presented with sudden-onset severe lumbosacral pain and S1 dermatomal symptoms during ice training. Assessment revealed positive straight leg raise at 40 degrees, diminished reflexes, and motor weakness consistent with S1 radiculopathy. Day 3 MRI confirmed mild L5-S1 disc protrusion with S1 nerve root impingement.*

Intervention: *McKenzie-based directional preference exercises with lumbar extension movements demonstrating centralization phenomenon. Treatment included progressive loading rehabilitation with sport-specific movement patterns through structured phases, McKenzie exercises performed 3-4 times daily (3-5 sets*

La gestion chiropratique de la protrusion discale L5-S1 chez un patineur de vitesse d'élite: un rapport de cas

Objectif: *Décrire les résultats cliniques et le retour au jeu à la suite d'une gestion chiropratique multimodale d'un patineur de vitesse d'élite présentant une protrusion discale aiguë L5-S1 et une radiculopathie S1.*

Caractéristiques cliniques: *Un patineur de vitesse élite âgé de 20 ans s'est présenté avec une douleur lombo-sacrée sévère d'apparition soudaine et des symptômes du dermatome S1 pendant l'entraînement sur la glace. L'évaluation a révélé un relèvement de jambe droite positif à 40 degrés, des réflexes diminués et une faiblesse motrice compatible avec une radiculopathie S1. La résonance magnétique du jour 3 a confirmé une légère protrusion du disque L5-S1 avec une compression de la racine nerveuse S1.*

Intervention: *Exercices de préférence directionnelle basés sur la méthode McKenzie avec des mouvements d'extension lombaire démontrant le phénomène de centralisation. Le traitement comprenait une réhabilitation par charge progressive avec des mouvements spécifiques au sport à travers des phases*

[1] Private Practice, Brisbane, Australia
[2] Durban University of Technology (DUT), South Africa.

Corresponding author: Henry Pollard, Durban University of Technology (DUT), South Africa
Email: drhenrypollard@gmail.com

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of 10-12 repetitions), and coordinated multidisciplinary care with physiotherapy, massage therapy, and strength coaching.

Outcome: *Complete return to competitive speed skating within 4.8 months with sustained participation without symptom recurrence at 12-month follow-up. Notable 5-second personal best improvement in week 9 of rehabilitation.*

Conclusion: *Conservative chiropractic management utilizing McKenzie-based protocols within a coordinated multidisciplinary framework achieved excellent outcomes in this elite athlete with lumbar disc herniation and radiculopathy, including successful return to competitive performance with enhanced outcomes.*

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KEY WORDS: intervertebral disc displacement, radiculopathy, elite athlete, speed skating, McKenzie method, exercise therapy, return to sport, chiropractic, multidisciplinary care

structurées, des exercices McKenzie effectués 3 à 4 fois par jour (3 à 5 séries de 10 à 12 répétitions), et des soins multidisciplinaires coordonnés avec la physiothérapie, la massothérapie et l'entraînement en force.

Résultat: *Un retour complet à la vitesse de patinage de compétition dans les 4,8 mois avec une participation soutenue sans récurrence des symptômes lors du suivi à 12 mois. Une amélioration notable de 5 secondes du meilleur temps personnel lors de la semaine 9 de réhabilitation.*

Résumé: *La gestion chiropratique conservatrice utilisant des protocoles basés sur la méthode McKenzie dans un cadre multidisciplinaire coordonné a obtenu d'excellents résultats chez cet athlète d'élite souffrant d'une hernie discale lombaire et de radiculopathie, notamment un retour réussi à la performance compétitive avec des résultats améliorés.*

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MOTS CLÉS : déplacement du disque intervertébral, radiculopathie, athlète d'élite, patinage de vitesse, méthode McKenzie, thérapie par l'exercice, retour au sport, chiropratique, soins multidisciplinaires

Introduction

The management of lumbar disc herniation (LDH) in elite athletes presents unique therapeutic challenges. Conservative treatment approaches, including multimodal non-operative management with exercise therapy, manual therapy, activity modification, and progressive loading protocols, yield successful return-to-play rates of 79% in athletes, with an average timeframe of 4.8 months from treatment commencement.[1] However, limited data exists regarding performance levels following return to competition, particularly in elite populations where biomechanical demands substantially exceed general athletic activities.

Recent systematic reviews demonstrate no significant difference in return-to-play rates between operative and non-operative management of lumbar disc herniation in elite athletes.[2,3] Professional athletes diagnosed with lumbar disc herniation successfully return to play at high rates with productive careers following treatment.[4] Nevertheless, the specific therapeutic protocols that optimize both return-to-play timeframes and post-injury performance remain underreported.

The McKenzie Method of Mechanical Diagnosis and Therapy (MDT) demonstrates effectiveness in treating lumbar disc herniation through exercises that promote disc centralization while avoiding peripheralization.[5,6] The centralization phenomenon, defined as the progressive migration of referred pain toward the spinal midline, serves both as a diagnostic indicator and prognostic factor for conservative management success.[7] However, application of McKenzie-based protocols in elite athletic populations with documented centralization has not been previously reported in the literature.

Elite athletes present unique management challenges due to extreme biomechanical demands, compressed recovery timelines for competitive preparation, and performance expectations that exceed pre-injury levels. Systematic review of the literature reveals no published

case reports documenting chiropractic management of elite athletes with acute disc herniation and radiculopathy achieving return to competition with performance enhancement. This evidence gap limits clinical decision-making for practitioners managing similar cases.

Speed skating imposes distinctive biomechanical stresses on the lumbar spine through prolonged flexion positioning combined with rotational forces and asymmetric loading patterns. These repetitive high-magnitude forces, particularly during training phases involving five to six sessions weekly for two to six hours per session, create substantial disc loading that may predispose athletes to annular disruption and subsequent radiculopathy.[8]

This case presents the application of conservative chiropractic management protocols within a multidisciplinary framework in an elite speed skater with documented progression from acute S1 radiculopathy to successful competitive performance with enhanced performance outcomes.

Case presentation

A 20-year-old male elite speed skater competed at Class 4 level under the Iwamoto sport-classification system (elite national standard). Clinical findings supported a working diagnosis of left L5-S1 disc protrusion with associated S1 radiculopathy, with pain intensity rated as severe (verbal NPRS 8/10) during weight-bearing activities.". The athlete maintained regular training schedules of five to six sessions weekly, averaging two to four hours per session, and had joined the national development program in May 2019 with ice training commencing in July 2019.

Medical History

The patient reported occasional mild mechanical lumbosacral pain described as dull and achy, which had never previously affected training capacity. No history of significant spinal trauma, fractures, or surgical interventions existed. Family and medical history were unremarkable.

Presenting Complaint

Sudden onset of sharp, intense left-sided lumbosacral pain with radiation to the superior gluteal region extending toward the lateral gluteal fold. Pain onset occurred during multiple skating drill repetitions mid-session, representing the most severe pain the athlete had experienced. He described inability to weight-bear normally and difficulty transitioning from seated to standing positions.

Clinical Findings

Initial on-site assessment revealed an antalgic lean toward the right with truncal forward flexion, requiring arm support to achieve standing position. Active lumbar range of motion was significantly restricted, with flexion limited to 30 degrees reproducing pain, left lateral flexion to 30 degrees, and extension to 10 degrees but remaining painless. Pain intensity was initially rated at 5/10 verbal Numeric Pain Rating Scale (vNPRS) but escalated to 8/10 within four hours post-injury, accompanied by worsening antalgic lean and development of left leg weakness requiring assistance for ambulation. Comprehensive neurological examination confirmed S1 radiculopathy with specific motor deficits, diminished reflexes, and positive neural tension signs. Detailed clinical events, assessment findings, interventions, and outcome measures at each time point are summarized in Table 1.

Diagnostic Assessment

Clinical findings supported a working diagnosis of left L5-S1 disc protrusion with associated S1 radiculopathy, with pain intensity rated as severe (verbal NPRS 8/10) during weight-bearing activities.

The differential diagnosis included L4-L5 disc herniation with L4 radiculopathy, excluded by preserved L4 myotome function (ankle dorsiflexion 5/5) and absence of anterior thigh dermatomal symptoms despite absent left patellar reflex; multi-level disc disease affecting both L4-L5 and L5-S1 levels, ruled out by MRI showing isolated L5-S1 pathology; and central disc herniation with bilateral neural compromise, made unlikely by the asymmetric symptom pattern, unilateral motor deficits, and imaging demonstrating unilateral subarticular protrusion. Mechanical low back pain, facet joint syndrome, piriformis syndrome, and sacroiliac joint dysfunction were excluded based on dermatomal referral patterns, positive neural tension signs, neurological deficits, absence of extension-related pain exacerbation, and negative Patrick-FABER testing.

The mixed neurological presentation (L4 reflex loss with S1 symptom pattern) reflects established clinical patterns. The patellar reflex tests spinal cord segments L2-L4; however, evidence demonstrates that altered

Table 1.
Timeline of clinical events and interventions

Time Point	Clinical Event/Assessment	Intervention	Outcome Measures
Day 0 (Injury onset)	Acute symptom development during ice training session	Training cessation	Immediate functional limitation requiring training cessation
Day 0 (4 hours post-injury)	Comprehensive assessment revealing S1 radiculopathy with severe pain intensity (vNPRS 8/10) during weight-bearing	Neurological examination; Provocative testing; Functional movement assessment	vNPRS escalated to 8/10; Antalgic lean worsened; Left leg weakness requiring assistance for ambulation; Symptoms improved to vNPRS 3-4 in recumbent position
Day 0 (Treatment initiation)	McKenzie assessment with prone press-up trials	Prone press-up exercises (11-12 repetitions); Three consecutive sets; Positioning recommendations (90/90 hip-knee flexion)	Centralization phenomenon demonstrated: Gluteal pain reduction from vNPRS 3-4 to 2; Proximal symptom migration
Day 3	MRI examination performed	Imaging assessment	Confirmed mild L5-S1 disc protrusion with left subarticular nerve root impingement
Weeks 1-4	Progressive symptom monitoring and functional assessment	Progressive McKenzie-based extension exercise protocol performed 3-4 times daily (3-5 sets of 10-12 repetitions each session); coordinated multidisciplinary care with frequency adjusted based on rehabilitation phase	Progressive symptom resolution; Pain levels reduced to manageable levels (vNPRS ≤ 3); Return to pain-free sitting and standing positions
Weeks 5-8	Continued rehabilitation and functional improvement	Sport-specific movement pattern introduction; Progressive loading rehabilitation; Strength and conditioning program modification with daily communication with coaching staff	Restoration of normal lumbar range of motion; Elimination of neurological deficits; Normal reflexes, motor strength, and sensory function restored
Week 9	Competitive return assessment	Multidisciplinary clearance for Canadian National competition participation; On-site vNPRS monitoring every 30 minutes during skating sessions	Return to Canadian National competition; Personal best improvement of 5 seconds achieved
Weeks 9-16	Graduated return to sport activities	Skating-specific movement patterns reintroduced with systematic loading tolerance assessment	Graduated return to ice training activities; Progressive loading tolerance achieved; Skating-specific postures tolerated
Week 19 (4.8 months)	Return to competition assessment	Full return to competitive training and competition	Complete return to elite-level competition
Month 12	Long-term follow-up	Continued competitive participation monitoring	Sustained competitive participation without symptom recurrence or performance degradation

knee jerk expression occurs in 30.3% of L5 monoradiculopathy patients.[9] This phenomenon involves impairment of proprioceptive drive from pretibial muscles to spinal premotor excitatory interneurons[9].

The consolidation of positive straight leg raise with S1 dermatomal distribution, diminished Achilles reflex, and imaging confirmation supported the S1 radiculopathy diagnosis despite some conflicting signs.

The clinical diagnosis was established through systematic neurological examination, provocative testing, and functional movement assessment. McKenzie-based directional preference testing demonstrated centralization phenomenon with lumbar extension movements[10], providing both diagnostic and prognostic information.

MRI examination performed Day 3 post-injury confirmed mild degenerative disc changes at L5-S1 with shallow broad-based disc protrusion in the left subarticular zone resulting in mild impingement of the descending left S1 nerve root.

The apparent incongruence between "mild" MRI findings and significant neurological presentation reflects established clinical patterns. Disc herniation of the same size may be asymptomatic in one patient and lead to severe nerve root compromise in another.[11] MRI accuracy for detecting disc containment demonstrates only 70% overall accuracy.[12] The mild imaging findings may inadequately represent the inflammatory cascade severity or individual anatomical susceptibility.

Conservative management and rehabilitation protocol

Conservative management utilizing McKenzie Method principles with emphasis on directional preference and centralization phenomenon formed the primary intervention approach.[10,11] Initial assessment confirmed lumbar extension as the preferred movement direction, with prone press-up exercises producing consistent symptom centralization and intensity reduction. The exercise protocol consisted of repeated prone press-up exercises performed to end-range lumbar extension, performed three to four times daily with 10 to 12 repetitions per set (3-5 sets each session). The specific repetition count was determined through real-time symptom monitoring as centralization typically occurred at the 11th to 12th repetition. Three consecutive sets were performed during the initial treatment session, demonstrating progressive symptom improvement.

Treatment frequency was applied within established clinical protocols: chiropractic visits twice weekly for the first four weeks then weekly thereafter, physiotherapy twice weekly including manual therapy and dry needling, massage therapy weekly, and daily communication with coaching staff for activity modification[13,14]. This frequency was based on clinical protocols for athletic populations requiring rapid return to competition while ensuring adequate healing time.

Treatment advanced through graduated phases incorporating postural education, movement re-education, and progressive loading strategies specific to speed skating biomechanics, as rehabilitation protocols for athletes with lumbar disc herniation must address the unique demands of sport-specific conditioning programs. Initial management included specific positioning recommendations such as 90/90 hip-knee flexion for symptom relief and activity restrictions to prevent symptom exacerbation while promoting disc healing, with progressive return to skating-specific positions implemented based on symptom response and functional capacity improvements. Treatment frequency and intensity were adjusted based on centralization response and functional improvement markers, maintaining the McKenzie principle of preferential loading in the extension direction throughout rehabilitation[15], with exercise progression guided by symptom behaviour.

Multidisciplinary Team Approach

Management involved collaborative coordination between chiropractic care, physiotherapy (including manual therapy, fascial release, and dry needling), massage therapy, strength and conditioning coaching, and skating coaching. The primary chiropractic intervention focused on McKenzie-based directional preference, while adjunctive passive therapies addressed secondary musculoskeletal restrictions. Critical to treatment success was the coordinated restriction of flexion-based training activities, with strength programming modified to maintain neutral spine positioning while targeting sport-specific energy systems. Daily communication between the primary clinician and head coach ensured ice training loads were adjusted based on the athlete's flexion capacity and symptom monitoring. On-site symptom monitoring using vNPRS scores every 30 minutes during skating sessions determined training continuation or modification. This integrated approach combining expertise in sports physiology, chiropractic care, physiotherapy, and strength conditioning enabled optimal loading management during the critical rehabilitation phases. Chiropractors provided directional-preference exercise prescription, spinal loading advice, and daily symptom monitoring, roles supported by previous sports-chiropractic integration models. Follow-up and outcomes are noted in Table 2.

Table 2.
Follow-up and outcomes summary

Time Period	Functional Outcomes	Pain/Symptom Measures	Neurological Status	Activity Level	Performance Measures
Within 24 hours	Restored ability to achieve standing position independently; Persistent antalgic lean present	Symptom centralization: vNPRS 3-4 to 2 (recumbent); vNPRS 7/10 during weight-bearing activities	S1 radiculopathy symptoms present; Motor weakness persisting	Activities of daily living limited; Weight-bearing restricted	No athletic activity; Training cessation
Weeks 1-8	Normal lumbar range of motion restored; Pain-free sitting and standing achieved; Independent mobility restored	Pain reduced to vNPRS ≤ 3 during ADLs; Centralization maintained; Symptom-free positioning achieved	Complete resolution of neurological deficits; Normal reflexes restored; Motor strength 5/5 bilateral; Sensory function normal	Full activities of daily living; Unrestricted mobility; Preparation for sport return	No competitive activity; Rehabilitation exercises only
Weeks 9-16	Skating-specific movement patterns tolerated; Progressive loading capacity; Sport-specific posture tolerance	Pain-free during skating movements; No symptom recurrence; Extension preference maintained	All neurological deficits resolved; Straight leg raise normalized bilaterally; No symptom reproduction	Graduated return to ice training; Progressive training loads; Sport-specific activities	Gradual return to training intensity; Movement quality assessment; Biomechanical optimization; 5-second personal best achievement at international competition, September 2019
4.8 months	Complete functional restoration; Full training capacity; Normal biomechanical patterns	Pain-free during all activities; No symptom recurrence; Normal pain responses	Complete neurological recovery; Normal reflex responses; Full motor function	Full training loads (5-6 sessions/ week, 2-6 hours/ session); Competitive participation	Return to elite-level competition; National and international competition; Pre-injury performance levels exceeded
12 months	Sustained functional capacity; No activity restrictions; Long-duration training tolerance	Sustained pain-free status; No symptom recurrence; Normal pain thresholds	Stable neurological status; No residual deficits; Normal examination findings	Unrestricted training and competition; Full competitive schedule; No modifications required	Sustained competitive performance; No performance limitations; Continued elite-level participation

Discussion

This case demonstrates successful chiropractic management of lumbar disc herniation in an elite athlete using McKenzie-based protocols within a coordinated multidisciplinary framework. The successful outcome achieving both rapid return-to-play and sustained competitive performance provides evidence for conservative management effectiveness in this population.

The McKenzie method demonstrates effectiveness in treating lumbar disc herniation through exercises that promote disc centralization while avoiding peripheralization.[10,11] The documented centralization phenomenon in this case provided both diagnostic confirmation and therapeutic direction, supporting the theoretical framework underlying directional preference treatment.

Recent evidence confirms that McKenzie-based interventions can produce measurable reductions in disc herniation size as documented through magnetic resonance imaging. McKenzie method enriched with manual techniques shows significant reduction in disc herni-

ation size on MRI, with 85% improvement in disability scores.[15]

Multidisciplinary Management Considerations

The successful outcome in this case highlights the importance of coordinated multidisciplinary care in elite athlete rehabilitation. The integration of chiropractic directional preference techniques with complementary passive therapies (massage, physiotherapy including dry needling and fascial release) addressed both primary disc pathology and secondary musculoskeletal adaptations. Crucially, the collaborative approach between healthcare providers and coaching staff enabled sport-specific load modification while maintaining training specificity for competitive preparation.

The achievement of a five-second personal best improvement at a Canadian National competition in week 9 demonstrates that appropriate multidisciplinary management can not only facilitate safe return to competition but can potentially enhance performance outcomes. This improvement was potentially achieved through the removal of suboptimal functioning associated with a chronically deteriorating disc lesion. This suggests that the systematic approach to load management, combined with targeted therapeutic interventions, may optimize both injury recovery and competitive readiness.

Conservative versus Surgical Outcomes

Current systematic reviews demonstrate no significant difference in return-to-play rates between operative and non-operative management of lumbar disc herniation in elite athletes.[16] This case supports conservative management as a viable first-line approach, particularly when centralization phenomenon is present.

The 4.8-month return-to-play timeline aligns with established averages for conservative management in athletic populations, demonstrating that non-operative approaches can achieve timely return to competition. Athletes with lumbar disc herniation show 79-82% return-to-play rates with conservative treatment, with average career lengths of 3.4 years post-treatment.[4,17]

The athlete's positive response to multidisciplinary chiropractic care can be attributed to several factors: the documented centralization phenomenon (studies show 58-91% prevalence of centralization in lower back pain, with 67-85% displaying directional preference for spinal extension)[7,18], age-related healing advantages; inflammatory resolution through natural disc resorption mechanisms[16]; and the extension-based approach successfully countering speed skating's prolonged flexion positioning demands.

Given the athlete's age (20 years), documented centralization response, and complete neurological recovery, the prognosis is favourable for sustained athletic participation. McKenzie method demonstrates sustained improvements in pain and disability at 12-month follow-up.[17,18] Recent systematic reviews show no significant difference in return-to-play rates between operative and non-operative management in elite athletes, supporting the conservative approach utilized.[15]

Study limitations

This single case report limits generalizability to broader athletic populations. Follow-up assessments at 4.8 months and 12 months were conducted via verbal confirmation of symptom-free status due to pandemic-related restrictions, limiting comprehensive physical re-examination. The multidisciplinary nature of care makes it difficult to isolate the specific contribution of individual interventions to the overall success. Future research should include control groups receiving alternative treatments, objective functional assessment tools specific to speed skating performance, blinded outcome assessors, standardized treatment protocols with defined progression criteria, and multiple treatment sites.

Clinical implications

The successful outcomes achieved through this conservative management support multimodal management approaches containing McKenzie-based protocols within multidisciplinary frameworks as effective first-line treatment for lumbar disc herniation in elite athletes. This approach is particularly indicated when centralization phenomenon is present.

Future research should focus on identifying predictive factors for conservative management success and developing standardized protocols for specific athletic populations. Controlled studies comparing conservative and surgical approaches in elite athletes would provide valuable evidence for clinical decision-making. Additionally, investigation into the optimal coordination of multidisciplinary teams and the specific contributions of individual

interventions within comprehensive care models warrants further study.

Unique Contribution to Literature

Systematic literature review reveals this represents the first published case report documenting:

- Chiropractic management of acute disc herniation with radiculopathy in an elite national-level athlete
- McKenzie-based centralization phenomenon application in speed skating biomechanics
- Complete return to elite competition with documented performance enhancement following acute disc herniation
- Detailed multidisciplinary protocol coordination between chiropractic care and elite athletic training programs

This evidence gap has limited clinical decision-making for practitioners managing similar cases. The documented protocol provides a replicable framework for conservative management in elite athletic populations.

Patient Perspective

The athlete was highly satisfied with the conservative multidisciplinary McKenzie approach, particularly valuing the active self-management component. Understanding the rationale behind exercises enhanced adherence and recovery confidence. Education about symptom centralization provided reassurance during early treatment when pain remained high, and the ability to control symptoms through movement reduced injury-related anxiety. The coordinated team approach provided confidence in the comprehensive nature of care delivery and facilitated clear communication regarding training modifications and progression.

Summary

This case demonstrates that conservative chiropractic management utilizing McKenzie-based principles within a coordinated multidisciplinary framework can achieve excellent outcomes in elite athletes with lumbar disc herniation and radiculopathy. The successful return to competitive performance within 4.8 months with enhanced performance outcomes including a 5-second personal best achievement supports multidisciplinary chiropractic management as an effective first-line approach for appropriate cases.

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Schwannoma causing chronic medial calf pain in a recreational skiing and running athlete: a case report

Madlaina Gruber, DC[1]
Christopher White, DC, MSc[2]
Glenn Cashman, DC, MSc, FRCCSSC[2]

Background: *Soft tissue masses in the extremities of athletes present commonly in clinical practice. Clinicians focusing on musculoskeletal care will be familiar with common causes such as myofascial trigger points, hematomas and even lipomas, but may overlook less common causes such as benign or metastatic tumours. This paper describes a case of a schwannoma, a benign nerve tumour.*

Case Presentation: *A 28-year-old recreational athlete presented with a five-year history of progressive calf pain and a palpable nodule unresponsive to conservative care. Imaging revealed a well-circumscribed intramuscular mass with vascular features. Surgical excision and histopathology confirmed a schwannoma. Postoperatively, the patient returned to full activity with resolution of pain.*

Un schwannome causant des douleurs chroniques au mollet médial chez un athlète de ski et de course récréatif : un rapport de cas

Context: *Les masses de tissus mous dans les extrémités des athlètes se présentent couramment dans la pratique clinique. Les cliniciens se concentrant sur les soins musculosquelettiques seront familiers avec des causes courantes comme les points de déclenchement myofasciaux, les hématomes et même les lipomes, mais peuvent négliger des causes moins courantes comme les tumeurs bénignes ou métastatiques. Ce document décrit un cas de schwannome, une tumeur nerveuse bénigne.*

Présentation de cas: *Un athlète récréatif de 28 ans s'est présenté avec un antécédent de cinq ans de douleur progressive au mollet et un nodule palpable non réactif aux soins conservateurs. Les examens d'imagerie ont révélé une masse intramusculaire bien circonscrite avec des caractéristiques vasculaires. L'excision chirurgicale et l'histopathologie ont confirmé un schwannome. Après l'opération, le patient est revenu à une activité normale avec une résolution de la douleur.*

[1] Private practice, Vancouver, BC
[2] Private practice, Burnaby, BC

Corresponding author: Madlaina Gruber, 1022 Regency Place, Squamish, BC V8B 0N2 Canada
Tel: 236-512-1023
Email: drmaddygruber@gmail.com

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Summary: *This case underscores the necessity of maintaining a broad differential and reinforces the importance of reevaluating diagnoses when conservative interventions fail. Early recognition and referral for imaging are critical to avoid prolonged mismanagement.*

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KEY WORDS: athletic injuries, chronic leg pain, intramuscular mass, peripheral nerve sheath tumor, schwannoma, soft tissue mass

Résumé: *Ce cas souligne la nécessité de maintenir un large éventail de diagnostics différentiels et renforce l'importance de réévaluer les diagnostics lorsque les interventions conservatrices échouent. La reconnaissance précoce et la référence pour l'imagerie sont essentielles pour éviter une mauvaise gestion prolongée.*

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MOTS CLÉS: lésions athlétiques, douleur chronique à la jambe, masse intramusculaire, tumeur de la gaine nerveuse périphérique, schwannome, masse de tissus mous

Introduction

Athletes frequently report leg pain, with causes ranging from sprains, strains, contusions and myofascial pain to less common but potentially more serious conditions such as blood clots or soft tissue tumours.[1] While acute injuries are often easily recognized and addressed, chronic or slowly progressing abnormalities, especially those that are initially asymptomatic, may go unnoticed.[2,3] Among these less obvious conditions are benign soft tissue masses such as schwannomas and neurofibromas.[2] These growths are typically painless until they enlarge to the point of compressing nearby structures or are subjected to regular external pressure, such as from tight clothing or athletic gear.[4]

Schwannomas are benign, encapsulated tumors arising from Schwann cells, which create the myelin sheaths around peripheral nerves. Although they can occur anywhere in the body, they are relatively rare and often slow-growing.[5] Symptoms, when present, are usually related to compression of the associated nerve, leading to localized discomfort, numbness, or functional impairment.[6] Schwannomas are often differentially diagnosed against neurofibromas, the most common type of peripheral nerve sheath tumor, due to the similarities in their pathology and clinical presentation.[7]

It is the clinical experience of the authors, and colleagues around them, that small nodules are commonly palpated during the course of assessment and diagnosis of patients and athletes. Some differentials may include lipomas, fibrolipomas, neurofibromas, schwannomas, arteriovenous malformations, myositis ossificans or small calcifications. The purpose of this case report is to remind manual therapists to be aware of and consider less common differential diagnoses before dismissing masses as inconsequential. This is especially true if the mass becomes symptomatic or does not respond to treatment as expected.

Case Presentation

In-office assessment

A 28-year-old female recreational skier presented to the clinic for a second opinion on her chronic calf tension with a "tight band/nodule" and intermittent shooting pain that began around five years prior but had been worsening over the last one to two years. This athlete reported having seen various other healthcare providers for treatment which produced temporary improvement in perceived calf 'tightness' without changes to size or sensitivity of the nodule. Prior treatment included soft tissue massage, intramuscular stimulation (IMS) needling, shockwave therapy, strength training, load management and stretching. At the point where the athlete presented to the office, she noted that she was no longer able to run and jump due to pain and skiing was very uncomfortable.

During the initial examination, a firm, ovoid nodule was identified in the medial proximal aspect of the gastrocnemius. Palpation of the nodule was intensely painful to the patient. The pain was reported as sharp and shooting with pain referring into the medial arch of the foot. Palpation of the deep calf musculature surrounding the nodule was non-painful.

Resisted muscle testing of the quadriceps, hamstrings, gastrocnemius, soleus, tibialis anterior and extensor hallucis longus was full, equal and painless bilaterally. No neurologic deficits were present. Crude touch was intact and symmetric bilaterally throughout the L4 – S1 dermatomes and deep tendon reflexes of the patella and Achilles were graded +2 and equal bilaterally. Based on the reported failure to improve from past treatments and the progressive worsening of symptoms, she was referred to her primary care physician for a second opinion and received a requisition for ultrasound imaging, to assist in establishing a working diagnosis.

Imaging

Ultrasound imaging was performed on the right upper medial calf. The report noted a "smooth contoured, well-circumscribed, heterogeneous isoechoic soft tissue lesion confined within the intramuscular compartment. It measures 3.8 x 2.6 x 1.9 cm and has intrinsic vascularity but no discrete calcifications or cystic components. Posterior acoustic enhancement is not seen. No surrounding inflammatory changes are apparent."

The report stated "The well-circumscribed lesion … probably represents an intramuscular fibrolipoma. It does not have the typical characteristics of an intramuscular myxoma. A local soft tissue sarcoma is considered less probable from the provided history. Elective MRI may be considered for further characterisation of the lesion, together with a surgical opinion from a sarcoma specialist." The athlete was scheduled for the initial appointment with an orthopedic surgeon that specializes in soft tissue tumours prior to acquiring the MRI imaging. At that appointment, the surgeon's working diagnosis was an arteriovenous malformation, however wanted the MRI imaging to confirm.

Two weeks later, a multiplanar non-contrast MRI was performed with fiducial markers. Within the medial head of the gastrocnemius a 4.7 x 2.2 x 2.2 cm well-cir-

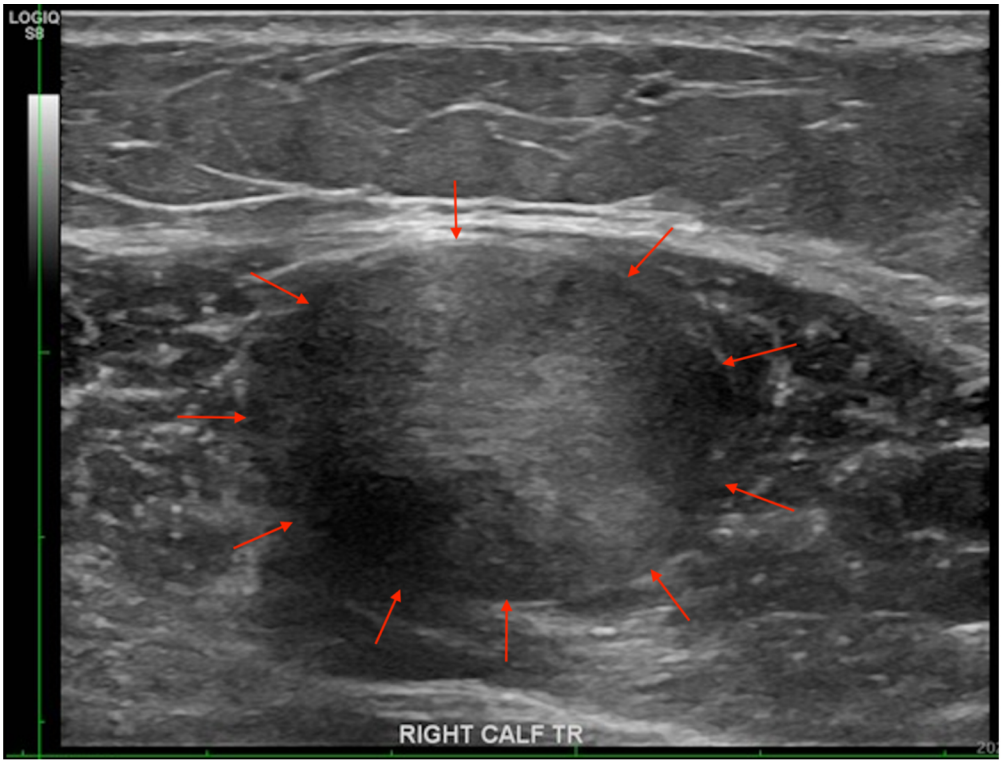

Figure 1.
Ultrasound image showing a well-circumscribed soft tissue nodule, clearly distinct from surrounding gastrocnemius muscle.

cumscribed ovoid lesion was visualized, demonstrating high signal on fluid sensitive sequences with no internal fat signal seen. Trace surrounding muscular edema was noted. The impressions noted "a peripheral nerve sheath tumor would seem most likely", but stated the appearance was not pathognomonic.

A month after the MRI, a second consultation occurred with the specialist, and the diagnosis of a nerve sheath tumor was finalized. Surgical excision was recommended considering the limitations to the patient's activities and quality of life. Based on the location of the lesion, off of an intramuscular branch in the medial gastrocnemius, the risk of secondary neurologic deficit or muscular atrophy was low. As this case was non-malignant, it was deemed non-emergent, resulting in a six month wait.

Surgical intervention

The tumour was surgically removed without complication and histopathological analysis confirmed the diagnosis of schwannoma. At the post operative check-up, the patient demonstrated loss of sensation to light touch over the right medial calf in the saphenous distribution but full function and no significant loss of strength in the gastrocnemius. The athlete was cleared to return to activity at her 6 week follow up with the surgeon. In this case, the athlete did not need any post-surgical rehabilitation program as their function was sufficient for them to return to activities of daily living and required only guidance on returning to sport as tolerated. By 16 weeks post-surgery, she was able to run 5km pain free and had returned to skiing with no reported deficits.

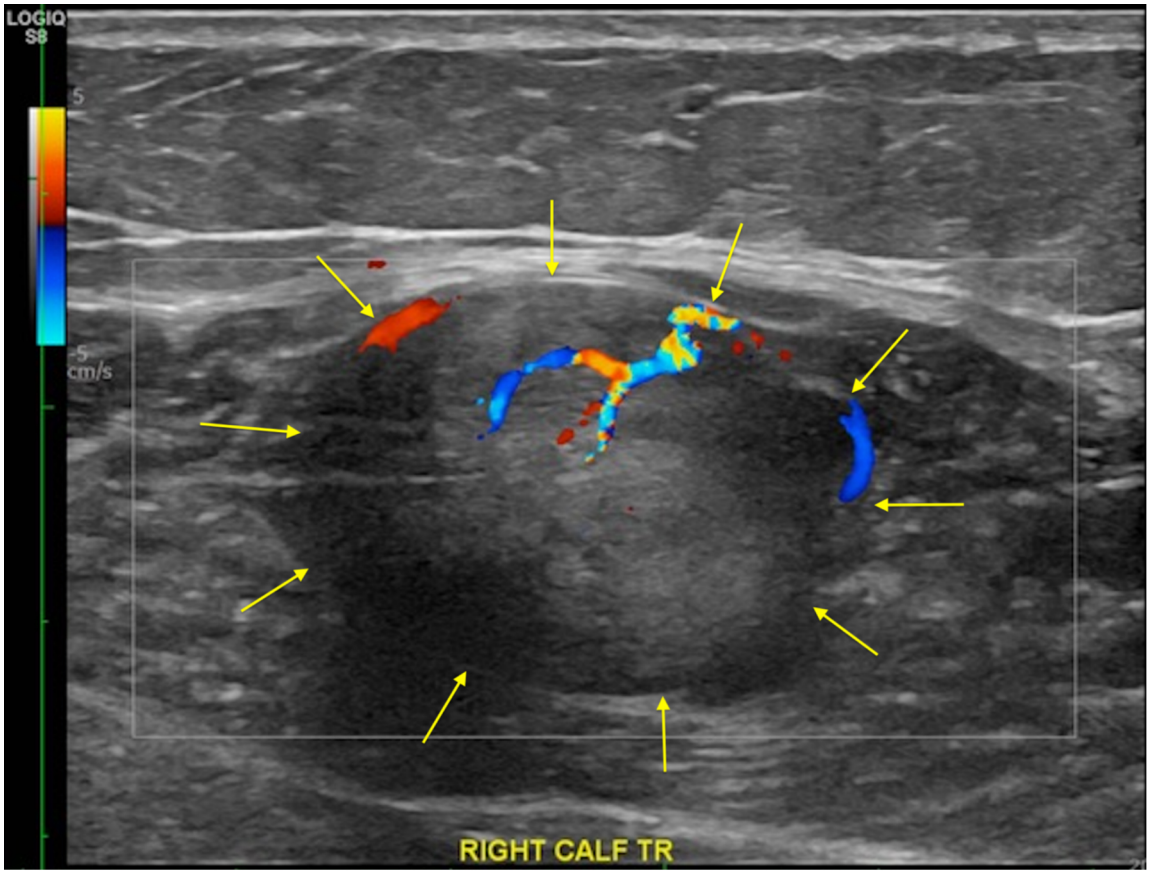

Figure 2.
Doppler Ultrasound image showing internal vascularity of the lesion, which prompted the working diagnosis of an arteriovenous malformation prior to MRI imaging.

Discussion

Posterior leg pain is common amongst athletes; however, it is often associated with conditions that do not commonly present as a palpable mass.[1] This case demonstrated the challenges of diagnosing less common causes of painful intramuscular nodules since atypical symptoms were repeatedly managed within the narrow framework of common musculoskeletal conditions, delaying appropriate diagnosis and intervention. When initial conservative management fails to yield lasting improvement, providers need to consider alternative diagnoses and refer for advanced imaging or specialist consultation.

Peripheral nerve sheath tumors, including neurofibromas and schwannomas, typically present as well-circumscribed, slow-growing soft tissue masses that may be associated with localized pain, paresthesia or motor deficits, depending on their anatomical relationship to the involved nerve.[8, 9] While they are more commonly found in the head, neck and upper extremities they can also occur in the lower limb, particularly along major nerve trunks such as the tibial or fibular nerves.[10] Schwannomas are the most common benign peripheral nerve sheath tumour, accounting for approximately 5% of all soft tissue tumours.[8,10] When left untreated, these tumors may continue to grow, leading to progressive nerve compression and resulting in neuropathic symptoms, including chronic pain, paresthesia, and motor dysfunction.[8] Thankfully, malignant transformation is low, estimated to be less than 1%.[8] Regardless, misdiagnosis or mismanagement can carry significant risk, especially if therapeutic modalities pose a risk of further injury or aggravation.

In this case, the intramuscular location of the nodule increased the difficulty of the diagnosis. Active Release Technique (ART) and Graston technique (instrument assisted soft tissue therapy) as well as acupuncture and intramuscular stimulation (IMS) needling were attempted as treatments from prior practitioners. ART and Graston techniques apply physical pressure, localized tension, sometimes vigorous, with the intent to break down or soften soft tissue adhesions or muscular tightness. If these forces are mistakenly applied to a tumour such as a schwannoma, such manipulations may lead to localized inflammation, nerve irritation, or even iatrogenic trauma.[11] Intramuscular Stimulation (IMS) and acupuncture, which involve needle insertion into muscular or fascial structures, pose a unique risk if a tumor is present but undiagnosed. Deep needling near a peripheral nerve can cause direct trauma to the nerve or tumor capsule, leading to hemorrhage, increased pain, or paresthesia.[12] Additionally, a study by Domingo *et al*.[13] showed that intramuscular nerves in a healthy mouse specimen underwent Wallerian degeneration following repeated application of dry needling.

When the athlete was asked about each individual modality, they noted that they were all much more sore than her previous experiences with these therapies and often caused post treatment soreness for multiple days. ART was the least painful and felt generally good in the surrounding musculature, but did not change the area of complaint. Dry needling was the most painful, with the athlete reporting it felt like the muscle was ripping off the attachment and extreme sharp pain would refer into to her foot.

In this case, the schwannoma was initially misdiagnosed as both a myofascial trigger point and as a lipoma. Trigger points are classified as either active or latent, with active MTrPs being spontaneously painful and often reproduce a patient's familiar pain pattern upon palpation. In contrast, latent MTrPs are not painful unless compressed, at which point they may elicit localized or referred pain.[14, 15] Lipomas typically present as soft, mobile and painless subcutaneous nodules, often identified by a characteristic "slippage sign" on palpation.[16] Although extremely rare and not considered in this case, intramuscular Baker's cyst have been reported with a few case studies including gastrocnemius and vastus lateralis locations.[17, 18]

As healthcare providers, it is important to recognize when conservative treatment has been unsuccessful and follow ideal referral pathways. In this case, the ideal referral was delayed for several years until the athlete's activities were significantly limited. Ideally, this case would have been referred after the first or second failed trial of conservative care. While ultrasound is very useful and typically more timely, MRI is the imaging modality of choice to assess soft tissue tumours.[19] Typical treatment involves surgical excision, particularly for symptomatic lesions. In the current case, the lesion's intramuscular location, firm consistency, and intrinsic vascularity raised suspicion for a peripheral nerve sheath tumor. Although imaging findings supported the consideration of this diagnosis, the absence of classic radiologic signs such as target sign, eccentric location on the nerve or well-estab-

lished encapsulation and the lack of definitive neurologic symptoms made it difficult to conclusively differentiate between schwannoma and neurofibroma. Preoperative diagnosis is often difficult, therefore final diagnosis was dependent on histopathological evaluation following surgical excision.

Limitations

This case report represents the management of a single patient with their own unique health history. Conclusions cannot be drawn relating to treatments or management recommendations for the broader population or other cases of schwannomas. The authors also recognize that our clinical biases and opinions influenced our writing and earnest recommendations for referral and consideration of non-MSK conditions.

Summary

This case highlights the importance of staying aware of and vigilant for the possibility of less common differentials in otherwise familiar presentations such as soft tissue nodules in musculoskeletal care. While posterior leg pain in athletes is often attributed to common overuse injuries, persistent symptoms and non-responsiveness to conservative management must prompt a re-evaluation of the working diagnosis. The failure to consider rare but significant pathologies, such as intramuscular schwannomas, can lead to years of mismanagement and patient distress. Clinicians must maintain diagnostic vigilance and be prepared to escalate investigations when presentations deviate from expected clinical patterns, ensuring that uncommon but clinically relevant conditions are not overlooked.

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The bi-directional adjustment? / L'ajustement bidirectionnel?

Jordan A. Gliedt, DC[1]

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KEY WORDS: chiropractic, narrative medicine, humanities, pain

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MOTS CLÉS: chiropratique, narratif

Banking – How I Was Taught to Learn

Unknowingly, much of my life had been lived under the same implicit messaging. I was a student striving to receive a deposit of knowledge so large that I could reach "expert" status. Like those before me, I passively received knowledge from professors, then demonstrated my "expertise" through regurgitation on examinations or imitation of professors' clinical techniques. I was pleased to eventually be given a title of "doctor" indicating my "expertise" and "authority".

As a young clinician I embodied this same model with patients: they were assessed and assigned a diagnosis by the "authority" (me – the "doctor"), and ended with treatment prescribed and performed by me, the "expert". This model was efficient and yielded a dependable technician who could manipulate the spine and soft tissue, prescribe home exercises for the patient to *comply* with, and provide educational information *for* the patient. This model also created hierarchy. Like teachers as "experts" and students as recipients, clinicians were "authorities" and patients were cases. Knowledge and interventions traveled in one direction – from "expert" to learner, from clinician to patient – rarely, if ever, did it travel back. This model was natural, even necessary, I thought. I accepted it, and in fact, reveled in my ignorantly distorted perception of self – the "expert".

Dialogue – How I Experienced Learning

Several years after being made into a clinician, I encountered a classroom that reimagined what "expertise" is. I

[1] Department of Neurosurgery, Medical College of Wisconsin, Milwaukee, WI, USA

Corresponding author:
Jordan A. Gliedt, Department of Neurosurgery, Medical College of Wisconsin, 1155 N. Mayfair Rd. Milwaukee, Wisconsin, USA 53213
Tel: 414.955.7199
Email: jgliedt@mcw.edu

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enrolled in a course that held a different heirloom at its center: Paolo Friere's critique of the banking model of education and his proposal for dialogical, problem-posing pedagogy that embodies co-learning.[1] Instead of passively receiving knowledge from our "expert" professor, we sat in a circle, posed problems from our academic and clinical lives, and co-authored responses through a model of dialogical co-learning. The professor did not bank knowledge into us; he facilitated inquiry, supported thought, and participated as an equal learner in communal dialogue.

This class felt awkward at first. I was accustomed to receiving information or, yet, giving information as a clinical "authority". However, I began to feel humbled and liberated as an active co-learner of knowledge with co-creation of solutions to problems. I realized I previously learned to *speak* with "authority" without appreciating how to *listen* as a member of a communal learning ecosystem that respects every human's inherent lived experience and expertise.

Bringing Dialogue into Clinic

As chiropractors, we commonly engage with patients experiencing pain. Upon exposure to Friere's pedagogy, I started interrogating the traditional clinical encounter in the context of pain. Pain is an experience that, arguably, is dynamically shaped by interactions between one's entire being, including unique bodies, environments, experiences, and contexts.[2,3] Thus, I questioned the value of banking in clinical care in many circumstances. How could I have any clue without *listening* and *valuing* patients' inherent expertise and lived experiences? Could we transform the clinical approach by facilitating dialogical co-learning of an individual's meaning of pain with a co-created plan?

As I began to practice this approach, I worried that inviting patients' input might give the impression I was uncertain and lacking "expertise". I questioned the theory of dialogical co-learning and was afraid patients wanted a clear "authority". Contrarily, I found asking for patients' perceptions and experiences did not undermine trust – it built it. Patients valued being seen as knowledgeable about their own bodies and lives. When asking patient's perspectives and encouraging a space for partnership, many have leaned in and become co-authors of their clinical plans. Many patients have been explicitly grateful for this approach and found it to be empowering.

Dialogue as Practice and Ethic

This approach to care has not come without criticism. As I shared this approach with colleagues, some have openly criticized it as clinically inefficient or unnecessary. I acknowledge and appreciate clinical time demands. Nevertheless, I argue that dialogical practice may be more than just a clinical approach. In some circumstances, could it be an ethical requirement – a stance of humility and professionalism that is centered on patients?[4] A dialogical approach asks the clinician to relinquish the illusion of total knowledge and instead treat each encounter as an opportunity for mutual learning.

In health professions education and clinical practice, the banking model is prominent. Of course there are reasons for this, including the need to establish an intense understanding of information with precision. Friere argues, though, that the banking model can potentially inhibit critical thinking and problem-solving skills and, instead, foster oppressive, hierarchical structures.[1] Friere argues that a dialogical approach can potentially re-humanize the relationship between [clinician and patient], transforming the relationship to *with* instead of *for*.[1]

Pragmatically in a pain-related clinical setting, assuming there are no emergent circumstances with equivocal options available, a dialogical approach includes open-ended questioning, reflective listening, and shared-goal setting with co-development of the meaning of pain. Ethically, it means valuing patients' perspectives as an integral component in the discovery process, shifting focus of "expertise" from an isolated object that can be banked to an essential, integrated source of meaning within the patient-clinician relationship.

The Bi-directional Adjustment?

As a chiropractic student I thought I needed to become an "expert" at adjusting [spinal manipulation]. However, I perceive the most important adjustments I have made have been relational, not manual. The introduction to Friere's pedagogy has allowed me to recognize that clinical care, like education, is often something that is built communally, not merely delivered in isolation.

When I enter a clinic room now, I remind myself that both the patient and I are students of the same body and

worldly phenomena, both searching for understanding. So much of clinical care has traditionally been centered around an "expert" alleviating pain through knowledge translation and intervention, such as the adjustment [spinal manipulation]. So, I ask, does this clinical care approach need to be reimagined? Perhaps, does the most meaningful adjustment occur when two people meet and are simply willing to learn from one another? Maybe, when we transform this approach we see a new adjustment, and its bi-directional.

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Conference Proceedings / Actes de conférence

Abstracts of the Scientific Poster Award Competition of the 2025 Royal College of Chiropractic Sports Sciences (Canada) Conference (RCCSS(C)) / Les résumés du Concours de Prix d'Affiche Scientifique de la Conférence 2025 du Royal College of Chiropractic Sports Sciences (Canada) Conference (RCCSS(C))

Alexander Dennis Lee, BSc(Hons)Kin, DC, FRCCSS(C)[1]

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MOTS CLÉS: sports, chiropratique, recherche

The Annual RCCSS(C) Conference continues to serve as a forum for advancing sports healthcare practice, education, and research through collaboration and knowledge exchange. The 2025 Annual RCCSS(C) Conference was held November 8-9, 2025, in Toronto, Canada. This year's conferenced marked the Second Annual Scientific Poster Presentation and Award Competition, showcasing innovative research and clinical insights from the sports healthcare community.

The RCCSS(C) Research and Education Committee extends its sincere appreciation to the Foundation for the RCCSS(C), individual donors who generously supported the poster awards, the RCCSS(C) Conference Committee, the peer review chair and all peer reviewers for their dedication in evaluating submissions. Their contributions made this year's competition possible and ensured its continued excellence. Presented below are the abstracts of the poster award recipients.

[1] Canadian Memorial Chiropractic College

Corresponding author: Alexander Lee, Canadian Memorial Chiropractic College, 6100 Leslie Street, Toronto, ON, M2H 3J1
Tel: 416-482-2340
Email: alee1@cmcc.ca

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First Prize Poster:

Title: The athlete-centred care study: bringing the athlete's voice to sports healthcare (step 1 – nominal group technique meetings)

Authors: Alex Lee, David Oh, Scott Howitt, Erica Gavel, Brad Muir, Lara deGraauw, Chris deGraauw, Caroline Poulin, Duong Nguyen, Alessandro Fancella, Sari Kraft, James Gardiner, Neville Wright, Chris Napier, Mohsen Kazemi, Heather Logan-Sprenger

Background: Athletes are key stakeholders in sport and should have a meaningful voice in shaping research and policy on how healthcare is delivered to them. Understanding their expectations, values, and preferences is essential for providing patient-centred care. While patient-centred care is well established in many healthcare settings, limited research has explored this approach in sport.

Objectives: To identify and prioritize athlete expectations, values, and preferences for care to co-create a practice toolkit that supports athlete-centred care.

Study Design: Stakeholder consensus study.

Methods: Canadian national team athletes (13 para and 10 non para athletes) participated in step one of a three-step stakeholder consensus study. Step one involved online nominal group technique (NGT) meetings conducted via Zoom. In small groups, athletes engaged in facilitated brainstorming and prioritization exercises to articulate their expectations, values, and preferences for healthcare. Responses were transcribed in real time, and a qualitative thematic content analysis was performed to identify key themes.

Results: Four NGT meetings were completed (two with para athletes and two with non para athletes). Common themes included clear communication and transparency, individualized care, collaboration, trust and confidentiality, holistic approaches, scheduling flexibility, and sport-specific understanding. Additional themes from para athlete groups included expertise in para sports and disability considerations, accessibility, affordability and insurance navigation, psychological impact of recovery, ethical and inclusive healthcare, and continuity of care.

Conclusion: These themes informed the development of seed statements for the step two prioritization survey in this stakeholder consensus study to develop an athlete-centred care practice toolkit.

Second Prize Poster:

Title: Sports healthcare providers' perspectives of working with chiropractors managing elite athletes: a qualitative study

Authors: Gabriella DeBono, Alex Lee, Scott Howitt, Melissa Atkinson-Graham, Patrick Bergeron, Silvano Mior

Introduction: Sports teams have established interprofessional healthcare teams to utilize the diverse expertise of professionals to optimize the health and performance of athletes. Historically, chiropractors are inconsistently included within this group. Studies have explored the value of including sport chiropractors within such teams from the perspective of athletes, coaches, and team staff, but few from the perspective of non-chiropractic sports healthcare providers. This study will focus on the perspectives of other healthcare providers who interact with chiropractors within the context of supporting elite athletic management.

Methods: We used an interpretive phenomenological approach framed using theories of professionalization in healthcare that speak to the formation and dynamic nature of professions through concepts like jurisdiction, work, competition, and abstract knowledge. These concepts, and past research exploring the integration of chiropractic in sports healthcare, situate and contextualize our interview guide and thematic analysis.

Participants: N=11 (3 athletic therapists, 5 physiotherapists, 3 medical doctors). Participants were recruited purposively and supplemented using snowball sampling.

Data collection: Semi-structured interviews were conducted and recorded via Zoom. Interviews were approximately 30-40 minutes long and transcribed verbatim.

Analysis: Transcripts were imported in MS Word and NVivo to facilitate analysis. Data were interpretively ana-

lyzed and codes were developed deductively and inductively. Codes evolved through iterative processes during research team meetings and were then clustered into representative themes. Qualitative reflective practices were used during data collection and analysis.

Results: Emerging themes and subthemes include: teamwork (roles and responsibilities, adaptability, and conforming), structuration of work (setting determined, hierarchy), jurisdiction (blurred boundaries, distinct boundaries), and trust (relationships, communication, familiarity).

Preliminary conclusions: Early findings suggest that professional boundaries in sport settings are fluid and often shaped by factors beyond professional designation. Additionally, being a "team player" appears to foster positive relationships and builds interprofessional trust between chiropractors and other sport healthcare professionals.