18th Annual Spine Academic Day

SPINEFEST

University of Toronto Spine Program

Surgery
UNIVERSITY OF TORONTO
Spine Program

Monday June 1, 2026
BMO EDU & Conf Centre
Hybrid

Table of Contents

About SpineFEST

This year marks the 18th anniversary of SpineFEST, the University of Toronto's Annual Academic Spine Day. SpineFEST serves as the program's flagship event, bringing together the spine community to share advances in spine surgery, spine care, and spine translational research. The event features a unique educational platform that fosters collaboration among clinicians and researchers from a broad range of disciplines, including neurosurgery, orthopaedic surgery, chiropractic medicine, physiatry, physical therapy, nursing, family medicine, pain medicine, biomedical engineering, and both basic and clinical sciences.

Previous Visiting Professors

2025	Professor Michael Wang, University of Miami Miller School of Medicine, Miami, Florida
2024	Professor Serena Hu, Stanford University, Stanford, California
2023	Professor Shekar Kurpad, Medical College of Wisconsin, Milwaukee, Wisconsin
2022	Professor Lawrence Lenke, Colombia University, New York
2021	Professor Richard Fessler, Rush University Medical Centre, Chicago, Illinois
2020	Professor Marcus Stoodley, Macquarie University, Sydney, Australia
2019	Professor Praveen Mummaneni, The University of California, San Francisco
2018	Professor Sanford Emery, West Virginia University
2017	Professor Zoher Ghogawala, Tufts University School of Medicine
2016	Professor Daniel Riew, Columbia University Medical Centre
2015	Professor Wilco Peul, Leiden University Medical Centre
2014	Professor Kenneth Cheung, University of Hong Kong
2013	Professor Alexander Richard Vaccaro, Thomas Jefferson University
2012	Professor Jean Dubousset, The University of Paris
2011	Professor Jens Chapman, University of Washington
2010	Professor Edward Benzel, Cleveland Clinic
2009	Professor Jeffrey Wang, University of California

Time and location:

- **Location**: BMO Education & Conference Centre, 60 Leonard Avenue, Toronto, Ontario.
- **Date/Time**: June 1, 2026, 8:00 AM to 3:00 PM (EST)
- **Day Program / agenda** on page 11

About the University of Toronto Spine Program

Vision & Integration

The Program's vision is "Innovation and excellence in the delivery of spine care with a unique collaborative program of clinical expertise, research, teaching, and education.

The University of Toronto Spine Program is a multidisciplinary collaborative fellowship program that brings together neurosurgery, orthopaedic surgery, and a broad range of non-operative clinical and research disciplines dedicated to spine care. The program integrates clinical and research activities across its affiliated teaching hospitals, including Toronto Western Hospital (University Health Network), Sunnybrook Health Sciences Centre, The Hospital for Sick Children, St. Michael's Hospital (Unity Health Toronto), and Mount Sinai Hospital (Sinai Health System), and Scarborough General Hospital (Scarborough Health Network).

Scan the QR Code to learn more about the program

Faculty Members

Toronto Western Hospital @ UHN	**St. Michael's Hospital @ UHT**
Michael G. Fehlings MD PhD FRCSC **(Co-Chair)**	Henry Ahn MD PhD
Christopher Nielsen MD FRCSC	Howard Ginsberg MD PhD FRCSC
Stephen Lewis MD MSc FRCSC	Christopher D. Witiw MD PhD FRCSC
Eric Massicotte MD MBA FRCSC	**Hospital for Sick Children**
Karlo Pedro MD FRCSC	Mark Camp MD FRCSC
Y Raja Rampersaud MD FRCSC	David Lebel MD PhD FRCSC
Suganth Suppiah MD PhD FRCSC	**Scarborough General Hospital @ SHN**
Sunnybrook Health Sciences Centre	Colby Oitment MD FRCSC
Jetan Badhiwala MD PhD FRCSC	Frank Jiang MD FRCSC
Leo da Costa MD	**University of Toronto**
Joel Finkelstein MD MSc FRCSC	Margarete Akens Dr med vet PhD
Michael Hardisty PhD	Carlo Ammendolia DC PhD CCRF
Meaghan O'Reilly PhD	Julio Furlan MD, PhD, FRCPC
Farhad Pirouzmand MD MSc FRCSC	Sukhvinder Kalsi-Ryan PhD
Arjun Sahgal BSc MD FRCPC	Mohamad Khazaei PhD
Cari Whyne PhD	Josh Plener BSc DC FCCSC
Jefferson Wilson MD PhD FRCSC	Karl Zabjek MSc PhD
Albert J. M. Yee MD MSc FRCSC **(Co-Chair)**	

Message from the Co-Directors

Colleagues,

As we approach the end of our academic year, we would like to celebrate our successes for 2025/2026. The U of T Spine Program continues to foster city-wide collaborations within the University and affiliated hospitals, while taking the lead in several key initiatives and garnering a respected academic footprint locally, nationally, and globally. Collaboration and inter-professional multi-disciplinary knowledge exchange remain key elements to our success. The Program has continued to provide, and indeed continues to expand, its full and rich calendar of academic activities in both online and in-person formats. This has increased engagement from alumni and the spinal community throughout Canada and across the globe.

On Monday, June 1st, our Program proudly celebrates the 18th Annual Spine Academic Day (**SpineFEST**) of 2026, a signature event where our spinal community gathers to showcase achievements and share the latest in clinical, scientific, and educational advancements. We are thrilled to welcome this year's Tator-Hall Keynote Lecturer, **PD Dr. med. Klaus Schnake**, Chief Physician and head of the Interdisciplinary Centre for Spinal and Scoliosis Therapy at the Malteser Waldkrankenhaus St. Marien in Erlangen, Germany, and a multidisciplinary team lead treating complex spinal disorders in adults and children. He is a specialist in orthopedics, trauma surgery, sports medicine, and spine surgery, holding excellence certification from the German Spine Society and frequent Top-Medician recognition. Schnake began his medical training at Charité – Universitätsmedizin Berlin and has extensive research and clinical experience. He is the Chairperson of the AO Spine Research Commission since 2024. We look forward to his keynote address on thoracolumbar spine trauma, drawing on his expertise in the field.

The U of T Spine Program continues to build on its strong educational foundation to deliver a comprehensive curriculum in cognitive, procedural, and clinical spine training. Through collaborations among Toronto Academic Health Science Network hospitals, including Toronto Western Hospital, Sunnybrook Health Sciences Centre, Unity Health Toronto, Scarborough Health Network and SickKids, the Program supports fellows from Canada and around the world with intensive one- and two-year university fellowship opportunities in spine surgery as well as subspecialty areas and research. The Program also remains strongly committed to advancing citywide fellowship education through ongoing centralized courses, collaborative initiatives, faculty mentorship, and a well-established standardized case-log program.

To formally recognize Spine Surgery as a distinct discipline within the Royal College of Physicians and Surgeons of Canada (RCPSC), we have collaborated with national colleagues to develop an **Area of Focused Competence (AFC)** in spine surgery, which was formally launched by the Royal College in June 2025. During this past academic year, universities across Canada, including ours, are commencing the process of attaining Royal College accreditation to deliver this Diploma Program. A Royal College AFC Spine Surgery working group, including leadership and representation from the U of T helped the College establish three foundational documents: a Trainee Portfolio outlining core training requirements, a Clinical Training Requirements (CTR) document representing the national curriculum, and Standards of Accreditation for university training centres. There are both adult as well as pediatric streams and a pathway for the College designation for fellows who herald from Canadian trained as well as internationally trained orthopedic or neurosurgical specialty backgrounds. There will also be a Practice Eligibility Route for spine surgeons in practice. This past year, we have worked closely with our University's Post Graduate Medical Education Office to direct steps towards applying for Royal College Accreditation. We are indebted to our Program faculty and fellow trainees for their engagement, support, and involvement in these efforts. Our Program Governance structure is evolving from a Program Council with Research and Education Subcommittees towards a Program as well as Competence Committee, which will further support the AFC by building upon our well-established Program foundation. Special thanks to Drs. Albert Yee, Jeremie Larouche, Michael Fehlings, Scott Paquette, Brad Jacobs, Hamilton Hall, and Ms. Nadia Jaber for promoting national engagement with academic spine programs and fellowship directors over the past several years. This competency-based diploma will enhance surgical education and formally recognized advanced spinal surgical training at the national as well as global level.

This year, we launched our academic calendar of events on August 19th with a **welcome dinner** for our incoming fellows and provided an **updated on our citywide research** opportunities. Many thanks to our young leads Drs. Michael Hardisty, Karlo Pedro, and Josh Plener for their success in providing a well-rounded research exposure to our fellows. Many thanks to Drs. Carlo Ammendolia, Karl Zabjek, and Michael Hardisty for their valued role in establishing and sustaining the research update over many years.

On November 20th and 21st, the U of T Spine Program, in collaboration with the Canadian Spine Society (CSS), successfully launched the inaugural National **U of T–CSS Fellow Surgical Skills Course**, led by Drs. Stephen Lewis, Christopher Nielsen, and Bradley Jacobs. The course delivered an immersive, hands-on educational experience in advanced spine surgery, providing fellows with the opportunity to perform both anterior and posterior approaches using state-of-the-art instrumentation while gaining practical exposure to cutting-edge surgical techniques. Over the two days, participants engaged in

complex procedures including deformity correction, minimally invasive techniques, and trauma-focused surgery through a dynamic combination of cadaveric labs, case-based discussions, and interactive faculty-led sessions.

The inaugural course welcomed 44 fellows from several national institutions. In addition to trainees from local fellowship programs, participants joined from the University of British Columbia, University of Alberta, University of Calgary, McGill University, University of Ottawa, Western University, McMaster University, and the University of Manitoba. Special thanks are extended to the Co-Directors of the U of T Spine Program, Drs. Michael Fehlings and Albert Yee, as well as Program Manager Ms. Nadia Jaber, whose leadership and dedication were instrumental in the success of this milestone initiative in spine education and training.

We also extend our sincere appreciation to the invited faculty who played a vital role in teaching and mentorship, including Dr. Jeremie Larouche from Calgary, Dr. Ahmed Aoude from Montreal, Dr. Jay Toor from Winnipeg, and local faculty surgeons, Dr. Frank Jiang and Dr. Simon Harris.

The **Traumatic Spinal Cord Injury Management and Classification Course** continues to run each year having adopted a dynamic hybrid learning model. The course this year was held on Jan 19th and integrated pre-recorded lectures, online instructional modules, as well as an in-person practicum followed by interactive case-based discussions. This comprehensive format provided an excellent platform for teaching both clinical and research expertise in TSCI care. Special thanks to Dr. Sukhvinder Kalsi-Ryan and Ms. Nadia Jaber for designing and establishing this outstanding hybrid model, and for their leadership in delivering a successful hybrid educational experience. We also gratefully acknowledge the course faculty, Drs. Michael Fehlings, Jetan Badhiwala, Jeff Wilson, Julio Furlan, and Dr. Mamad Khazaie for their valued clinical and research knowledge.

On March 23rd, we progressed the residents' surgical education in our annual Royal College **Mock Oral** Course, designed to prepare senior neurosurgery and orthopedic surgery residents for their Royal College examinations. This year, we had 10 orthopedic surgery residents and 2 neurosurgery residents prepped for their examination in Spring. Special thanks to Drs. Jetan Badhiwala, and Luke Reda for their valued leadership. We extend our thanks to Drs. Colby Oitment, Frank Jiang, and Karlo Pedro, and to our fellows, Drs. Celina Nahanni, Bandar Alzahrani, and Vanessa Giddins for taking part in teaching and prepping our residents.

We are pleased to have continued the annual **Pediatric Spine Deformity Surgery course** for its 4th year on April 27th. Many thanks to Dr. David Lebel for chairing and organizing the course and to SickKids educators Mr. Mike Vandenberk (RNT), Ms. Jennifer Dermott, and Dr. Mark Camp for their outstanding

teaching material. The Pediatric Spine Deformity Surgery Course was very well received, bringing together an outstanding faculty and engaged participants in an excellent interactive discussion, and collaborative learning. The fellows particularly valued the practical breakout sessions, expert-led presentations, and the exciting debate session led by Drs. Ahmad Alelaumi, and Nadav Rinott.

The recently introduced course on **Non-Operative Treatment of Spine Disorder**, now in its 2nd year, was held on December 11th in a successful hybrid model. Thanks to Dr. Ammendolia for his leadership in establishing this course, and Dr. Josh Plener for his valued contribution to our Program. The Nonoperative Management of Spine Disorders Annual Course was very well received for its comprehensive, evidence-based approach and highly interactive format. Fellows appreciated the fusion of pre-course learning, hands-on demonstrations, and case-based discussions, which provided practical insights into contemporary non-operative spine care and fostered meaningful multidisciplinary collaboration and learning.

Throughout the academic year, our Program hosts several world-renowned professors via our well-established **Hospital-Based Visiting Professorship Series**, as well as in collaboration with affiliated hospitals and University programs. Jointly organized by the U of T Spine Program, UHN, and the University of Toronto Collaborative Program in Neuroscience, The Tator-Turnbull SCI Symposium continues to be, under the chairpersonship of Dr. Michael Fehlings, a flagship academic event jointly organized by the U of T Spine Program, UHN, and the U of T Collaborative Program in Neuroscience, bringing together leading clinicians, researchers, trainees, and patient advocates in the field of spinal cord injury. This year's symposium was highlighted by the distinguished keynote address, *"Making Hard Choices—Viewed from Different Perspectives,"* delivered by Dr. Naomi Kleitman, Senior Vice President of Grants and Research at the Craig H. Neilsen Foundation, whose internationally recognized leadership, as well as lifelong contributions to spinal cord injury research and translational science, both inspired attendees and enriched the program's multidisciplinary discussions.

The U of T continues collaborative efforts with Chinese delegation in a series of **Symposium on Current Concepts in Musculoskeletal Tumour Treatment and Research** which this year occurred on August 8th. The event, chaired by Drs. Albert Yee and Ed Chow, was a highly successful collaborative academic event collectively organized by the U of T Spine Program, the University of Toronto Division of Orthopedic Surgery, Toronto Sarcoma group, UHN/Princess Margaret Hospital, and Sunnybrook Health Sciences Centre (Odette Cancer Centre). The symposium brought together clinicians, researchers, and trainees from disparate disciplines to share advances in musculoskeletal tumor care, multidisciplinary treatment strategies, surgical innovation, and translational research, fostering meaningful collaboration and knowledge exchange across the academic spine and oncology communities.

This year we also welcome and **congratulate** Dr. Nir Lipsman who assumed a key University leadership role as the Dan Family Chair of the Division of Neurosurgery. Dr. Lipsman has pioneered several first-in-Canada and world-first clinical trials for neuromodulation innovation. His internationally recognized expertise as a surgeon-scientist complements the outstanding academic productivity of our University Division. He, alongside Dr. Jefferson Wilson (who assumed a Division Head of Spine Surgery leadership role at Sunnybrook this May) as well as Dr. Raj Rampersaud are working in collaboration with province-wide surgical colleagues and the Ministry of Health to actively advance initiatives that improve spinal care triage in response to growing population needs and prolonged wait times for specialist consultation. Key efforts include expanding centralized intake systems and optimizing the role of Advanced Practice Providers (APPs) to address current gaps in clinical care, thereby complementing ongoing enhancements to the provincial Degenerative Spine Quality-Based Procedures (QBP) program and Provincial Neurosurgical as well as urgent spine accelerated care pathways. Broader provincial priorities remain centered on regionalized care models, streamlined central intake processes, and strategies targeting wait time management, alongside ongoing efforts to bolster workforce recruitment, retention, system capacity, and operational efficiency.

We are proud of our **2025–2026 spine fellows** who have successfully completed fellowship training after a year of dedication and hard work. Congratulations to Drs. Nadav Rinott, Ahmad Alelaumi, Nitish Agarwal, Andres Rodríguez Buitrago, Muhammad Ali Akbar, Abdulrahman Almalki, Ryo Nogami, Vincent Ye, Mohammad Almalki, Celina Nahanni, Bhushan Thombre, Bandar Alzahrani, Rajesh Kumar, Vanessa Giddins, and Ran Ankory. We extend our warmest wishes for furthering success in their professional journeys and look forward to their ongoing involvement in our Program as esteemed alumni.

As we close another remarkable academic year, we extend our heartfelt **gratitude** to the University of Toronto Department of Surgery Spine Program Council, our dedicated educators, and our trainees for their unwavering commitment and exceptional contributions to the ongoing success of our Program. We are privileged to draw on the diverse and specialized expertise of our members, and we deeply value the enduring support from the Department of Surgery as well as the Divisions of Neurosurgery and Orthopedic Surgery. We thank Dr. Carol Swallow (Chair, Department of Surgery), Dr. Najma Ahmed (Vice-Chair, Education) Dr. Peter Ferguson (Chair, Orthopedic Surgery), and Dr. Nir Lipsman (Chair, Neurosurgery) for their steadfast leadership, support, and advocacy for our University-Wide Program.

We also gratefully **acknowledge** the continued support of our industry partners, whose generosity and collaboration play an important role in advancing our educational mission. Our sincere thanks to our Strategic Partner, Medtronic, and our Educational Partners, DePuy Synthes, Stryker, and Bioventus for their ongoing commitment to excellence in both spine surgical education and clinical research.

Special thanks to Ms. Nadia Jaber, our Program Manager, whose outstanding expertise in education Program organization, information technology, and communications remains integral to the growth and innovation of our Program. Her leadership has been vital in implementing new models for delivering academic content, ensuring we remain adaptable and impactful. We also thank our dedicated volunteer, Ms. Jane Lee and Zuhal Olomi for their valued assistance with fellow case log management and Program coordination.

With sincere appreciation, we celebrate another outstanding year in the U of T Spine Program and wish everyone a safe, restful summer and a successful start to the 2026–2027 academic year.

Enjoy SpineFEST!

Sincerely,

Michael Fehlings & Albert Yee

Co-Directors, U of T Spine Program

Agenda

8:00- :8:30 AM	Breakfast	
8:30 - 8:45	Opening Remarks	Dr. Michael Fehlings & Dr. Albert Yee
	Greetings from the U of T	Dr. Peter Ferguson, Dr. Nir Lipsman, Dr. Carol Swallow
SESSION I: THE TATOR-HALL VISITING PROFESSOR LECTURE | Chair: Dr Michael Fehlings		
8:45 - 8:55	Remarks from Tator & Hall	Dr. Charles Tator & Dr. Hamilton Hall
8:55 - 9:00	Introduction to Keynote speaker Professor Klaus Schnake	Dr. Michael Fehlings
9:00 - 9:45	Keynote: "Thoracolumbar spine trauma: Insights from 15 years of AO Spine Knowledge Forum Trauma research"	PD Dr. med. Klaus Schnake, Waldkrankenhaus, Erlangen, Germany
9:45 - 10:00	Discussion	
10:00 - 10:15	Research Projects (Elevator Pitch)	Research Trainees
10:15 - 10:30 AM	Coffee Break	
SESSION II: SPINE TRAUMA AND SPINAL CORD INJURY | Chair Dr. Michael Fehlings (10 Min Presentation & 5 Min Discussions)		
10:30 - 10:45	DCM vs CCS-- or a Continuum? Challenging Traditional Paradigms in Cervical Cord Injury	Dr. Karlo Pedro - New Faculty
10:45 - 11:00	The management of acute spinal cord injury: Optimizing outcomes	Dr. Jetan Badhiwala
11:00 - 11:15	Updates on the Management of Mild Traumatic and Non-Traumatic Spinal Cord Injury	Dr. Jeff Wilson
11:15 - 11:30	The Evolving Paradigm of Central Cord Syndrome: From Schneider's Original Description to Contemporary Understanding	Dr. Colby Oitment
11:30 - 11:45	Virtual Reality in Spine Surgery Education	Dr. Luke Reda
11:45 - 12:00	Coffee Break	
SESSION III: SPINE SURGERY FELLOWSHIP EDUCATION SESSION | Chair: Dr. Albert Yee (10 Min Presentation)		
12:00 - 12:10	Delivering the Royal College AFC Diploma Program in Spine Surgery at U of T	Dr. Albert Yee

12:10 - 12:20	From Concept to National Success: Developing a High-Impact Spine Surgical Skills Course	Dr. Stephen Lewis
12:20 - 12:30	Research Projects (Elevator Pitch)	Research Trainees
12:30 - 1:15 PM	Lunch	
SESSION IIII: RESEARCH TRAINEE PRESENTATIONS | Chair: Dr. Albert Yee (10 Min Presentation & 5 Min Discussions)		
a. Invited Trainees		
1:15 - 1:30	SMART Scheduling: Integrated Machine Learning and Optimization for Comprehensive Operating Room Management	Dr. Aazad Abbas
1:30 - 1:45	Returning Home After Spinal Cord Injury: Days at Home as a Measure of Recovery and Healthcare Value After Traumatic SCI	Dr. Chris Lozano
1:45 – 2:00	Regional Spinal Cord Identity of Neural Stem Cells Promote Optimal Synaptic Function and Motor Recovery Following Traumatic Spinal Cord Injury	Mr. William Brett McIntyre
2:00 – 2:15	Research Projects (Elevator Pitch)	Research Trainees
b. Best Abstracts | Oral Presentations		
2:15 – 2:30	Best Abstract – Clinical Research | Impact of Posterior Spinal Fusion for Neuromuscular Scoliosis on Hip Coverage: Three-Dimensional Comparison of Preoperative and Postoperative CT Scans	Dr. Nadav Rinott
2:30 - 2:45	Best Abstract - Basic Research | Fracture Prediction Using Deep Learning	Ms. Rachel Leung
AWARD PRESENTATIONS | Fehlings & Yee		
2:45	Award Presentation & Closing Remarks	
3:00 PM	Wrap up	

Bios

Tator & Hall

Dr. Charles Tator is a Professor in the Department of Surgery, at the University of Toronto, and a neurosurgeon at the Toronto Western Hospital. He is the former Chair of Neurosurgery at the University of Toronto. He started the first Acute Spinal Cord Injury Unit in Canada in 1974, and has reported on the epidemiology, prevention and treatment of spinal cord injury. He has undertaken seminal translational and clinical research in spinal cord injury. In 1992, he founded ThinkFirst, Canada, a national brain and spinal cord injury foundation whose mission is to reduce the incidence of catastrophic injuries in Canada. In 2012, ThinkFirst merged with three other charities to form Parachute Canada, the country's foremost injury prevention agency, of which he is a founding Director. In 2008, the University of Toronto Press published his book "Catastrophic Injuries in Sports and Recreation, Causes and Prevention-a Canadian Study." He has held two research chairs at the University of Toronto, the Dan Family Chair in Neurosurgery and the Campeau Family-Charles Tator Chair in Brain and Spinal Cord Research. In 2000, he received the Order of Canada, and in 2009 he was inducted into the Canadian Medical Hall of Fame. In 2017, he was promoted to Officer within the Order of Canada, and was also inducted into Canada's Sports Hall of Fame for his work on prevention of sports injuries. In 2025, he was awarded the King Charles Medal for his work in spinal cord and concussion injuries

Dr. Hamilton Hall is a Professor Emeritus in the Department of Surgery at the University of Toronto. He completed his medical degree at the University of Toronto then joined CARE and was stationed at a rural hospital in Malaysia. Dr. Hall returned to Toronto for his orthopaedic residency which concluded with a fellowship in medical education at the University of Dundee, Scotland. In 1974, because of his interest in patient education and rehabilitation, Dr. Hall founded the Canadian Back Institute which expanded into the CBI Health, now the largest rehabilitation company in Canada. He is co-founder and first Executive Director of the Canadian Spine Society and has served on the editorial boards of Spine, The Spine Journal and The BackLetter. Dr. Hamilton Hall has worked as a team physician for the NBA Toronto Raptors and doctor for the National Ballet of Canada.

Dr. Hall has received Outstanding Paper and Poster awards from the North American Spine Society and the International Society for the Study of the Lumbar Spine. He is a recipient of the Laurie Chute Award for Best Undergraduate Clinical Lecturer Award at the University of Toronto, the NASS Henry Farfan Award for outstanding contributions to the field of spine care and two Lifetime Achievement Awards, one from Stryker Spine and the other from the Canadian Spine Society. In 2019 he was inducted into the Toronto Orthopaedic Hall of Fame.

Dr. Hall's concept of a syndrome approach to classifying mechanical back pain is an essential component of several Canadian provincial initiatives to improve spine care. In addition to over 140 published articles and book chapters and over 1200 invited presentations, many as Visiting Professor, to universities in North America, Europe and Asia, he is author of the best-selling Back Doctor series of books for the lay public.

U of T Spine Program | Co-Chairs

Dr. Michael Fehlings the Vice Chair Research for the Department of Surgery at the University of Toronto and a Neurosurgeon at Toronto Western Hospital, University Health Network. Dr. Fehlings is a Professor of Neurosurgery at the University of Toronto, holds the Robert Campeau Family Foundation / Dr. C.H. Tator Chair in Brain and Spinal Cord Research at UHN, is a Senior Scientist at the Krembil Brain Institute and is Editor-in-Chief of Spinal Cord. In the fall of 2008, Dr. Fehlings was appointed the inaugural Director of the University of Toronto Neuroscience Program (which he held until June 2012) and is currently Co-Director of the University of Toronto Spine Program. Dr. Fehlings combines an active clinical practice in complex spinal surgery with a translationally oriented research program focused on discovering novel treatments to improve functional outcomes following spinal cord injury (SCI). He has published over 1,150 peer-reviewed articles (h-index 129; cited over 49,000 times) chiefly in the area of central nervous system injury and complex spinal surgery. His seminal 1991 paper, cited over 2,000 times, outlined the severe and lasting consequences of SCI due to a cascade of secondary injury mechanisms following the initial trauma. His research on secondary injury mechanisms ultimately led to the commencement of the multicenter, international Surgical Timing in Acute Spinal Cord Injury Study (STASCIS), aimed at establishing the

need for early surgical decompression to prevent the negative effects of the secondary injury cascade. His work examining the use of regenerative approaches including neural stem cells to repair the injured nervous system led to numerous international awards and has helped lead the field toward clinical translation in this area. Dr. Fehlings has published in prominent journals such as Nature, Nature Neuroscience, Lancet Neurology, and Science Translational Medicine and received numerous prestigious, international awards.

Dr. Albert Yee is the Holland Bone and Joint Program Chief and the Head of the Division of Orthopaedic Surgery at Sunnybrook Health Sciences Centre, where he holds the Marvin Tile Chair in Orthopaedic Surgery. Dr. Yee is an Orthopaedic Spine Surgeon at Sunnybrook Health Sciences Centre, an Associate Scientist (Physical Sciences Platform) at Sunnybrook Research Institute and a Consultant in Surgical Oncology, Odette Cancer Centre. He is a Professor in the University of Toronto Department of Surgery, Temerty Faculty of Medicine and Co-Director of the Department's Spine Program. Dr. Yee has been a Past President of the Canadian Orthopaedic Research Society and the Canadian Spine Society as well as a Past Co-Chair of Bone & Joint Canada. He has received the American British Canadian (ABC) International Travelling Fellowship distinction (American Orthopaedic Association / Canadian Orthopaedic Association, 2013), the Charles H. Tator Surgeon-Scientist Mentoring Award (2012), and the Canadian Orthopaedic Foundation J. Edouard Samson Award (2011). Dr. Yee has focused translational orthopaedic research utilizing pre-clinical surgical models to evaluate novel minimally invasive vertebral metastatic therapies (e.g., Photodynamic Therapy, Radiofrequency Ablation). His work has led to first in human clinical trials and FDA approval with commercialization of new minimally invasive spine technology. More recently he has been working with colleagues around the country towards establishing and implementing an Area of Focused Competence AFC Diploma in recognition of Canadian spine surgical fellowship training.

Keynote Speaker | Tator-Hall Lectureship

PD Dr. med. Klaus John Schnake, MD is an internationally recognized spine surgeon and academic leader serving as Head of the Centre for Spinal and Scoliosis Surgery at Malteser Waldkrankenhaus St. Marien in Erlangen, Germany. His multidisciplinary centre is renowned for comprehensive spinal care, including deformity, trauma, degenerative disease, infection, and tumor surgery, with expertise spanning advanced technologies such as robotics, navigation, minimally invasive surgery, and endoscopy.

With more than two decades of experience in spine surgery, Dr. Schnake has held senior leadership positions at several of Germany's premier spine institutions, including Schön Klinik Nürnberg Fürth, BG-Unfallklinik Frankfurt, and Charité – Universitätsmedizin Berlin. Dr. Schnake is a prominent figure in the international spine community. He currently serves as Chair of the AO Spine Research Commission and has held numerous leadership roles within AO Spine, the German Spine Society, and the German Spine Foundation. He will serve as President of the German Spine Society in 2026 and was the local host of the EUROSPINE Meeting in Frankfurt in 2023.

A highly respected educator and researcher, Dr. Schnake has delivered more than 450 scientific and educational presentations worldwide, authored over 200 PubMed-indexed publications, and maintains an H-index of 40. He also serves on the editorial boards of leading journals including the Global Spine Journal and the European Spine Journal. Dr. Schnake's contributions to spine surgery and research have been recognized with numerous honors, including the Georg Schmorl Prize of the German Spine Society and multiple international best paper and abstract awards.

Invited Speakers

Dr. Karlo Pedro currently serves as a clinical and research fellow at Toronto Western Hospital. Following his medical degree (cum laude) and neurosurgery training at the University of the Philippines, he pursued a spine fellowship at Toronto Western Hospital in 2021. He then further specialized in neurotrauma and critical care at Montreal General Hospital & Montreal Neurological Institute -McGill University. Karlo has garnered multiple research awards including the best paper at the Fraser Gurd surgical research forum and the Teuber Graduate Award from McGill University. He aspires to make significant contributions as an academic spinal neurosurgeon and is currently pursuing a PhD degree from University of Toronto through the Surgeon-Scientist Training Program under the mentorship of Dr. Michael G. Fehlings. Karlo's research interest focuses on the application of innovative statistical and modeling techniques to comprehensively analyze the multidimensional clinical signatures and outcomes of spine patients.

Dr. Jetan Badhiwala is a staff spinal neurosurgeon at Sunnybrook Health Sciences Centre and Assistant Professor within the Division of Neurosurgery, Department of Surgery at the University of Toronto. He completed medical school at McMaster University, neurosurgical residency at the University of Toronto, and a Fellowship in Complex Spine Surgery at the Cleveland Clinic. His clinical interests focus on spinal trauma and oncology. His academic program is focused on health outcomes research in traumatic and non-traumatic spinal cord injury. This includes harnessing big data to address clinical knowledge gaps and the application of artificial intelligence to healthcare data for 'personalized' or 'precision' medicine. He has published over 125 peer-reviewed papers, 50 conference abstracts, and 15 book chapters to date. Many of these have been published in high impact general medical journals, such as The Lancet, JAMA, BMJ, The Lancet Neurology, and Annals of Internal Medicine, as well as subspecialty journals, such as Neurosurgery, Journal of Neurosurgery, Journal of Neurotrauma, The Spine Journal, and Spine. Jetan has been the recipient of a number of honors and awards, including the CIHR Fellowship, the AANS/CNS Spine Section Research Grant, First Place Resident/Fellow Paper (CSRS), and the Stewart B. Dunsker Award (AANS/CNS).

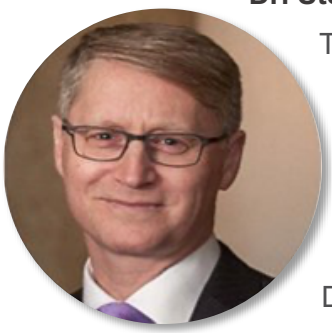
Dr. Jeff Wilson entered the neurosurgery program at University of Toronto after completing his MD at the University of Saskatchewan in 2007. During residency he earned a PhD through IMS and the Surgeon Scientist Program under the mentorship of Michael Fehlings and Abhaya Kulkarni with his research focused on the epidemiology and clinical epidemiology of traumatic spinal cord injury. Jeff's research has been funded by multiple grants from the Christopher and Dana Reeve Foundation, Cervical Spine Research Society and the Ontario Neurotrauma Foundation; further, he has been the recipient of numerous prestigious awards including: the K.G. McKenzie Prize from the Canadian Federation of Neurological Sciences, the Synthes Spinal Cord Injury Award from the American Association of Neurological Surgeon and the Shafie S. Fazel Outstanding Resident Surgeon and Investigator Award from the U of T Department of Surgery. After obtaining his FRCSC in neurosurgery in 2015, Jeff undertook a combined neurosurgery orthopedic fellowship in complex spine surgery at Thomas Jefferson University in Philadelphia, PA under the mentorship of James Harrop and Alex Vaccaro. Jeff returns to Toronto as a Surgeon Scientist at St. Michael's Hospital with clinical focus on the full spectrum of spinal disorders. Dr. Wilson has recently assumed a Division Head of Spine Surgery leadership role at Sunnybrook. From a research perspective, he is primarily interested in topics related to the epidemiology and clinical epidemiology of spinal trauma and spinal cord injury. Currently he serves as the Deputy Editor of the journal Clinical Spine Surgery.

Dr. Colby Oitment is an Adult and Pediatric Orthopaedic Spine Surgeon at Scarborough Health Network and Assistant Professor in the Department of Surgery at the University of Toronto. He completed his MD at the University of Queensland, orthopaedic surgery residency at McMaster University, a complex adult spine fellowship at the University Health Network / Toronto Western Hospital, and an MSc in Health Research Methodology at McMaster.

At SHN, he is the founding Director of the Complex Adult and Pediatric Spine Fellowship — the first of its kind at SHN, launching July 2026. He founded the Adolescent Idiopathic Scoliosis Program in collaboration with The Hospital for Sick Children, and the hospitals first Adult Spine Deformity Program.

His research spans appropriateness and outcomes in spine surgery, informed consent, and intraoperative neuromonitoring. He serves on the AO Spine Knowledge Forum Deformity, co-authored the 2026 AO Spine clinical practice recommendations on patient-specific alignment planning, and reviews for the Global Spine Journal and The Spine Journal. Dr. Oitment leads weekly Royal College teaching for University of Toronto orthopaedic surgery residents, and monthly neuroimaging rounds at Afiya Spine and Pain Institute.

Dr. Luke Reda, MD FRCSC MHPE(c) is an early-career spine surgeon and surgical educator at Sunnybrook Health Sciences Centre, where he serves as a Clinical Associate in the Division of Spine Surgery. His clinical practice focuses on spine trauma, oncology, and complex revision degenerative pathology. Dr. Reda completed medical school at Columbia University, orthopaedic surgery residency at the University of Toronto, and spine surgery fellowship at Sunnybrook Health Sciences Centre. He is currently completing a Master of Health Professions Education, with academic interests in surgical education, simulation, competency-based training, and the integration of emerging technologies into surgical learning. His educational work includes the development and application of virtual reality–based approaches to spine surgery education, with a focus on enhancing learner exposure to complex and uncommon pathology, supporting deliberate practice, and advancing innovative models of resident and fellow training.



Dr. Stephen Lewis is a spine orthopaedic surgeon and the Spine Program Lead at the Toronto Western Hospital (TWH). He is Associate Professor of Orthopaedic Surgery at the University of Toronto (U of T) Department of Surgery. Dr. Lewis' clinical practice focused on spinal deformities at TWH. He has held a number of key leadership roles. He is the current Chairman of the AO Spine Knowledge Forum Deformity, and past Chair of the Scoliosis Research Society (SRS) Adult Deformity Committee and Awards committee. He is also sitting on a numerous spine committee including Worldwide Course committee, and U of T Spine Program Council and education and research committee. Dr. Lewis serves as abstract reviewer for international meetings including SRS, IMAST, and NA Spine Society. Dr Lewis is a researcher and clinical investigator at the Krembil Research Institute with research focus on spine deformity. He has led several multi-centre

international prospective studies through AO Spine, including the elderly spinal deformity surgery study, and the study of interpretation and management of intra-operative multi-modality neuromonitoring. Dr Lewis' has a longstanding and active leading role, locally and internationally, in education and teaching, particularly in spine deformity surgery. He has trained over 200 surgeons in-training and hosted a number of international surgeons in-practice. He is active in designing several complex spine surgery instrumentations, including osteotomy set. Dr Lewis is on editorial board and reviewing committee for the Spinal Deformity Journal and the Spine Journal. He has received numerous international awards for outstanding research papers including Whitecloud Award, Russell S. Hibbs Clinical Award, NASS Award, and CSS Deborah Scarlett Award. He also has received several awards for excellence in teaching including Best Teacher Award from U of T Spine Program, and Individual Teaching Excellence Award from the Department of Surgery, and the Centre of Excellence Award from the AO Spine.

Invited Research Trainees Presentations

Dr. Dr. Aazad Abbas is an Orthopaedic Surgery Resident in the Surgeon-Scientist Training Program pursuing his PhD at the Institute of Biomedical Engineering (IBME). He combines his clinical training with a background in physics and mathematics to drive healthcare innovation. His research focuses on applying artificial intelligence and machine learning to optimize perioperative care and healthcare system efficiency. He is particularly interested in developing data-driven tools for predictive modeling, surgical scheduling, and resource allocation to improve patient outcomes.

Dr. Christopher Lozano is a fourth-year neurosurgery resident and PhD candidate at the Institute of Health Policy, Management and Evaluation at the University of Toronto. His research focuses on outcomes following traumatic spine injuries, particularly among older adults, a rapidly growing segment of the population. Using large provincial health administrative databases, his work leverages routinely collected data to better characterize recovery trajectories after these injuries and identify opportunities to optimize access to care and resource allocation. He

plans to pursue a career as a surgeon-scientist focused on improving outcomes in patients with traumatic and degenerative spine disorders.

William Brett McIntyre is a PhD candidate at the University of Toronto, completing his doctorate in the Institute of Medical Sciences (IMS) program, with a collaborative diploma in Neuroscience. William studies the effects of transplantable neural progenitor cells in preclinical rodent models of cervical spinal cord injury. Specifically, he investigates the effects of regionalizing progenitor cells to optimize therapeutic efficacy and translation of cell-based therapies for spinal cord injury

Best Abstracts Winners | Oral Presentations

Best Abstract winner in Clinical Research

Dr. Nadav Rinott is a pediatric orthopedic surgeon and spine surgery fellow at the University of Toronto, currently training at The Hospital for Sick Children. He completed his orthopedic training in Israel and pursued advanced fellowship training in pediatric orthopedic surgery and spine surgery at McGill University, Montreal. Prior to returning to Israel to establish a pediatric spine service, he is completing a dedicated pediatric spine fellowship at SickKids. His clinical interests focus on pediatric spinal deformity, including scoliosis, with particular Interest on early onset scoliosis, neuromuscular and congenital conditions

Best Abstract winner in Basic Research

Rachel Leung is a PhD Candidate in Biomedical Engineering at the University of Toronto and a member of the Holland Bone and Joint Program at Sunnybrook Research Institute. Her research focuses on leveraging artificial intelligence to model the effects of mechanical loading on both healthy and diseased bone, as well as its fracture mechanics, with an emphasis on translational applications that inform clinical decision-making and treatment planning. She is supervised by Dr. Michael Hardisty and Dr. Cari Whyne. Rachel also holds a BASc in Biomedical Engineering from the University of Waterloo. In her free time, she enjoys paddling with her dragon boat team, Iron Dragons, and reading her Bible.

Organizing Team

Nadia Jaber is the Program Manager at the University of Toronto Spine Program. She has extensive experience managing postgraduate surgical skills training programs, and is responsible for operations, communications, fundraising, and the planning and coordination of Program's educational initiatives. Nadia holds a Bachelor of Arts in English Literature from Philadelphia University (Amman) and a Master of Information Studies from the University of Toronto. She completed her professional training in Entrepreneurship and Leadership from Harvard Business School Online. Nadia has extensive expertise in educational program development, bringing a combination of academic rigor, organizational leadership, and strategic vision to advance the spine fellowship training experience.

Jane Lee serves as a volunteer at the University of Toronto Spine Program. completed her Honours Bachelor of Science in Biology and Immunology at the University of Toronto and plans to pursue a PhD. Jane started volunteering in 2024 to gain exposure to spine care and learn more about research and

education initiatives in the Program. Jane has enjoyed her time helping Nadia plan and organize activities and events, and she is grateful for the knowledge and experience she gained.

Zuhal Olomi is a volunteer at the University of Toronto Spine Program. She is pursuing her Honours Bachelor of Science in Cognitive Neuroscience with concurrent studies in Mathematics and Computer Science. She began volunteering in 2026 to gain exposure to spine care research and build professional connections within the field. Zuhal values the mentorship of Nadia, whose guidance has strengthened her professional confidence. She is grateful for this opportunity and remains committed to contributing to future research initiatives.

Scientific Abstracts

#	Author	Title
1	Nadav Rinott, David Lebel, Richard Gardner, Ahmad Alelaumi, Mark Camp	Impact of Posterior Spinal Fusion for Neuromuscular Scoliosis on Hip Coverage: Three-Dimensional Comparison of Preoperative and Postoperative CT Scans
2	Ran Ankory, Amari Randhawa, Eric Crawford, Joel Finkelstein	Long and Short-Term Recovery Outcomes Following Spinous Process Splitting Approach: Comparative Postoperative Outcomes versus Conventional Laminectomy
3	Ran Ankory, Joel Finkelstein	Surgical Decompression for Lumbar Spinal Epidural Lipomatosis: A Systematic Review and Meta-Analysis
4	Lori Moffat, Hoda Gerami, Bettina Benigno, Ajay Matta, Muhammad Zia Karim, W. Taylor, Mark Erwin	NTG-102: A Refined Molecular Therapeutic to Treat Degenerative Disc Disease
5	Shintaro Honda, Mohammed A. Alvi, Michael G. Fehlings	Spinal Cord Morphometrics in Degenerative Cervical Myelopathy
6	Bandar Alzahrani, Lauren Daunt, Eliana Seider, Vanessa Vashishth, Aazad Abbas, Matthew Kwok, Stephen Lewis	Rod Fracture Mechanisms in Long-Segment Spinal Fusion: Comparative Analysis of Pseudarthrosis vs. Fusion-Mass Fatigue
7	Yuyang T Jiao, Ran Ankory, Raj Kumar Ranabhat, Tayler Declan Ross, Joel Finkelstein, Michael Hardisty	Patient Specific Virtual Reality for Spine Surgery Education
8	Mohammad Abdullah Almalki	Does Anterior Plating Improve Outcomes in ACDF? A Comparative Analysis of Cage-Only Versus Cage-with-Plating Techniques: A Comprehensive Meta-Analysis of Clinical and Radiological Outcomes
9	Ahmad Alelaumi, Nadav Rinott, Emma Nadler, Mark Camp, Lily Switzer, Jennifer Dermott, David Lebel	Proximal Junctional Kyphosis in Early-Onset Scoliosis Revisited: Local Versus Global Alignment Factors
10	Vincent C. Ye, Christopher S. Lozano, Vishwathsen Karthikeyan, Husain Shakil, Armaan K. Malhotra, Ahmad Essa, Christopher D. Witiw	Predictors of In-hospital Mortality Among Operative Traumatic Spine Fractures without Neurologic Deficit

11	Vincent C. Ye, Christopher Lozano, Vishwathsen Karthikeyan, Husain Shakil, Armaan K. Malhotra, Christopher D. Witiw	Minimally Invasive Stabilization of Ankylosed Spine Fractures: An Institutional Case Series and Pooled Systematic Review
12	Rachel Leung, Allison Tolgyesi, Kennice Wong, Cari Whyne, Michael Hardisty	Fracture Prediction Using Deep Learning
13	Mouad Elganga, Mohammed Ali Alvi, Raman Abbaspour, Yuxii Zhang, Karlo Pedro, Michael G. Fehlings	MRI Tissue Bridges Predict Recovery and Treatment Response After Cervical Spinal Cord Injury: A Sub-Analysis of the RISCIS Trial
14	Aysu Kollu, Shanhang Jia, Azam Asgarihafshejani, Brett McIntyre, Mohamad Khazaei, James Hong, Michael G. Fehlings	Examining Regionally Specified Spinal Neural Progenitor Cells and Targeted Forelimb Rehabilitation in Enhancing Recovery After Bilateral Compressive-Contusive Cervical Cord Injury
15	Aazad Abbas, Robert Koucheki, Vishwathsen Karthikeyan, Christopher Lozano, Jay Toor, Albert J. M. Yee, Robert Fowler, Avery Nathens, Stephen Lewis, Jefferson R. Wilson, Christopher D. Witiw, Michael G. Fehlings, Cari Whyne, Jetan Badhiwala	Optimal Timing and Agent Selection for Thromboprophylaxis in Acute Spinal Cord Injury: A National Trauma Database Analysis
16	Christopher J. Nielsen, Fatemeh Alavi, Vanessa Giddins, Raja Rampersaud, Stephen Lewis	Variability of Mechanism of Mechanical Complications Between Low-Thoracic to Pelvis and Lumbar to Pelvis Fusions Accurately Predicted by Musculoskeletal Analysis
17	Omar I. Hassan, Soichiro Takamiya, Azam Asgarihafshejani, Daniel Furlan, Mohammad Zavvarian, Akshat Modi, Tetsuhiko Mimura, James Hong, Michael G. Fehlings	Torsemide Enhances Functional Recovery After Cervical Spinal Cord Injury by Modulating NKCC1-Mediated Hyperexcitability
18	Dharsan Ravindran, Aazad Abbas, Vishwathsen Karthikeyan, Robert Koucheki, Christopher Lozano, Jay Toor, Albert J. M. Yee, Stephen Lewis, Jefferson R. Wilson, Christopher D. Witiw, Cari Whyne, Jetan Badiwala	Machine Learning Prediction of Pulmonary Composite Complications After Acute Spinal Cord Injury: A TQIP Analysis of Respiratory Failure
19	Aden Wong, Raj Kumar Ranabhat, Geoff Klein, Ran Ankory, Albert J. M. Ye, Michael Hardisty	The utilization of Merged MRI and CT Imaging in the Evaluation of Cervical Spine Foraminal Stenosis
20	Mohammed Ali Alvi, Raman Abbaspour, Mouad Elganga, Karlo M. Pedro, Yuxii Xiang, Michael G. Fehlings	Imaging Biomarkers Derived Using an Artificial Intelligence (AI) Pipeline Enhance Prognostication of Patients Undergoing Surgery for Nontraumatic Spinal Cord Injury due to Degenerative Cervical Myelopathy

21	Mohammed Ali Alvi, Mouad Elganga, Karlo M. Pedro, Raman Abbaspour, Yuxii Zhang, Michael G. Fehlings	Quantitative Imaging Biomarkers Derived Using an Artificial Intelligence (AI) Pipeline Enhance Prognostication of Patients Undergoing Surgery for Degenerative Cervical Myelopathy
22	Chloe Gui, Mira Li, Frank Fan, Colleen Deng, Jeff Liu, Andrew Gao, Katherina Baranova, Laura Lockau, Bret Wehrli, Nalan Gokgoz, Jay Wunder, Irene Andrulis, Qingxia Wei, Severa Bunda, Gelareh Zadeh, Suganth Suppiah	Molecular subgroups of malignant peripheral nerve sheath tumours predict metastasis and survival
23	Hannah Ghassabeh, Terence Tang, Lauren Toy, Zachary Fishman, Cari Whyne, Michael Hardisty	Vertebral Fracture Risk After Spine SBRT: The Role of Paraspinal Muscle
24	Lauren Toy, Geoff Klein, Cari Whyne, Michael Hardisty	Automated Vertebral Detection and Segmentation Model for Spinal Metastases CT Imaging Pipeline
25	Aashir Meeran, Mohammed A. Alvi, Karlo Pedro, Michael G. Fehlings	Rate of Change in Non-Compressed Spinal Cord Cross-Sectional Area May Identify Patients at Risk of Progression Among Patients with Mild Degenerative Cervical Myelopathy (DCM)
26	Akram Alayed, Josh Plener, Mark Fillery, Patricia Tavares, Aksa Ahmed, Corey Hofkirchner, Craig Jacobs, Carlo Ammendolia	The tailoring, implementation, and evaluation of the spinemobility boot camp program for degenerative lumbar spinal stenosis at an inner-city community clinic. A mixed methods approach.
27	Celina Nahanni, James Young, Raj Rampersaud	Mismatch Between Predicted and Observed Duration of Impact of Adverse Events Following Lumbar Spine Surgery
28	Zijian Lou, Sogolie Kouhzaei, Oliver Zhang, Nader Hejrati, Jian Wang, Mohamad Khazaei, Michael G. Fehlings	A Mechanistic Exploration of the Role of GDNF-Expressing Transplanted Neural Progenitor Cells on Facilitating Functional Recovery and Regeneration after Traumatic Spinal Cord Injury

Abstract # 1

Title: Impact of Posterior Spinal Fusion for Neuromuscular Scoliosis on Hip Coverage: Three-Dimensional Comparison of Preoperative and Postoperative CT Scans

Authors and Affiliations: Nadav Rinott[1], David Lebel[1], Richard Gardner[1], Ahmad Alelaumi[1], Mark Camp[1]

1 The Hospital for Sick Children, Toronto Ontario Canada

Purpose: To assess the impact of scoliosis correction with posterior spinal fusion on femoral head coverage using a newly developed three-dimensional quantification method.

Methods: A retrospective cohort study was performed of non-ambulatory patients with neuromuscular scoliosis who underwent PSIF between 2020 and 2025 and had both preoperative and postoperative CT scans including the pelvis. Three-dimensional models of the pelvis and proximal femora were generated using AI-based segmentation. A best-fit sphere was applied to the femoral head, and coverage was defined as regions of the sphere located within 7 mm of the acetabular surface. Total femoral head coverage was calculated as the percentage of the femoral head surface meeting this criterion. Regional coverage was evaluated by subdividing the sphere into eight sectors defined by axial, coronal, and sagittal planes. Conventional radiographic parameters including Cobb's angle, Reimers' migration percentage and pelvic obliquity were also recorded.

Results: The study included 35 patients (66 hips). Ten hips were completely dislocated and were excluded from the coverage analysis, leaving 56 hips for quantitative evaluation (26 higher hips and 30 lower hips). Posterior spinal fusion resulted in significant deformity correction, with mean Cobb angle improving from 83.6° to 36.4° (mean correction 47.2°, $p < 0.001$) and mean pelvic obliquity improving from 24.3° to 11.1° (mean correction 13.2°, $p < 0.001$).Three-dimensional analysis demonstrated a small but statistically significant increase in total femoral head coverage in the higher hips (34.0% preoperatively vs 35.1% postoperatively, $p < 0.05$), whereas no significant change in total coverage was observed in the lower hips. Regional analysis showed a redistribution of coverage. Lateral coverage of the higher hips increased from 4.5% to 7.2% ($p < 0.001$), while the lower hips demonstrated a decrease in lateral coverage from 21.7% to 17.6% ($p < 0.001$).

Conclusions: Three-dimensional CT-based analysis enables detailed characterization of femoral head coverage in neuromuscular hips and allows comparison independent of pelvic orientation. Correction of spinal deformity and pelvic obliquity with PSIF alters the spatial distribution of hip coverage, although the magnitude of change in overall containment appears limited. Three-dimensional evaluation may improve understanding of the spine–pelvis–hip relationship and assist in future surgical planning and hip surveillance in neuromuscular patients.

Abstract # 2

Title: Long and Short-Term Recovery Outcomes Following Spinous Process Splitting Approach: Comparative Postoperative Outcomes versus Conventional Laminectomy

Authors and Affiliations: Ran Ankory[1], Amari Randhawa[1], Eric Crawford[1], Joel Finkelstein[1]

1 Division of Orthopaedic Surgery, Department of Surgery, Sunnybrook Health Sciences Centre, Toronto, Ontario, Canada

Purpose: Conventional laminectomy disrupts the posterior tension band by removing the spinous processes and detaching paraspinal muscle attachments, potentially contributing to greater early postoperative axial back pain. The spinous process splitting (SPS) approach preserves these midline structures while achieving neural decompression equivalent to conventional open laminectomy (COL). Although retrospective data suggest comparable long-term functional outcomes, early postoperative recovery trajectories remain poorly characterized. This study prospectively compares early postoperative back pain, leg pain, and functional recovery at 14 days following SPS versus COL, with a retrospective SPS cohort describing longer-term outcomes.

Methods: We conducted a single-centre retrospective and prospective cohort study of adults undergoing 1–3 level lumbar decompression without instrumentation for neurogenic claudication or radiculopathy. In the prospective cohort (target N = 60, ongoing), patients underwent SPS or COL with standardized assessments preoperatively and at postoperative day 14 (POD14): back and leg pain VAS, JOA score, ODI, and EQ-5D-5L, plus a 14-day daily pain diary summarized by area under the curve (AUC) and recovery slope. The retrospective cohort included 50 consecutive SPS patients (2021–2025) with outcomes at latest follow-up (6 months–5 years).

Results: This interim analysis includes 24 prospective participants with complete POD14 data (SPS N = 13, COL N = 11). In SPS, back VAS improved from 6.77 ± 2.24 to 2.77 ± 1.48 (P < 0.001), leg VAS from 7.92 ± 1.93 to 2.38 ± 3.18 (P < 0.001), and JOA from 6.85 ± 1.86 to 15.31 ± 3.57 (P < 0.001). In COL, leg VAS (P = 0.023) and JOA (P = 0.004) improved significantly, while back VAS did not (P = 0.20). SPS showed lower pain burden (AUC 63.6 ± 20.9 vs. 71.7 ± 30.5) and steeper recovery slopes (−0.32 ± 0.30 vs. −0.20 ± 0.21), though not statistically significant. Retrospective SPS outcomes (N = 50; median follow-up 23 months) showed marked improvement from baseline to best recovery (leg VAS −6.17; back VAS −5.35) with modest worsening at latest follow-up.

Conclusions: In this interim prospective cohort, SPS was associated with statistically significant improvement in back pain by POD14, whereas COL did not demonstrate a significant change over the same interval; both techniques showed early improvements in leg pain and JOA. Ongoing enrollment will enable higher-resolution characterization of postoperative recovery trajectories and may identify procedure-specific differences in early morbidity not captured by standard longer-term follow-up metrics.

Abstract # 3

Title: Surgical Decompression for Lumbar Spinal Epidural Lipomatosis: A Systematic Review and Meta-Analysis

Authors and Affiliations: Ran Ankory[1], Joel Finkelstein[1]

1 Division of Orthopaedic Surgery, Department of Surgery, Sunnybrook Health Sciences Centre, Toronto, Ontario, Canada

Purpose: Spinal epidural lipomatosis (SEL) is an increasingly recognized cause of neurogenic claudication, yet surgical outcomes remain poorly characterized. Prior systematic reviews have pooled case reports alongside series, introducing substantial reporting bias. This review aimed to synthesize outcomes of surgical decompression exclusively from case series of ≥10 patients with radiologically confirmed lumbar SEL.

Methods: A PRISMA-compliant systematic review was prospectively registered (PROSPERO CRD42020288512). Six databases were searched from inception through December 2025. Eligible studies reported surgical outcomes for radiologically confirmed SEL in series of ≥10 patients. Two reviewers independently screened, extracted, and appraised study quality using the Robbins criteria. Where ≥3 studies reported comparable pre- and post-operative continuous outcomes, random-effects

meta-analysis using Hedges' g with a DerSimonian–Laird model was performed; otherwise, narrative synthesis was conducted per SWiM guidance.

Results: Nine studies met inclusion criteria, comprising 239 surgically treated SEL patients (mean age 70.0 years, 64.9% male, mean BMI 28.5 kg/m²). All patients underwent posterior decompression with lipectomy. Meta-analysis demonstrated large improvements in back pain (Hedges' g = 2.65, 95% CI 1.25–4.05) and leg pain (g = 2.85, 95% CI 1.46–4.24), with substantial heterogeneity (I^2 >90% for both). Functional disability (ODI) improved significantly (g = 8.09, 95% CI 2.58–13.60; I^2 = 96.2%), with weighted mean ODI declining from 58.5 ± 9.8 preoperatively to 27.5 ± 13.8 at final follow-up — a 53% reduction. Composite surgical success ranged from 71–100% across studies. The overall complication rate was 10.4% (dural tear 4.0%, wound complications 4.0%, reoperation 5.6%, recurrence 2.4%); no perioperative mortality was reported.

Conclusions: Surgical decompression with epidural fat debulking is associated with clinically meaningful improvements in pain and function in lumbar SEL, with a complication profile comparable to standard lumbar decompression. Evidence is limited by retrospective designs, heterogeneous outcomes, and high between-study heterogeneity. Prospective comparative studies and standardized imaging severity reporting are needed to establish evidence-based surgical indications.

Abstract # 4

Title: NTG-102: A Refined Molecular Therapeutic to Treat Degenerative Disc Disease

Authors and Affiliations: Lori Moffat[2], Hoda Gerami[2], Bettina Benigno[2], Ajay Matta[2], Muhammad Z. Karim[2], MPhil, W. Taylor[3], Mark Erwin[1,2]

1 University of Toronto, Toronto, Ontario, Canada
2 Notogen Inc., Toronto, Ontario, Canada
3 University of California San Diego, San Diego, California, United States of America

Purpose: In vitro determination of the efficacy of a novel molecular therapeutic to treat degenerative disc disease

Methods: Bovine IVD-nucleus pulposus (NP) / annulus fibrosus (AF) cells encapsulated in alginate bead hydrogels (3D-cell culture) cultured under hypoxic conditions were used as in vitro models to test the efficacy of NTG-102 (i.e., rhTGF-β1 mixed in excipient solution) for its therapeutic potential. In addition, we used degenerative, painful IVD tissues derived from patients undergoing discectomy or fusion surgery

to compare the levels of Collagen type 2A1 in samples that were immunopositive or negative for TGF-β1 protein.

Results: Treatment with NTG-102 in the presence of IL-1β increased the expression of healthy ECM proteins aggrecan and collagen type 2 (ACAN / Col2A1), reduced the gene expression of the inflammation and pain marker (Cox-2) and the matrix degrading enzyme (MMP-13) in bovine IVD-NP/AF 3D-cell culture models in vitro. Moreover, treatment with rhTGF-β1 preferentially activated and sustained phsopho-Smad-2/3 signaling whereas phosphorylation of the Smad-1/5 pathway was undetectable in 3D-cell culture models of bovine IVD-NPs. Further, immunohistochemical analysis revealed significantly higher Col2A1 protein expression in TGF-β1 immunopositive patient derived degenerative IVD tissues than in TGF-β1 negative samples.

Conclusions: Notably, treatment with NTG-102, containing rhTGF-β1 as an important key ingredient, demonstrated higher in vitro efficacy in both IVD-NP AND Annulus Fibrosus (AF) models of DDD by inducing anabolic repair and suppressing inflammation / catabolic changes. The loss of TGF-β1 protein expression in a majority of the patient-derived human tissue samples was associated with a loss of collagen type 2 ECM protein and the onset of a catabolic microenvironment in IVD. NTG-102 is currently being formulated in collaboration with an international CRO and these findings coupled with past in vivo large animal studies will enable a first in humans pilot study projected to begin in mid 2026.

Abstract # 5

Title: Spinal Cord Morphometrics in Degenerative Cervical Myelopathy

Authors and Affiliations: Shintaro Honda[1,2], Mohammed A. Alvi[1], Michael G. Fehlings[1,2]

1 Division of Neurosurgery and Spine Program, Department of Surgery, University of Toronto, Toronto, Ontario
2 Division of Genetics and Development, Krembil Brain Institute, University Health Network, Toronto, Ontario

Purpose: The aim of this study was to characterize spinal cord morphometric indices using the SCT (SCT indices) in an international cohort of surgically treated patients with DCM and to provide descriptive statistics. This approach describes the characteristics of surgically treated patients and enables clinicians to assess an individual patient relative to a representative surgical population. Furthermore, this study sought to elucidate the relationship between SCT indices and clinical symptoms, and to evaluate the potential of SCT indices as imaging biomarkers for DCM.

Study design:

This study represents a retrospective imaging analysis of data derived from the AOSpine CSM-International study, a prospective, international, multicentre cohort designed to evaluate surgical outcomes in patients with degenerative cervical myelopathy (DCM). The original study enrolled 479 consecutive patients with symptomatic DCM between 2007 and 2011 across multiple centres in Asia–Pacific, Europe, Latin America, and North America [2].

Automated image metrics (SCT indices):

Among 201 available MR scans, 117 with slice thickness <6 mm were reviewed, and after exclusion of non-cervical, non-displayable, postoperative scans, 106 scans were processed using the SCT (v7.2) . All segmentations were visually inspected, resulting in 100 cases for final analysis. Per-slice morphometric metrics including cross-sectional area (CSA), AP/RL diameters, solidity, eccentricity, and flattening were computed using standardized SCT metrics [3] . The stenosis index (SI) quantifies spinal cord compression by normalizing the CSA at each slice to the maximum CSA within a ±15 mm region centered at that level. SCT indices were extracted within surgically treated levels, and summary measures (minimum CSA, minimum solidity, maximum flattening, maximum eccentricity, and maximum SI) were used for analysis. Total T2 hyperintensity lesion volume (tT2HLV) was calculated from lesion masks and voxel volume.

Outcome:

At baseline and 2-year follow-up, signs and symptoms of myelopathy, the modified Japanese Orthopaedic Association (mJOA) score, Nurick grade, Neck Disability Index (NDI), and Short Form-36 version 2 score were investigated.

Statistical analysis:

Analyses were performed in R using complete-case data for each test; two-sided $p < 0.05$ was considered statistically significant.

Spearman rank correlations were used to assess associations between SCT indices and baseline mJOA total score and subdomains (Q1–Q4). Subgroup Spearman analyses were repeated in OPLL patients as sensitivity analysis. Linear regression models were fitted to predict baseline mJOA Q2, and models were adjusted for clinically important variables selected a priori based on clinical discussion. Multicollinearity was assessed using variance inflation factors (VIF). For postoperative outcomes,

Spearman correlations were computed between 2-year mJOA MCID and SI/tT2HLV. MCID rates were visualized across fixed SI bins (width 0.05), and proportions were summarized for SI <0.2, 0.2–0.4, and >0.4. A cutoff within SI <0.3 was identified by maximizing Youden's index.

Results:

The cohort included 100 patients (mean age 57.6 ± 10.9 years; 63% male). Race distribution was 69% White, 18% Asian, 12% Black or African American, and 1% Native American. Fifty-six patients (56%) were smokers. The most common diagnoses were cervical spondylosis (78%), disc herniation (62%), hypertrophy of the ligamentum flavum (44%), and ossification of the posterior longitudinal ligament (OPLL; 26%).

Association between SCT indices and clinical scores:

Cases with severe mJOA trended toward higher SI and flattening and lower CSA and solidity, but these differences did not reach statistical significance in this cohort (Figure 2). The minimum spinal cord CSA at the surgical level was approximately 50 mm². Although this value is not normalized for variation, the CSA in our cohort was lower than that reported in previous studies of healthy control populations [3,4]. The SI at the level of compression was approximately 0.3 in patients with moderate/severe DCM. Even in patients with mild DCM, an SI of ≥0.3 may need careful clinical follow-up as stenosis has been reported to be associated with myelopathy progression [5].

Baseline mJOA was weakly and inversely correlated with SI (Spearman rho = -0.197, p = 0.049). No other SCT indices showed significant correlations with baseline mJOA.

Furthermore, correlations between SCT indices and mJOA subdomains were analyzed. In univariate analyses, only the lower-extremity motor subscore (mJOA Q2) showed significant correlations with SI (rho = -0.258, p = 0.010) and tT2HLV (rho = -0.215, p = 0.032). In the linear regression model including age, sex, modified frailty, the coefficients for SI and tT2HLV were β = -2.79 (95% CI: -5.0 to -0.6; p = 0.013) and β = -0.004 (95% CI: -0.006 to -0.001; p = 0.002) (Figure 3). These findings suggest that spinal cord compression may have a stepwise effect on the long tracts. In addition, SI was also correlated with mJOA in OPLL characterized by sustained spinal canal narrowing over a continuous segment, demonstrating the clinical robustness of SI as a quantitative metric (rho = -0.474, p = 0.014). In terms of postoperative outcomes, no significant correlations were found between MCID of mJOA at 2 years and either SI or tT2HLV (Spearman: MCID vs SI, ρ = 0.00, p = 1.00; MCID vs tT2HLV, ρ = 0.025, p = 0.817; n = 87). These findings suggest that the presence of T2 hyperintensity lesion does not

preclude postoperative functional improvement.

When MCID rates were visualized across SI ranges, MCID achievement was 0.545 for SI < 0.2 (n = 22), 0.661 for SI = 0.2–0.4 (n = 56), and 0.444 for SI > 0.4 (n = 9), showing a trend toward higher improvement rates in the intermediate SI range. This distribution suggests that low SI may reflect non-compressive contributors to symptoms, whereas high SI may be associated with more irreversible cord damage.

Exploratory cutoff analysis within the SI < 0.3 range identified an optimal threshold of SI = 0.21 based on the maximum Youden index (sensitivity = 0.59, specificity = 0.61; n = 47). Taken together, these results indicate that SI ≈ 0.2 may represent a potential decision boundary for considering surgical intervention in DCM.

Conclusions: This study automatically quantified spinal cord imaging indices in a global surgical DCM cohort and described their distributions. We introduced a simple stenosis index derived from automated segmentation to quantify spinal cord compression. The stenosis index and T2 hyperintensity lesion volume were associated with baseline lower-extremity motor dysfunction. Neither the stenosis index nor T2 lesion volume predicted 2-year functional improvement. However, MCID achievement was highest at intermediate stenosis index values, suggesting a stenosis index of 0.2 as a practical boundary for surgical intervention in DCM.

Abstract # 6

Title: Rod Fracture Mechanisms in Long-Segment Spinal Fusion: Comparative Analysis of Pseudarthrosis vs. Fusion-Mass Fatigue

Authors and Affiliations: Bandar Alzahrani[1], Lauren Daunt[2], Eliana Seider[2], Vanessa Vashishth[2], Aazad Abbas[2], Matthew Kwok[2], Stephen Lewis[1]

1 Division of Orthopaedic Surgery, Department of Surgery, Toronto Western Hospital (University Health Network), Toronto, Ontario, Canada
2 University of Toronto, Toronto, Ontario, Canada

Purpose: Rod fracture after long-segment thoracolumbar fusion is a well-recognized complication, traditionally attributed to pseudarthrosis. However, clinical experience suggests that fractures can also

occur through an apparently solid fusion mass, likely reflecting biomechanical and biological compromise of the fused bone. This study aimed to identify factors associated with rod fracture over a 10-year period, emphasizing the role of bone quality, fixation completeness, and interbody support.

Methods: A retrospective review of 263 patients undergoing thoracic to pelvic fusions between 2014–2023 were retrospectively reviewed. Patients were stratified by fracture mechanism: fusion mass fracture (n = 24) versus pseudarthrosis (n = 21) based on CT scan findings at the time of their rod fractures. Clinical, radiographic, and construct parameters—including bone density (HU), interbody support, missed fixation points, and junctional degeneration—were assessed. Statistical comparisons and logistic regression were performed to identify predictors of rod failure. All were treated with 2 rod constructs.

Results: Of the 263 patients, 52 patients were identified with rod fractures. Seven patients were excluded due to incomplete postoperative CT scans or missing data, leaving 45 patients for analysis. The mean age was 63 ± 9 years, with 62% females. The average time to rod fracture was 33 ± 17 months, and the mean HU was 118 ± 58. Rod fracture occurred through a fused segment in 24 patients (53%) and across pseudarthrosis in 21 patients (47%). In the fusion mass fracture subgroup, a transverse fracture within the fusion bone was identified, while in the pseudarthrosis, clear discontinuity of the fusion mass through the facet joints was evident. Independent predictors of rod fracture included HU <120, missed pedicle screws, and absence of interbody cages ($p < 0.05$ for all). Pseudarthrosis most often occurred at the lumbosacral junction, whereas the fusion masses fractures occurred in the mid and upper lumbar regions. Fusion mass fractures occurred later than fractures seen for pseudarthrosis.

Conclusions: Rod fracture may develop not only from pseudarthrosis but also from fatigue failure within a solid posterior fusion mass, particularly when anterior column support is lacking and in areas of lower screw density. Preventive strategies should therefore be considered that include higher screw density, interbody reconstruction and accessory rods to minimize the risk of late mechanical failure.

Abstract # 7

Title: Patient Specific Virtual Reality for Spine Surgery Education

Authors and Affiliations: Yuyang (Tony) Jiao[1], Ran Ankory[1], Raj Kumar Ranabhat[1], Tayler Declan Ross[2], Joel Finkelstein[1], Michael Hardisty[1,2]

1 Sunnybrook Health Sciences Centre, Toronto, Canada
2 Division of Orthopaedic Surgery, Department of Surgery, University of Toronto, Toronto, Canada

Purpose: Effective surgical education requires multimodal approaches, yet hands-on training is often limited by patient safety concerns and restricted operating room access. While Virtual Reality (VR) simulations improve performance, most platforms utilize generic scenarios that fail to align with specific clinical cases, limiting trainee uptake. The objective of this study was to evaluate the feasibility, face validity, and preliminary learning impact of a novel VR platform that converts patient-specific lumbar stenosis MRI/CT data into interactive 3D models for bespoke pre-operative instruction.

Methods: Patients scheduled for elective lumbar spinal stenosis (L2–S1) surgery were eligible for model generation. The platform automates anatomical segmentation using nnU-Net for soft tissues and an in-house neural network for vertebrae. These segmentations are merged via affine and deformable registration into high-fidelity, simulation-ready 3D models featuring interactive decompression tools and real-time bone removal. Trainees participated in faculty-led walkthroughs and exploration. Assessment included case-specific pre/post-tests generated by a large language model (LLM)—expert-reviewed prior to use—alongside self-reported confidence and engagement metrics.

Results: Nine trainees (undergraduates, residents, and fellows) completed the sessions. Participants reported that the 3D anatomy closely mirrored intra-operative landmarks, facilitating precise instrument positioning. Median test scores improved from 6/10 (range 0–10) to 7/10 (range 1–10), with a median gain of +1; the largest absolute gains occurred in lower-baseline learners. Among respondents (n=7), median post-session confidence was 5/10 (range 1–9) and engagement was 8/10 (range 6–10). Qualitative feedback emphasized the platform's utility for deliberate pre-operative planning and improved 3D anatomical comprehension not feasible in a busy operating room environment.

Conclusions: The automated generation of patient-specific spine models allows for scalable, case-based VR rehearsal. Preliminary results suggest significant educational benefits in anatomical knowledge and surgical planning. A larger clinical study is ongoing to further quantify the impact on decision-making and confidence, informing the integration of VR into competency-based surgical curricula.

Abstract # 8

Title: Does Anterior Plating Improve Outcomes in ACDF? A Comparative Analysis of Cage-Only Versus Cage-with-Plating Techniques: A Comprehensive Meta-Analysis of Clinical and Radiological Outcomes

Authors and Affiliations: Mohammad Abdullah Almalki[1]

1 Department of Surgery, University of Toronto, Toronto, Ontario, Canada

Purpose: Anterior cervical discectomy and fusion (ACDF) is a common operation done to address cervical disc issues. Whether cage-only or cage-with-plating methods should be used is still up for argument; some research indicate that plating could offer more stability and enhance clinical results. However, the effect of plating on ACDF's radiographic and clinical results is not yet proven. This study looks at how well cage-only and cage-with-plating methods work, both from a clinical and a radiological point of view

Methods: A thorough search across several sources found 16 studies that fit the inclusion criteria. There were 1325 total patients, 615 of whom had cage-only operations and 710 of whom had cage-with-plating procedures. The research encompassed observational, retrospective, and randomized controlled experiments. Meta-analysis methods were used to examine the combined data, contrasting the two surgical techniques across a number of clinical and radiological results. For each outcome, standardized mean differences (SMDs) and risk ratios (RRs) were determined.

Results: Regarding cervical alignment (pre- and post-operatively), segmental angle, or segmental height, both pre- and post-operatively, the meta-analysis found no major differences between the two groups. Furthermore, the Neck Disability Index (NDI) and Visual Analog Scale (VAS) scores showed no notable differences in clinical outcomes. Moreover, the cage-only and cage-with-plating groups did not differ notably in terms of subsidence, adjacent segment disease (ASD), and fusion rates

Conclusions: In ACDF, cage-only treatments have no appreciable advantages over cage-with-plating methods in terms of clinical or radiological results, according to this meta-analysis. In terms of cervical alignment, segmental stability, clinical recovery, and long-term consequences, both techniques yield

somewhat similar outcomes. These results imply that best outcomes in ACDF might not require plating, hence promoting cage-only techniques as a successful and perhaps less intrusive alternative.

Abstract # 9

Title: Proximal Junctional Kyphosis in Early-Onset Scoliosis Revisited: Local Versus Global Alignment Factors

Authors and Affiliations: Ahmad Alelaumi[1], Nadav Rinott[1], Emma Nadler[1], Mark Camp[1,2], Lily Switzer[1], Jennifer Dermott[1], David Lebel[1,2]

1 Division of Orthopaedic Surgery, Department of Surgery, The Hospital for Sick Children, Toronto, Ontario, Canada
2 Department of Surgery, University of Toronto, Toronto, Ontario, Canada

Purpose: To evaluate the incidence and risk factors for proximal junctional kyphosis (PJK) in early-onset scoliosis (EOS) among patients treated with spine-spine distraction instrumentation, and to investigate the local effects of different proximal anchor types (i.e., all hooks vs. combined hooks and screws) as well as the impact of staging the instrumentation (i.e., 1 stage for anchor placement, rods insertion and deformity correction vs, 2 stages with anchors placed first stage and rods and deformity correction second stage).

Methods: A retrospective cohort study was conducted on 45 EOS patients who underwent a spine-spine dual growing rod (GR) insertion between 2010 and 2023, with a minimum follow-up of 2 years. Patient charts and radiographs were reviewed, and demographic data and surgical details were collected. Patients were categorized according to proximal anchor type (all hooks, n=30; combined hooks and screws; n=15), and according to staging of GR insertion (staged, n=23; unstaged; n=22). Radiographic parameters included curve magnitude, global kyphosis, and proximal junctional angle (PJA) at different timepoints. PJK was defined as a PJA >10 degrees and an increase in PJA of at least 10 degrees from the preoperative value. Statistical tests included independent sample t-tests and linear mixed model regressions.

Results: The overall PJK incidence was 13.3% (6/45): 10% in the all-hooks group (n=3) and 20% in the combined group (n=3) (p = 0.384). PJK incidence in the unstaged group was 22.7% (n=5) compared to 4.3% in the staged group (n=1) (p = 0.096) . In both groups, the PJA gradually increased

over time, with mean values 6° higher in the combined group and 4° higher in the unstaged group at 2 years. No differences were found in preoperative or postoperative global kyphosis between the groups.

Conclusions: In EOS patients treated with a distraction spine–spine construct, the PJA continues to increase over time. Local factors, including the use of all-hook proximal anchors and staged instrumentation, were associated with a lower incidence of PJK in our cohort, although this difference did not reach statistical significance. Local factors may play a more important role than global alignment in PJK development in EOS.

Abstract # 10

Title: Predictors of In-hospital Mortality Among Operative Traumatic Spine Fractures without Neurologic Deficit

Authors and Affiliations: Vincent C. Ye[1,2], Christopher S. Lozano[1,2,3], Vishwathsen Karthikeyan[1,2,3], Husain Shakil[1,2,3], Armaan K. Malhotra[1,2,3], Ahmad Essa[2,3,4], Christopher D. Witiw[1,2,3]

1 Division of Neurosurgery, Department of Surgery, University of Toronto, Toronto, Ontario, Canada
2 Li Ka Shing Knowledge Institute, St Michael's Hospital, Toronto, Ontario, Canada
3 Institute of Health Policy Management and Evaluation, University of Toronto, Toronto, Ontario, Canada
4 Faculty of Medicine, Tel Aviv University, Tel Aviv, Israel.

Purpose: Traumatic spine fractures are a common occurrence in trauma patients and contribute to significant mortality and morbidity. However, the outcomes of major traumatic spine fractures in patients without spinal cord injury (SCI) and are not well explored.

Objective: The primary objective of this study was to assess factors associated with in-hospital mortality in patients with surgically-treated major traumatic spine fractures without neurologic deficit.

Methods: This retrospective observational cohort study used data from the American College of Surgeons Trauma Quality Improvement Program (TQIP) database between 2017 and 2020. The study included adult patients with traumatic spine fractures, excluding patients with neurologic deficits, and isolated transverse/spinous process fractures. A total of 29, 951 patients from 629 centres were analyzed. We selected for our population of interest with operative spine fractures, in patients with major trauma (Injury Severity Score > 16).

The primary outcome was in-hospital mortality among operative spine fracture patients. Secondary outcomes included identifying factors associated with mortality a using Firth logistic regression.

Results: There were 110 921 major trauma patients with spine fractures. Of these, 18.2% were injures that underwent operative management (n = 20 224). In operative spine fractures without neurologic deficit, mortality is a rare event (4.7%). Adjusted odds ratios were estimated using Firth penalized logistic regression to account for rare events and quasi-complete separation. Between-centre variation was assessed using a mixed-effects logistic regression model with facility as a random intercept.. Factors predictive of in-hospital mortality: pre-existing renal co-morbidity (OR 2.12 95% CI 1.32 – 3.28), severe abdominal injury (OR 2.07, 95% 1.46 – 2.86), male sex (OR 2.02, 95% CI 1.68 – 2.44), cervical spine fracture (OR 1.98, 95% CI 1.52 – 2.60), severe head injury (OR 1.78, 95% CI 1.47-2.15), severe thoracic injury (OR 1.67, 95% CI 1.33 – 2.09), and pre-hospital hypotension (OR 1.56, 95% CI 1.09 – 2.17). Surgery within 24 hours of admission was predictive against mortality (OR 0.61, 95% CI 0.53 – 0.71)

Conclusions: Among patients with operatively managed major traumatic spine fractures without neurologic deficit, in-hospital mortality was uncommon and driven primarily by systemic injury severity and pre-existing comorbidity rather than spine pathology. Early surgical intervention within 24 hours was independently associated with improved survival, supporting timely operative management and emphasizing the importance of early resuscitation and multidisciplinary trauma care in this high-acuity population.

Abstract # 11

Title: Minimally Invasive Stabilization of Ankylosed Spine Fractures: An Institutional Case Series and Pooled Systematic Review

Authors and Affiliations: Vincent C. Ye[1,2], Christopher Lozano[1,2,3], Vishwathsen Karthikeyan[1,2,3], Husain Shakil[1,2], Armaan K. Malhotra[1,2], Christopher D. Witiw[1,2,3]

1 Division of Neurosurgery, Department of Surgery, University of Toronto, Toronto, Ontario, Canada

2 Li Ka Shing Knowledge Institute, St Michael's Hospital, Toronto, Ontario, Canada

3 Institute of Health Policy Management and Evaluation, University of Toronto, Toronto, Ontario, Canada

Purpose: Ankylosing conditions of the spine, most commonly ankylosing spondylitis (AS) and diffuse idiopathic skeletal hyperostosis (DISH), predispose patients to unstable spinal fractures with high rates of morbidity and mortality. Minimally invasive surgery (MIS) has emerged as an alternative to traditional open fixation, but optimal construct length and outcome durability remain incompletely defined.

Methods: A retrospective institutional review was performed of patients with ankylosed thoracolumbar fractures treated with MIS posterior fixation between 2020 and 2025. A pooled systematic review of the literature was also conducted following PRISMA guidelines. Outcomes included complications, fusion or pseudoarthrosis, revision surgery, mortality, and neurologic deterioration. Subgroup analyses were performed for AS versus DISH

Results: The institutional cohort included 10 patients (mean age 78.4 years), all with AO Spine B3 fractures treated with moderate-length constructs (mean 4.0 levels). No surgical complications, neurologic deterioration, revision surgeries, pseudoarthrosis, or mortality were observed. Three patients (30%) experienced medical complications. The pooled analysis included 19 studies comprising 485 patients. Overall complication rate was approximately 24%, with more than 80% being medical in nature. Surgical complications were uncommon (~4%). Most studies employ traditional long posterior constructs (≥ 6 instrumented levels) which demonstrated near-universal fusion (97–100%). Moderate length constructs (4-5 instrumented levels) also demonstrated good biomechanical outcomes, with revision surgery and postoperative neurologic deterioration being rare. DISH patients exhibited higher complication rates and mortality compared with AS patients. Temporal analysis demonstrated progressive reductions in complication and mortality rates over time.

Conclusions: Minimally invasive posterior fixation provides safe and durable stabilization for ankylosed thoracolumbar fractures. Moderate-length constructs of approximately four to five levels achieve excellent biomechanical durability without increased complication or revision rates and may represent an optimal balance between stability and invasiveness. DISH patients remain at higher medical risk, underscoring the importance of perioperative optimization. These findings support refinement of fixation strategies toward individualized, moderate-length MIS constructs in ankylosed spine fractures.

Abstract # 12

Title: Fracture Prediction Using Deep Learning

Authors and Affiliations: Rachel Leung[1,2], Allison Tolgyesi[1,2], Kennice Wong[2,3], Cari Whyne[1,2,4], Michael Hardisty[1,2,4]

1 Institute of Biomedical Engineering, University of Toronto, Toronto, Ontario, Canada
2 Orthopaedic Biomechanics Lab, Sunnybrook Research Institute, Toronto, Ontario, Canada
3 Faculty of Applied Science & Engineering, University of Toronto, Toronto, Ontario, Canada
4 Department of Surgery, University of Toronto, Toronto, Ontario, Canada

Purpose: Understanding bone mechanics is both challenging and essential for developing insight into the functioning of normal and diseased bone, specifically how it responds to trauma, and effective methods for its mechanical stabilization. Diseases cause changes in bone structure and properties that affect mechanical strength, leading to elevated fracture risk, morbidity and mortality. Current modelling techniques, such as micro finite element analysis (uFEA) models rely on analytically solving mechanics equations for sample-specific geometries, making them computationally complex and labor-intensive, which limits their practical application. Deep Learning (DL), a data-driven approach, offers an alternative by modeling physical systems from relationships in data, simplifying model formulation. This project seeks to combine simple mechanics models with DL to develop hybrid models that can model bone damage mechanics and predict fracture.

Methods: We hypothesize that hybrid models will generate higher quality synthetic fractured μCT images and will better replicate experimental fractures than pure DL. Rat lumbar vertebrae μCTs (n=72) were obtained during axial compressive loading to train both models. Hybrid models integrate conditional generative adversarial networks (cGAN) and simple mechanics models. cGAN input included the output of simple mechanical models (axial rigidity, principal strain magnitude or a bone segmentation (used for ablation)) and the unloaded μCTs. Model performance was assessed based on similarity to the ground truth with fracture location agreement (F1, dice similarity coefficient) and image quality (Fréchet inception distance, structural similarity index).

Results: Both DL only and hybrid models generated realistic synthetic μCT images with fractures. Synthetic fractures were present in 62% of the validation set (n=8). Hybrid models using axial rigidity and bone labels outperformed the baseline DL model, with 4% and 25% improvement in F1 score in the number of fractures predicted in the correct location. Image quality metrics were similar for all models. Lack of diversity was evident in the synthetic images because of the presence of identical artifacts appearing in multiple predictions.

Conclusions: This suggests that incorporating simpler biomechanical predictions into generative DL models can enhance fracture prediction accuracy from vertebral imaging. Future work will focus on mitigating this issue to improve the accuracy and quality of predictions.

Abstract # 13

Title: MRI Tissue Bridges Predict Recovery and Treatment Response After Cervical Spinal Cord Injury: A Sub-Analysis of the RISCIS Trial

Authors and Affiliations: Mouad Elganga[1], Mohammed Ali Alvi[1,2], Raman Abbaspour[1], Yuxii Zhang[1], Karlo Pedro[1,2], Michael G. Fehlings[1,2]

1 University of Toronto, Toronto, ON, Canada.
2 University Health Network, Toronto, ON, Canada

Purpose: Cervical spinal cord injury (SCI) is a devastating condition where accurate early prognostication remains a challenge that complicates patient counseling, rehabilitation, and efficient clinical trial design. Following injury, small regions of intact tissue, referred to as “tissue bridges,” may remain across the lesion site and represent preserved neural pathways. We investigated whether the size of tissue bridges, measured on routine MRI, can serve as a clinically useful biomarker to predict recovery and identify patients most likely to benefit from neuroprotective therapy.

Methods: We analyzed participants from the multicentre Riluzole in Spinal Cord Injury Study (RISCIS) who underwent acute T2-weighted MRI. RISCIS was a RCT that demonstrated benefit of riluzole on recovery across neurological, functional, and quality of life (QOL) measures on secondary analysis. Using automated segmentation (Spinal Cord Toolbox v7.2), we quantified the width of residual tissue bridges spanning the injury site (ventral, dorsal, and total). We evaluated relationships between tissue-bridge size and baseline injury severity (American Spinal Injury Association [ASIA] impairment scale), motor function, independence, and QOL over 12 months using multivariable regression. A global statistical test was used to assess overall recovery across neurological, functional, and QOL outcomes. Interaction analyses assessed whether tissue bridges influenced response to riluzole.

Results: Twenty-four participants were included (12 riluzole, 12 placebo). Larger tissue bridges were consistently associated with less severe injury (ASIA grade) and better baseline motor and sensory

function ($p<0.05$ for ventral, dorsal, and total bridge width). Ventral and total tissue-bridge size predicted 12-month recovery across motor, functional, and quality-of-life domains ($p=0.012$, 0.025, respectively). Importantly, larger ventral tissue bridges identified patients who derived greater upper-limb motor recovery with riluzole compared to placebo ($\beta=17.08$, $p=0.035$).

Conclusions: Tissue bridges captured on early MRI provide a simple, clinically translatable, and biologically meaningful measure of spared spinal cord pathways. This study demonstrates that they not only predict recovery but also modify treatment response in a randomized trial setting, thus representing a biomarker that identifies patients more likely to benefit from treatment. With further research, incorporation of tissue-bridge metrics into clinical practice and trial design could enable earlier prognostication, better patient stratification, and more efficient evaluation of emerging therapies.

Abstract # 14

Title: Examining Regionally Specified Spinal Neural Progenitor Cells and Targeted Forelimb Rehabilitation in Enhancing Recovery After Bilateral Compressive-Contusive Cervical Cord Injury

Authors and Affiliations: Aysu Kollu[1,2], Shanhang Jia[3], Azam Asgarihafshejani[2], Brett McIntyre[1,2], Mohamad Khazaei[4], James Hong[2], Michael G. Fehlings[1,2,5]

1 Institute of Medical Science, University of Toronto, Toronto, Canada;
2 Genetics and Development, Krembil Research Institute, University Health Network, Toronto, Ontario, Canada;
3 Xuanwu Hospital of Capital Medical University, Beijing, China
4 Department of Anatomy, University of Toronto, Toronto, Ontario, Canada
5 Division of Neurosurgery and Department of Surgery, University of Toronto, Toronto, Ontario, Canada

Purpose: Transplantation of regionally specified spinal cord neural progenitor cells (spNPCs) represents a novel approach to promote enhanced graft integration, neural repair, and functional recovery following cervical spinal cord injury (SCI). In the study, we aimed to examine the therapeutic effect of combining spNPC transplantation with forelimb rehabilitation in SCI.

Methods: Following a unique and clinically relevant bilateral C6/C7 clip compression-contusion SCI (n=52), female immunodeficient Rowett Nude rats were randomly assigned to injury, rehabilitation, spNPC transplantation, and rehabilitation + spNPC transplantation groups (n=8-15/group). Control animals (n=9) received a laminectomy surgery. 4-7 days after spNPC transplantation, 8 weeks of forelimb

rehabilitation was conducted and involved two pellet reaching tasks that enabled continuous engagement. Forelimb grip strength, Montoya staircase test (skilled reaching), inclined plane (trunk stability), and Von Frey (mechanical sensitivity) were conducted biweekly for 15 weeks post-SCI to examine behavioural outcomes. CatWalk gait analysis (locomotion) and electrophysiological assessment of the corticospinal tract (n=8-12/group) were completed at endpoint. Perilesional scar components (collagen IV and chondroitin sulfate proteoglycans), excitatory synapses, and spNPC differentiation were assessed by immunohistochemistry and confocal imaging (n=4-6/group).

Results: The combined treatment enabled better performance at the Montoya staircase test ($p<0.05$; weeks 3-13) and grip strength test ($p<0.05$; weeks 7-9), demonstrating improved recovery of forelimb function. The combined treatment also improved electrophysiological outcomes, specifically the stimulation threshold, latency, and total muscle response ($p<0.05$).

Conclusions: The observed enhancement in functional and electrophysiological recovery indicates the importance of regional specification of cell therapies and targeted rehabilitation strategies as exciting approaches to inform future therapeutic strategies.

Abstract # 15

Title: Optimal Timing and Agent Selection for Thromboprophylaxis in Acute Spinal Cord Injury: A National Trauma Database Analysis

Authors and Affiliations: Aazad Abbas[1], Robert Koucheki[1], Vishwathsen Karthikeyan[2], Christopher Lozano2, Jay Toor[3], Albert J. M. Yee[1], Robert Fowler[4], Avery Nathens[5], Stephen Lewis[1], Jefferson R. Wilson[2], Christopher D. Witiw[2], Michael G. Fehlings[2], Cari Whyne[1], Jetan Badhiwala[2]

1 Division of Orthopaedics, Department of Surgery, University of Toronto, Toronto, Ontario, Canada
2 Division of Neurosurgery, Department of Surgery, University of Toronto, Toronto, Ontario, Canada
3 Section of Orthopaedic Surgery, Department of Surgery, University of Manitoba, Winnipeg, Manitoba, Canada
4 Department of Medicine, University of Toronto, Toronto, Ontario, Canada
5 Division of General Surgery, Department of Surgery, University of Toronto, Toronto, Ontario, Canada

Purpose: Venous thromboembolism (VTE) is a leading cause of preventable morbidity and mortality after acute spinal cord injury (SCI). Despite guideline recommendations for pharmacologic thromboprophylaxis, uncertainty persists regarding the optimal agent—low molecular weight heparin

(LMWH) versus unfractionated heparin (UFH)—and the ideal timing of initiation. This study aimed to determine both the preferred pharmacologic agent and the optimal postoperative window for thromboprophylaxis in acute SCI.

Methods: Two complementary analyses were performed using the American College of Surgeons Trauma Quality Improvement Program (TQIP) database (2017–2023). Adults with acute SCI secondary to blunt trauma undergoing operative treatment within 24 hours were included. For agent comparison, a leave-one-out instrumental variable (IV) analysis using hospital-level prescribing preference was employed to control for unmeasured confounding, comparing LMWH versus UFH. For timing optimization, restricted cubic spline modeling identified a risk inflection point, followed by propensity score–matched comparison of early (<48 hours, i.e. postoperative day 1) versus late (≥48 hours) thromboprophylaxis initiation. Primary outcomes were in-hospital VTE events; secondary outcomes included mortality, return to operating room, and length of stay.

Results: In the agent analysis (N=12,046; LMWH: 8,782; UFH: 3,264), LMWH was associated with a 58% reduction in VTE compared to UFH (OR 0.42; 95% CI: 0.29–0.60; p<0.001), with no significant differences in mortality (p=0.053) or length of stay (p=0.417). In the timing analysis (N=15,960), spline modeling revealed increasing VTE risk beyond postoperative day 1. Propensity-matched comparison (N=6,867 per group) demonstrated that thromboprophylaxis initiated by postoperative day 1 was associated with lower VTE rates (4.7% vs. 5.9%; OR 1.26; 95% CI: 1.09–1.46; p=0.002), reduced mortality (4.0% vs. 4.9%; OR 1.28; p=0.003), shorter hospital stay (15.8 vs. 16.9 days; p<0.001), and no increased risk of return to operating room for same-level spine procedure (p=0.07).

Conclusions: This large-scale national analysis provides robust evidence that LMWH, initiated by postoperative day 1, represents the optimal thromboprophylaxis strategy in acute SCI. Together, these findings offer a unified, evidence-based framework for VTE prevention that may establish a new clinical standard for this high-risk population.

Abstract # 16

Title: Variability of Mechanism of Mechanical Complications Between Low-Thoracic to Pelvis and Lumbar to Pelvis Fusions Accurately Predicted by Musculoskeletal Analysis

Authors and Affiliations: Christopher J. Nielsen[1], Fatemeh Alavi[1], Vanessa Giddins[1], Raja Rampersaud[1], Stephen Lewis[1]

1 Toronto Western Hospital (University Health Network), Toronto, Ontario, Canada

Purpose: Postoperative mechanical complications are the most common cause of reoperation following spinal fusion, underscoring the need to understand and mitigate fusion-induced biomechanical changes. There are limited biomechanical studies to predict the development of mechanical complication following correction fusion surgery. This study aimed to predict the mechanical complications in patients undergoing adult spine deformity (ASD) surgery from lumbar and lower thoracic to the pelvis investigating if increased postoperative/preoperative forces at upper-instrumented vertebra (UIV) and UIV+1 levels are associated with the development of mechanical complications (MCs).

Methods: 66 ASD patients, 27 with T10 to the pelvis and 39 from L2 to pelvis, with minimum 18-month follow-up were reviewed in this retrospective study. Patient-specific musculoskeletal (MSK) models were created by adjusting sex, height, weight and spinal curvature based on preoperative and immediate postoperative EOS images. MSK analyses were performed under upright standing and 20-degree trunk flexion posture. Vertebral forces (shear and compression) at UIV and UIV+1 and post-to-pre operative load ratio were calculated. A high-risk patient for MC development was defined as one demonstrating elevated shear and/or compression forces with a load ratio >1.

Results: A total of 66 patients were included in the study, comprising 32 with and 34 without mechanical complications. Of 32 patients with MCs, 28 patients (87.5%) were predicted by MSK approach. Overall, the musculoskeletal modeling approach achieved 75% accuracy, with 87.5% sensitivity and 63.3% specificity. Lower thoracic-to-pelvis fusion exhibited high post-to-pre shear ratios, whereas lumbar-to-pelvis fusion showed high post-to-pre compression ratios suggesting shear loading is more critical in long thoracic constructs, while compressive loading is more influential in shorter lumbar constructs.

Conclusions: Musculoskeletal modeling accurately predicted mechanical complications following spinal fusion, with distinct failure mechanisms depending on fusion level. Increased shear loading was predictive of complications in lower thoracic-to-pelvis fusions, whereas elevated compressive loading predominated in lumbar-to-pelvis fusions. Identifying high-risk patients using postoperative-to-preoperative load ratios can inform preoperative planning and guide strategies to minimize mechanical complications, potentially improving long-term outcomes and reducing revision rates.

Abstract # 17

Title: Torsemide Enhances Functional Recovery After Cervical Spinal Cord Injury by Modulating NKCC1-Mediated Hyperexcitability

Authors and Affiliations: Omar I. Hassan[1,2], Soichiro Takamiya[2], Azam Asgarihafshejani[2], Daniel Furlan[1], Mohammad Zavvarian[2], Akshat Modi[1,2], Tetsuhiko Mimura[2], James Hong[1,2], Michael G. Fehlings[1,2,3]

1 Institute of Medical Science, University of Toronto, Toronto, Ontario, Canada
2 Division of Genetics and Development, Krembil Brain Institute, University Health Network, Toronto, Ontario, Canada
3 Division of Neurosurgery and Spine Program, Department of Surgery, University of Toronto, Toronto, Ontario, Canada

Purpose: Traumatic spinal cord injury (SCI) is a devastating condition that compromises motor, sensory, and autonomic function, resulting in long-term disability and reduced quality of life. SCI disrupts chloride homeostasis by upregulating Na-K-2Cl cotransporter 1 (NKCC1), which shifts GABAergic signaling towards excitation. This pathological shift exacerbates neuronal hyperexcitability, contributing to persistent neurological dysfunction. Although NKCC1 inhibition has shown preclinical promise through bumetanide, poor blood-spinal cord barrier (BSCB) permeability has limited its translational potential due to invasive intrathecal injections.

This study investigates torsemide, an FDA-approved NKCC1 inhibitor with pharmacokinetic advantages over bumetanide including improved bioavailability, a longer half-life, and greater penetration into the injured spinal cord. We hypothesized that systemic torsemide administration would attenuate hyperexcitability and enhance functional recovery after cervical SCI.

Methods: Female rats underwent clip-compression SCI and received bidaily intraperitoneal injections of torsemide (0, 2, 4, or 6mg/kg) for eight weeks before transcardial perfusion. Neurobehavioural recovery was assessed weekly through Basso, Beattie and Bresnahan scoring, grip strength, and inclined plane with terminal walking analysis conducted via CatWalk XT. Motor evoked potentials (MEP) and immunohistochemistry evaluated neuronal excitability and membrane NKCC1 expression.

Results: Torsemide improved forelimb and hindlimb function in a dose-dependent manner, significantly enhancing grip strength, stance, and locomotion with trends toward improvement in inclined plane performance. Complimenting functional improvements, the 6 mg/kg group showed reduced NKCC1

expression and attenuated hyperexcitability in the ventral horn as evidenced by reduced Vglut2 expression and in MEPs through decreased latency, area under the curve, and amplitude – closely resembling sham data.

Conclusions: Our findings suggest that torsemide can penetrate the injured spinal cord to reduce pathological hyperexcitability, promoting functional recovery and potentially a more homeostatic excitatory/inhibitory balance. Building on its established clinical use and safety profile, this study highlights torsemide as a promising and feasible candidate for repurposing as a pharmacological therapy in SCI.

Abstract # 18

Title: Machine Learning Prediction of Pulmonary Composite Complications After Acute Spinal Cord Injury: A TQIP Analysis of Respiratory Failure

Authors and Affiliations: Dharsan Ravindran[1], Aazad Abbas[2], Vishwathsen Karthikeyan[3], Robert Koucheki[1], Christopher Lozano[4], Jay Toor[5], Albert J. M. Yee[6], Stephen Lewis[7], Jefferson R. Wilson[8], Christopher D. Witiw[9], Cari Whyne[10], Jetan Badiwala[9]

1 Institute of Biomedical Engineering, University of Toronto, Toronto, Ontario, Canada
2 Holland Bone & Joint Program, Sunnybrook Research Institute, Toronto, Canada
3 Division of Neurosurgery, Department of Surgery, St. Michael's Hospital, Toronto, ON, Canada
4 Institute of Health Policy, Management and Evaluation, University of Toronto, Toronto, ON, Canada
5 Department of Orthopaedic Surgery, University of Manitoba, Winnipeg, Manitoba, Canada
6 Division of Orthopaedic Surgery, Department of Surgery, University of Toronto, Toronto, ON, Canada
7 Department of Surgery, Sunnybrook Health Sciences Centre, University of Toronto, Toronto, Canada
8 Division of Neurosurgery, Department of Surgery, St. Michael's Hospital, Toronto, ON, Canada
9 Krembil Research Institute, Toronto Western Hospital, Toronto, ON, Canada
10 Holland Bone & Joint Program, Sunnybrook Research Institute, Toronto, Canada

Purpose: Respiratory complications represent one of the leading causes of morbidity and mortality following acute spinal cord injury (SCI), often surpassing cardiac and renal causes. While clinical guidelines emphasize venous thromboembolism prophylaxis, risk stratification for airway failure remains imprecise. Conventional linear prediction tools frequently fail to capture the complex, non-linear interactions between injury level, shock physiology, and patient frailty that precipitate respiratory collapse.

The purpose of this study is to develop and validate machine learning (ML) algorithms to predict a composite outcome of respiratory failure in patients undergoing operative treatment for acute SCI.

Methods: A 70/15/15 training-validation-test split was utilized for model development. To address class imbalance, the training set underwent synthetic minority over-sampling technique (SMOTE). Models were trained on covariates including patient demographics, modified frailty index (MFI-5), injury severity score (ISS), Glasgow coma scale (GCS), abbreviated injury scale (AIS) by body region, presence of hypotension on arrival, need for immediate blood transfusion and comorbidities. Six supervised learning algorithms were developed: logistic regression (LR), random forest (RF), XGboost, lightGBM (LGBM), multilayer perceptron (MLP), and k-nearest neighbors (KNN), compared against a frequent-class baseline. Hyperparameter tuning was conducted via 5-fold cross-validation. To address class imbalance and minimize missed diagnoses, decision thresholds were dynamically optimized to maximize the F2-score (weighting sensitivity over precision) on the validation set. Performance was evaluated on the unseen test set using area under the receiver operating characteristic curve (AUC), F1-score, sensitivity, and specificity.

Results: A total of 56,336 patients met inclusion criteria. The LGBM model achieved the highest discrimination for the pulmonary composite outcome with an AUC of 0.77 and a specificity of 77.4%. This outperformed the conventional LR model (AUC 0.75; specificity 68.9%). The XGBoost model performed comparably (AUC 0.76), demonstrating higher sensitivity (67.8%) but lower precision compared to LGBM. Neural network approaches (MLP) did not outperform tree-based gradient boosting methods in this tabular dataset (AUC 0.65). Feature importance analysis identified ISS, GCS, and AIS Spine as the strongest independent predictors of respiratory failure.

Conclusions: This study demonstrates that gradient-boosting machine learning algorithms, specifically LGBM, provide superior predictive discrimination for respiratory failure in acute SCI compared to traditional logistic regression. By capturing non-linear relationships in high-dimensional trauma data, these models offer a more granular tool for early risk stratification, potentially guiding aggressive pulmonary surveillance and targeted preventative strategies in high-risk patients.

Abstract # 19

Title: The utilization of Merged MRI and CT Imaging in the Evaluation of Cervical Spine Foraminal Stenosis

Authors and Affiliations: Aden Wong[1], Raj Kumar Ranabhat[1], Geoff Klein[1], Ran Ankory[2], Albert J. M. Yee[2], Michael Hardisty[1]

1 Holland Bone and Joint Orthopaedic Biomechanics Laboratory, Sunnybrook Health Sciences Centre,
2 Department of Surgery, University of Toronto

Purpose: Cervical foraminal stenosis is a common degenerative condition resulting in nerve root compression, radiculopathy, and functional impairment. While Magnetic Resonance Imaging (MRI) provides excellent soft-tissue visualization and Computed Tomography (CT) offers superior bony detail, each modality independently presents diagnostic limitations and considerable inter-observer variability in stenosis grading. We aim to develop and evaluate a deep-learning–enhanced MRI-CT fusion workflow for improved visualization and quantification of cervical foraminal stenosis.

Methods: A deep-learning–assisted image registration pipeline will be implemented to merge cervical spine MRI and CT datasets. The fused output will preserve CT-derived osseous fidelity and MRI-based neural structure definition. We first identify and match the same vertebrae on both scans and use their centres to align the images in 3D space. This initial alignment is then applied to the MRI, so it matches the CT in position and orientation. Next, we perform a more precise alignment using an AI-based method that adjusts the images at a very fine (voxel) level. This step accounts for subtle anatomical differences and produces a fully aligned MRI and segmentation that closely matches the CT anatomy. Novel 3D geometric quantification metrics of foraminal narrowing will be derived and compared to traditional 2D measurements. To assess the clinical value of this approach, the workflow will be applied to a preliminary cohort of patients identified at Sunnybrook Hospital, selected to ensure representation across the spectrum of stenosis severity. The merged images will be evaluated by spine surgeons, fellows, and radiologists in a blinded, multi-observer reliability study. Observers will grade stenosis severity using the validated Park classification system across C5-C6 and C6-C7 levels, and results will be compared to standard-of-care imaging

Results: Pipeline development and initial validation testing are currently underway. Early registration experiments demonstrate accurate vertebral alignment with preservation of vertebral bone boundaries. Data collection and blinded grading are in progress.

Conclusions: This project proposes a unified MRI-CT fusion framework to address persistent diagnostic limitations in cervical spine imaging. By integrating complementary imaging strengths and introducing 3D

quantitative assessment of foraminal stenosis, this approach aims to improve objectivity, reliability, and pre-operative planning in spine surgery.

Abstract # 20

Title: Imaging Biomarkers Derived Using an Artificial Intelligence (AI) Pipeline Enhance Prognostication of Patients Undergoing Surgery for Nontraumatic Spinal Cord Injury due to Degenerative Cervical Myelopathy

Authors and Affiliations: Mohammed A. Alvi[1,2], Raman Abbaspour[1,2], Mouad Elganga[2,3], Karlo M. Pedro[1,2,4], Yuxii Xiang[5], Michael G. Fehlings[1,2,3,4]

1 Division of Neurosurgery and Spine Program, Department of Surgery, University of Toronto, Toronto, Ontario, Canada.
2 Division of Neurosurgery, Krembil Neuroscience Centre, Toronto Western Hospital, University Health Network, Toronto, Ontario, Canada.
3 Temerty Faculty of Medicine, University of Toronto, Toronto, Ontario, Canada
4 Institute of Medical Science, University of Toronto, Toronto, Ontario, Canada
5 The Department of Cell and Systems Biology at University of Toronto, Toronto, Ontario, Canada

Purpose: Degenerative cervical myelopathy (DCM) is the most common cause of spinal cord dysfunction in adults. Conventional MRI assessment provides limited prognostic information, often relying on qualitative interpretation. Advances in artificial intelligence (AI) and deep learning have enabled extraction of high-dimensional imaging biomarkers from routine MRI images in a feasible way. Question: Can radiomic features, extracted from baseline axial T2-weighted MRI be used to enhance predictive model performance for 1-year postoperative outcomes?

Methods: Data was sourced from AO-spine cervical spondylotic myelopathy (CSM) international study (CSM-I) and the CSM North America (CSM-NA) study. Segmentation of the spinal cord was performed using the SpinalCordToolbox (SCT v7.2), and the images and segmentation masks were divided into compressed and non-compressed segments. Radiomic features were extracted from each using Pyradiomics. Outcomes included minimum clinically important difference (MCID) in mJOA, 30% change in SF36-PCS, and 30% change in NDI by 1 year. Four predictors sets were generated: clinical alone, clinical + compressed radiomics, non-compressed radiomics, and with all radiomics. Radiomic dimensionality was reduced using gain-based feature selection with gradient-boosted decision trees. Supervised learning was performed using XGBoost with stratified 10-fold cross-validation.

Results: A total of 204 patients were included in the final analysis. For MCID in mJOA by 1 year, clinical + all-radiomics yielded a 6% improvement in AUC (0.781) compared to clinical-alone (0.735). For SF36-PCS, clinical + radiomics from compressed segment yielded a 12.5% improvement in AUC from 0.73 to 0.834. For S_global, clinical +radiomics from non-compressed segment performed the best with an R2 of 0.414 (clinical-alone: 0.103), and RMSE of 77.2 (clinical alone: 96.2).

Conclusions: Combining radiomic features from compressed and non-compressed levels on baseline T2-weighted MRI via an AI-facilitated pipeline improved prognostic model performance for DCM surgical outcomes. These findings highlight the potential of imaging biomarkers to augment clinical decision-making, enabling more personalized risk stratification and optimizing patient counseling before surgical intervention.

Abstract # 21

Title: Quantitative Imaging Biomarkers Derived Using an Artificial Intelligence (AI) Pipeline Enhance Prognostication of Patients Undergoing Surgery for Degenerative Cervical Myelopathy

Authors and Affiliations: Mohammed A. Alvi[1,2], Mouad Elganga[1,2], Karlo M. Pedro[1,2,3], Raman Abbaspour[1,2], Yuxii Zhang[4], Michael G. Fehlings[1,2,3]

Division of Neurosurgery and Spine Program, Department of Surgery, University of Toronto, Toronto, Ontario, Canada.
Division of Neurosurgery, Krembil Neuroscience Centre, Toronto Western Hospital, University Health Network, Toronto, Ontario, Canada.
Institute of Medical Science, University of Toronto, Toronto, Ontario, Canada.
The Department of Cell and Systems Biology at University of Toronto, Toronto, Ontario, Canada

Purpose: Background: Degenerative cervical myelopathy (DCM) is a leading cause of spinal cord dysfunction, yet clinical decision-making remains challenging due to substantial heterogeneity in patient presentation, imaging findings, and postoperative outcomes.

Research Question: Can quantitative imaging biomarkers extracted from compressed and non-compressed–level morphometrics be used to optimize prognostication of outcomes after DCM surgery?

Methods: We analyzed a multi-centre cohort of 350 surgically treated DCM patients with preoperative cervical MRI available. A custom pipeline segmented the spinal cord at all cervical levels and generated quantitative metrics including cross-sectional area (CSA), anteroposterior (AP), and right–left (RL)

diameters, and maximum spinal cord compression (MSCC) among others. Morphometrics were extracted at the level of maximal compression and at non-compressed levels to capture global cervical morphology. Dimensionality reduction was performed using principal component analysis (PCA). XGBoost and LightGBM models were trained to predict three 1-year outcomes including improvement in SF-36 PCS, mJOA, and NDI

Results: Patients with severe myelopathy had significantly lower CSA, AP-diameter and RL-diameter in the compressed segment as well as the non-compressed segment, and also had significantly higher maximum spinal cord compression (MSCC) for the most-compressed level, compared to those with moderate and mild myelopathy. PCA demonstrated that global structural patterns, particularly CSA and AP diameter gradients across the cervical spine were strongly associated with symptomatic severity. XGBoost and LightGBM achieved AUCs of 0.702 and 0.710 for minimum clinically important difference (MCID) in mJOA by 1 year, respectively, 0.753 and 0.754 for 30% change in SF36-PCS and 0.578 each for 30% in NDI by 1 year. Feature importance analyses highlighted cord CSA, MSCC, and multilevel diameter asymmetry as key predictors.

Conclusions: Quantitative cervical spine morphometrics, including features outside the zone of maximal compression, provide meaningful prognostic information in DCM. Machine-learning models integrating these multilevel metrics show promise for supporting individualized surgical decision-making and identifying patients at risk of suboptimal recovery.

Abstract # 22

Title: Molecular subgroups of malignant peripheral nerve sheath tumours predict metastasis and survival

Authors and Affiliations: Chloe Gui[1,2], Mira Li[2], Frank Fan[2], Colleen Deng[2], Jeff Liu[2], Andrew Gao[2,3], Katherina Baranova[4], Laura Lockau[4], Bret Wehrli[4], Nalan Gokgoz[5,6], Jay Wunder[5,6], Irene Andrulis[5,6], Qingxia Wei[2], Severa Bunda[2], Gelareh Zadeh[2,7], Suganth Suppiah[1,2]

1 Princess Margaret Cancer Centre, University Health Network, Ontario, Canada

2 Division of Neurosurgery, Department of Surgery, University of Toronto, Ontario, Canada

3 Department of Laboratory Medicine and Pathobiology, University of Toronto, Toronto, Ontario, Canada

4 London Health Science Centre, Western University, London, Ontario, Canada

5 Division of Orthopaedics, Mount Sinai Hospital, Toronto, Ontario, Canada
6 Lunenfeld-Tanenbaum Research Institute, Toronto, Ontario, Canada
7 Department of Neurosurgery, Mayo Clinic, Rochester, Minnesota, USA

Purpose: Malignant peripheral nerve sheath tumors (MPNSTs) are rare, highly aggressive sarcomas that arise sporadically, following radiation exposure, or in association with Neurofibromatosis type 1. Although they comprise only 2–3% of soft tissue sarcomas, MPNSTs carry a disproportionately poor prognosis, with median survival just over 30 months. Surgical resection remains the cornerstone of treatment, but complete resection is often not feasible due to tumor size, anatomic location, and invasion of critical structures. Radiation and chemotherapy are commonly used, yet neither has demonstrated a clear survival benefit. There is a critical need for improved biological stratification to identify clinically meaningful subgroups and guide therapeutic development.

Methods: We assembled a multi-institutional cohort of 139 MPNST patients, the largest clinically annotated and molecularly characterized cohort to date. Genome-wide DNA methylation and transcriptomic profiling independently identified two stable molecular subgroups through unsupervised consensus clustering.

Results: Subgroup identity was stable across primary, recurrent, and metastatic presentations from the same patient. The two subgroups exhibited markedly divergent outcomes. Group 1 tumors had significantly shorter progression-free survival (median 8.2 vs. 58.0 months) and overall survival (median 17.3 vs. 83.7 months) compared to Group 2. Rates of local progression were similar between groups, but Group 1 tumors showed significantly earlier metastatic progression (median 21.4 months vs. not reached), indicating that metastatic propensity is the primary driver of poor outcomes in patients with Group 1 tumours. Notably, margin-negative resection did not confer a survival benefit in patients with Group 1 tumours due to early metastatic dissemination. In contrast, patients with Group 2 tumours derived significant better from margin-negative resection, with improved local control and overall survival.

Genomic analysis revealed that Group 1 tumors harbored a markedly higher copy number alteration burden (median 13 vs. 2; $p=1.7\times10^{-7}$), consistent with greater genomic instability. Transcriptomic profiling revealed divergent pathway activity: Group 1 was enriched for proliferation and cell cycle programs, while Group 2 showed upregulation of immune and inflammatory pathways. Methylation analysis further supported immune pathway suppression in Group 1 through promoter hypermethylation.

Conclusions: These findings validate two biologically and clinically distinct MPNST subgroups, establishing a framework for molecularly directed therapeutic strategies in this difficult disease.

Abstract # 23

Title: Vertebral Fracture Risk After Spine SBRT: The Role of Paraspinal Muscle

Authors and Affiliations: Hannah Ghassabeh[1,2], Terence Tang[2], Lauren Toy[1,2], Zachary Fishman[2], Cari Whyne[1,2,3], Michael Hardisty[1,2,3]

Purpose: Vertebral compression fracture (VCF) is a common complication following spine stereotactic body radiotherapy (SBRT). Current risk stratification focuses on osseous factors such as baseline fracture and mechanical instability but does not account for tumor extension into surrounding soft tissues or the potential effects of radiation on paraspinal musculature. We evaluated whether extraosseous extension into paraspinal muscle and radiation dose to these tissues are associated with VCF risk.

Methods: We performed a retrospective cohort study of patients treated with spine SBRT, excluding lesions with prior surgical stabilization. Major paraspinal muscle groups were segmented using a deep learning approach. Extraosseous extension was defined as overlap between the clinical target volume and segmented musculature. Radiation exposure was quantified using biologically effective dose (BED_3, α/β = 3 Gy), across treatment courses to vertebrae and muscle. Time to VCF was measured from first SBRT to fracture or death, with censoring at last MRI. Covariates included SINS (0–18), age, sex, baseline fracture, and local recurrence. Cox proportional hazards models were used.

Results: Among 833 lesions, 169 VCF events occurred. Extraosseous extension into paraspinal musculature was independently associated with increased VCF risk (HR 1.61, 95% CI 1.04–2.48, $p = 0.033$). Baseline VCF (HR 1.39, 95% CI 1.27–1.56, $p < 0.0005$) and local recurrence (HR 2.35, 95% CI 1.65–3.36, $p < 0.0005$) were associated with fracture. Age (HR 1.02/year, 95% CI 1.01–1.04, $p = 0.004$) and male sex (HR 1.39, 95% CI 1.00–1.93, $p = 0.047$) were also significant. Higher cumulative vertebral BED_3 (HR 1.027, 95% CI 1.01–1.05, $p = 0.014$) and muscle BED_3 (HR 1.020, 95% CI 1.01–1.03, $p = 0.001$) were associated with increased risk. SINS ≥10 showed a borderline association (HR 1.57, 95% CI 0.96–2.55, $p = 0.070$). Model discrimination was good (concordance = 0.71; likelihood ratio $\chi^2 = 90.97$, $p < 0.001$).

Conclusions: Extraosseous extension into paraspinal musculature and radiation dose to these tissues are associated with increased VCF risk following spine SBRT. Fracture risk may be influenced not only by osseous factors but also by adjacent stabilizing soft tissues. Incorporating cumulative dose exposure and paraspinal muscle involvement may improve risk stratification and inform patient-specific treatment planning.

Abstract # 24

Title: Automated Vertebral Detection and Segmentation Model for Spinal Metastases CT Imaging Pipeline

Authors and Affiliations: Lauren Toy[1,2], Geoff Klein[1,2], Cari Whyne[1,2], Michael Hardisty[1,2]

1 University of Toronto, Toronto, Ontario, Canada
2 Sunnybrook Research Institute, Toronto, Ontario, Canada

Purpose: Spinal metastases occur across many malignancies including breast, lung, and prostate cancer. Stereotactic body radiotherapy (SBRT) delivers high doses of radiation in precise regions to provide excellent local tumor control and pain relief for patients. A common adverse effect to bone health from high dose radiation is vertebral compression fracture (VCF). The Spinal Instability Neoplastic Score (SINS) is a clinical framework that quantifies stability in tumor-affected spines by evaluating six factors that can impact VCF risk, including spinal alignment, tumor location and type [2]. A key limitation of SINS is that it relies on subjective clinical judgment that can vary between reviewers. Therefore, our research is motivated to leverage medical image analysis to develop more objective, quantitative measures of spinal instability. We have developed a vertebral detection and segmentation model for CT images which is used as an initial step within an image analysis pipeline to automatically and quantitatively evaluate vertebral stability and fracture risk. However, in conducting quality assurance testing, the current model was found to include cases of improperly cropped and mislabeled vertebrae. The purpose is to evaluate a closed-loop feedback enhancement to the vertebral detection model that refines input CT images to improve the reliability of downstream analyses of a quantitative and automated SINS pipeline.

Methods: The existing and enhanced pipelines were evaluated on a retrospective cohort of 977 SBRT patients with vertebral metastases (45% female; 2,364 vertebral segments) from the Odette Cancer Centre. Model outputs include segmentations and centroid coordinates for each vertebra. To address

cropping errors in the original pre-processing, we implemented a closed-loop feedback step which generates a bounding-box crop using normative vertebral volume and dimensional constraints. Crop location is then determined from initial centroid predictions. This refined input is then passed back through the detection and segmentation stages. Quality control was performed using multi-planar maximum intensity projection visualizations that overlay model outputs.

Results: Qualitative review of MIPs comparing the original and enhanced model outputs demonstrated that the feedback mechanism not only corrected previous cropping errors but also resolved additional failure modes (misses, merges, and skips). In a random sample (n=816), excluding cases with no performance change, segmentation quality improved by 85.6 ± 3.5% using a 95% binomial confidence interval.

Conclusions: The addition of the closed-loop feedback to the model improved segmentation quality and expanded the usable dataset for downstream analyses of SINS. Furthermore, quantitative metrics calculated from outputs such as volume change and inter-centroid distance can be used to automatically identify pipeline failures. Together this closed-loop feedback enhancement helped to establish a data-driven quality control framework that improved the accuracy and scalability of subsequent pipeline outputs that assess vertebral stability and fracture risk.

Abstract # 25

Title: Rate of Change in Non-Compressed Spinal Cord Cross-Sectional Area May Identify Patients at Risk of Progression Among Patients with Mild Degenerative Cervical Myelopathy (DCM)

Authors and Affiliations: Aashir Meeran[1], Mohammed Ali Alvi[2,3], Karlo Pedro[2,3,4], Michael G Fehlings[2,3,4]

1 University of Toronto Division of Engineering Science, Toronto, Ontario, Canada
2 Division of Neurosurgery and Spine Program, Department of Surgery, University of Toronto, Toronto, Ontario, Canada
3 Institute of Medical Science, University of Toronto, Toronto, Ontario, Canada
4 Division of Neurosurgery, Krembil Neuroscience Centre, Toronto Western Hospital, University Health Network, Toronto, Ontario, Canada

Purpose: Degenerative cervical myelopathy (DCM) is the leading cause of non-traumatic spinal cord impairment. In mild DCM (modified Japanese Orthopedic Association (mJOA) score ≥15) the natural history is unpredictable and clinical metrics often do not detect early progression. Biomarkers from

conventional T2-weighted MRI remain underexplored. This study aimed to determine whether annualized rates of change in T2-weighted spinal cord morphometrics differ between patients who deteriorate and those who remain stable.

Methods: Twenty-eight patients with mild DCM undergoing conservative management and serial cervical T2-weighted MRI were studied. Deterioration was defined as either a) surgical intervention or b) decline of total mJOA score by one or more points (n=11 deteriorated; n=17 stable). Each patient underwent serial imaging every 6 months for 5 years or until decline in neurological status warranting surgical intervention. For each patient, we selected the very first and the last scan. Each image was processed through the Spinal Cord Toolbox (SCT) v7.2 segmentation and vertebral labeling pipelines. Next we divided each image into a compressed segment and a non-compressed segment and extracted 11 metrics in absolute and normalized forms for each. Annualized change was calculated as the difference between the last and the first scan divided by follow-up years; subjects with < 3 months of follow-up were excluded (final sample: n=11 deteriorated, n=13 stable). A secondary baseline comparison (n=39) tested whether groups differed structurally at enrollment.

Results: Non-compressed CSA was the only metric with a significant and FDR-surviving difference in annualized change (median: −0.43 mm²/year deteriorated vs +0.60 mm²/year stable; p=0.001, p_FDR=0.013, Cohen's d=−1.76). No other imaging metric including CSA at compression, anteroposterior diameter, maximum spinal cord compression (MSCC) ratio, eccentricity, or solidity reached significance after correction. Clinical measures (mJOA, Nurick, NDI) showed no significant rate-of-change differences. Critically, baseline imaging values were indistinguishable between groups (all p >0.98), confirming the divergence reflects a dynamic process rather than a pre-existing difference.

Conclusions: The annualized decline in the area of the non-compressed region of the spinal cord may help identify mild-DCM patients at risk of deterioration This metric captures diffuse cord atrophy remote from the compression site. These findings require validation in larger, multi-centre cohorts.

Abstract # 26

Title: The tailoring, implementation, and evaluation of the spinemobility boot camp program for degenerative lumbar spinal stenosis at an inner-city community clinic. A mixed methods approach.

Authors and Affiliations: Akram Alayed[1], Josh Plener[1,2], Mark Fillery[1], Patricia Tavares[1], Aksa Ahmed[2], Corey Hofkirchner[1], Craig Jacobs[1], Carlo Ammendolia[1,2,3]

1 Canadian Memorial Chiropractic College, Toronto, Ontario, Canada
2 Department of Pain Management and Anesthesiology, Sinai Health Toronto, Canada
3 Department of Surgery, University of Toronto, Toronto, Canada

Purpose: Degenerative lumbar spinal stenosis (DLSS) is a common and disabling condition in older adults and a leading indication for spine surgery in individuals over 65 years of age. The six-week DLSS self-management Boot Camp program has demonstrated clinically meaningful and durable improvements in walking tolerance, pain, and physical function. However, prior DLSS studies largely excluded underserved populations, despite evidence that groups such as 2SLGBTQI+ individuals, newcomers to Canada, and those experiencing housing insecurity face greater disease burden and barriers to care. To address this gap, a Spinal Stenosis Clinic at the Rekai Centre was established to implement and evaluate a tailored Boot Camp Program for underserved communities.

Objectives: The objectives are to explore the lived experience of DLSS among underserved individuals, tailor the Boot Camp Program to address population needs, implement the adapted intervention in an inner-city community clinic, and evaluate its clinical outcomes.

Methods: A sequential mixed methods design will be used. In the qualitative phase, semi structured interviews lasting 30 to 45 minutes are conducted at baseline and six weeks with 15 adults aged 50 years or older with DLSS. Thematic analysis will examine the physical, emotional, and social impact of DLSS and identifies barriers and facilitators to self-management. Findings will inform structured intervention mapping sessions involving researchers, clinicians, interns, and patient participants.

In the quantitative phase, a prospective cohort of 75 consecutive patients will complete the tailored Boot Camp Program delivered by supervised CMCC interns. Outcomes will be assessed at baseline, six weeks, and three, six, and twelve months. The primary outcome will be the physical function measured using the Zurich Claudication Questionnaire Physical Function Scale. Secondary outcomes include pain intensity, disability, and depressive symptoms.

Results: Preliminary qualitative findings indicate that DLSS imposes substantial physical, emotional, and social burdens, amplified by financial insecurity and limited access to care. Participants viewed the program as acceptable and empowering, particularly its emphasis on education and self-management.

Conclusions: Early findings support the relevance and acceptability of a tailored DLSS Boot Camp Program for underserved populations. Ongoing quantitative evaluation will determine its clinical effectiveness.

Abstract # 27

Title: Mismatch Between Predicted and Observed Duration of Impact of Adverse Events Following Lumbar Spine Surgery

Authors and Affiliations: Celina Nahanni[1], James Young[2], Raj Rampersaud[1,2]

1 Division of Orthopaedic Surgery, Department of Surgery, University Health Network, Toronto, Ontario, Canada
2 Schroeder Arthritis Institute, University Health Network, Toronto, Ontario, Canada

Purpose: Adverse event (AE) reporting in spine surgery remains inconsistent, with over one-third of studies omitting AE data and few using standardized classification systems with high-quality reporting. SAVES-V2 was developed to improve this by incorporating surgeon judgment at the time of the event, including whether an AE is expected to have a temporary or sustained impact on patient-reported outcomes (PROMs). However, the accuracy of this prediction has not been well established. This study aimed to determine whether surgeon-assigned AE severity grades accurately predict long-term outcomes and whether specific AE subtypes explain observed differences in recovery.

Methods: We analyzed a prospective cohort of adults undergoing surgery for degenerative lumbar pathology from the CSORN registry. Patients were stratified by maximum AE grade (AE0–AE3). Longitudinal PROMs, including ODI, EQ-5D, and back and leg pain scores, were assessed to 24 months using multivariable mixed-effects models. In a secondary analysis of patients with AE1–3 (n=962), multivariable logistic regression was used to evaluate predictors of worse-than-expected 12-month disability (ODI >25.3), adjusting for baseline and perioperative factors.

Results: Adverse events occurred in approximately 16% of patients and were predominantly minor (AE1–2). Patients with AE1–2 demonstrated no clinically meaningful differences in PROMs at any time point. In contrast, AE3 events—classified as having a temporary (<6 months) impact—were associated with persistent, clinically significant deficits in disability and quality of life at 3, 12, and 24 months,

exceeding established MCID thresholds. In the subtype analysis, 43% of patients experienced worse-than-expected 12-month outcomes. Only transfusion was independently associated with worse recovery, while most AE1–3 subtypes were not predictive after adjustment.

Conclusions: Surgeons appear to systematically underestimate the duration and impact of adverse events at the time of classification. Events labeled as “temporary” frequently result in sustained functional impairment, suggesting misclassification of long-term impact within current AE grading frameworks. The lack of independent effects from most adverse event subtypes suggests that adverse events are a component of a larger clinical picture, with long-term outcomes also shaped by underlying patient factors and overall treatment burden.

Abstract # 28

Title: A Mechanistic Exploration of the Role of GDNF-Expressing Transplanted Neural Progenitor Cells on Facilitating Functional Recovery and Regeneration after Traumatic Spinal Cord Injury

Authors and Affiliations: Zijian Lou[1], Sogolie Kouhzaei[1], Oliver Zhang[1], Nader Hejrati[3], Jian Wang[1], Mohamad Khazaei[1,2], Michael G. Fehlings[1,2,4]

1 Division of Genetics and Development, Krembil Brain Institute, University Health Network, Toronto, Ontario, Canada
2 Division of Anatomy, Department of Surgery, University of Toronto, Toronto, Ontario, Canada
3 Department of Neurosurgery, HOCH health Ostschweiz, Cantonal Hospital St. Gallen, St. Gallen, Switzerland
4 Division of Neurosurgery and Spine Program, Department of Surgery, University of Toronto, Toronto, Ontario, Canada

Purpose: Spinal cord injury (SCI) is a devastating condition resulting in lifelong motor dysfunction and sensory impairment, and there still is a lack of treatment options for facilitating recovery of motor and sensory function. Human induced pluripotent stem cell-derived neural progenitor cell (hiPSC-NPCs) transplantation is a promising field of research that potentially offers a mode of regeneration and functional recovery for patients with SCI, who exhibit loss of tissue and scarring around the cystic cavity that formed in the spinal cord following SCI. Previous research from the lab had revealed that overexpression of glial derived neurotrophic factor (GDNF) by NPCs transplanted in the acute phase of SCI resulted in improved white matter sparing, increased neuronal differentiation, and facilitated recovery of function. However, chronic exposure to GDNF has been shown to induce unwanted side effects such as pancytopenia and cerebellar lesions. To address this, we propose controlling GDNF expression using a progenitor state promoter to limit ectopic expression to the early phase after transplantation.

Methods: Athymic nude rats were transplanted with hiPSC-NPCs expressing GDNF under a progenitor-state promoter candidate in the chronic phase of the C6-7 SCI model. The motor function of the rats were assessed using grip strength, inclined plane, and catwalk gait behavioural tests. Motor evoked potential recordings were taken at endpoint, and cells were profiled through spatial transcriptomics and immunohistochemistry.

Results: We observed that the rats that sustained SCI and were given transplants of the NPC lines expressing GDNF showed improved functional recovery when compared to conventional NPCs. When compared to the constitutively active promoter expressing GDNF, one of the progenitor state promoter lines of GDNF-expressing NPCS facilitated similar levels of recovery, as seen in the catwalk, grip strength, and inclined plane behavioral tests. However, the progenitor state promoters did not push the grafted NPCs to differentiate towards a larger neuronal population than the control NPC lines, whereas the constitutive promoter was able to do so.

Conclusions: These results suggest that the progenitor promoter expresses GDNF for the critical temporal stages to facilitate the benefits that we observed in the constitutively active EF1a: GDNF group.

Acknowledgement

Medtronic

DePuy Synthes

stryker

bioventus®

Scan QR code to Make a Gift!

Info and contact:
Nadia Jaber, Program Manager
uoft.spine@utoronto.ca
Tel: (416)978 8468
Room #: 503, 5th Floor Stewart Building
149 College St Toronto, ON, M5T 1P5

Surgery
UNIVERSITY OF TORONTO
Spine Program

Info: uoft.spine@utoronto.ca