

TABLE OF CONTENTS

Volume 26
Number 3
March 2026

EDITORIAL

What is endoscopic spine surgery? An introduction to a special issue..... 437
Charla R. Fischer, MD

SPECIAL FOCUS: ENDOSCOPIC SPINE SURGERY

What is the learning curve for endoscopic spine surgery? A comprehensive systematic review..... 438
Justin P. Chan, MD, Thomas Olson, MD, Beshoy Gabriel, BS, Sohaib Hashmi, MD, Hao-Hua Wu, MD, Hansen Bow, MD, Yu-Po Lee, MD, Nitin Bhatia, MD, Michael Oh, MD, Don Y Park, MD

Primer on unilateral biportal endoscopic spine surgery: technical overview for beginners..... 450
Erick R. Kazarian, MD, Jason I. Yang, MD, Gregory S. Kazarian, MD, Yong H. Kim, MD

Advances in endoscopic lumbar spine surgery: a comprehensive review of the techniques used for the treatment of lumbar disc herniations and spinal stenosis and lumbar spinal fusion 457
Brian Kwon, MD, Andrew Moon, MD

History of endoscopic spine surgery: where did it all begin? Development of indications and techniques..... 467
Dong Hwa Heo, MD, PhD, Hyeun Sung Kim, MD, PhD, Yoon Ha Whang, MD, Dong Chan Lee, MD, Kangtaek Lim, MD

SYSTEMATIC REVIEW/META-ANALYSIS

Full-endoscopic lumbar spine discectomy: are we finally there? A meta-analysis of its effectiveness against nonmicroscopic discectomy, microdiscectomy and tubular discectomy 479
Kajetan Latka, PhD, Klaudia Kozłowska, PhD, Kacper Domisiewicz, MD, Tomasz Klepinowski, PhD, Dariusz Latka, MD

CLINICAL STUDIES

Postoperative adverse events following 2-level hybrid cervical construct relative to 2-level anterior cervical discectomy 498
Philip P. Ratnasamy, BS, Sahir S. Jabbouri, MD, Michael J. Gouzoulis, BS, Arya G. Varthi, MD, Jonathan N. Grauer, MD

Contemporary decision-making factors leading to cervical disc replacement versus fusion for the treatment of single-level degenerative cervical radiculopathy or myelopathy: survey opinions from members of the society of minimally invasive spine surgeon and cervical spine research society 504

*Karim A. Shafi, MD, Adrian T.H. Lui, MBBS, Christopher Mikhail, MD, Kyle Morse, MD,
Joshua Zhang, BS, Cole Kwas, BS, Hyun Bae, MD, Sravisht Iyer, MD, MPH,
Sheeraz Qureshi, MD, MBA*

Anterior cervical discectomy and fusion provides better outcome compared to posterior cervical
foraminotomy when foramen is vertically narrow 515
Sehan Park, Dong-Ho Lee, MD, PhD, Chang Ju Hwang, Jae Hwan Cho, San Kim

Distinct postoperative quality of life trajectories after surgery for degenerative cervical myelopathy:
a multicenter prospective cohort study 525
*Takahiro Kitagawa, MD, PhD, Narihito Nagoshi, MD, PhD, Junichi Yamane, MD, PhD,
Toshiki Okubo, MD, PhD, Yasuhiro Kamata, MD, PhD, Yosuke Horiuchi, MD, PhD,
Norihito Isogai, MD, PhD, Hitoshi Kono, MD, PhD, Reo Shibata, MD, PhD.,
Yoshiomi Kobayashi, MD, PhD, Kanehiro Fujiyoshi, MD, PhD, Yoshiyuki Yato, MD, PhD,
Takahito Iga, MD, PhD, Kazuki Takeda, MD, PhD, Masahiro Ozaki, MD, PhD,
Satoshi Suzuki, MD, PhD, Morio Matsumoto, MD, PhD, Masaya Nakamura, MD, PhD,
Kota Watanabe, MD, PhD*

Impact of posterior cervical spine surgery on neck pain-related driving disability and risk factor analysis
of postoperative worsening or poor improvement: a retrospective multicenter cohort study 536
*Naoki Okamoto, MD, Hideki Nakamoto, MD, PhD, Hiroki Iwai, MD, PhD, Naohiro Kawamura, MD, PhD,
Akiro Higashikawa, MD, PhD, Nobuhiro Hara, MD, Yujiro Takeshita, MD,
Masayoshi Fukushima, MD, Takashi Ono, MD, Masahito Oshina, MD, Shima Hirai, MD,
Kazuhiro Masuda, MD, Shurei Sugita, MD, PhD, Sakae Tanaka, MD, PhD, Yasushi Oshima, MD, PhD*

Fulfillment of patient expectations after surgery for degenerative cervical myelopathy. A retrospective
analysis of prospectively collected data from the multicenter Canadian Surgical Spine Registry
(CSORN) 548
*Julien Francisco Zaldivar-Jolissaint, MD, Nathan Evaniew, MD, PhD, FRCSC,
Nicolas Dea, MD, MSc, FRCSC, W. Bradley Jacobs, MD, FRCSC, Jérôme Paquet, MD, FRCSC,
Jefferson R Wilson, MD, PhD, FRCSC, Hamilton Hall, MD, FRCSC, Supriya Singh, MD, FRCSC,
Michael H. Weber, MD, PhD, FRCSC, Andrew Nataraj, MD, MSc, FRCSC,
Najmedden Attabib, MD, MBBCH, FRCSC, David W. Cadotte, MD, PhD, FRCSC,
Y. Raja Rampersaud, MD, FRCSC, Philippe Phan, MD, PhD, FRCSC, Sean D. Christie, MD, FRCSC,
Charles G. Fisher, MD, MHSC, FRCSC, Christopher Small, MD, FRCSC,
Alex Soroceanu, MD, MPH, FRCSC, Christopher S. Bailey, MD, FRCSC,
Kenneth Thomas, MD, MHSC, FRCSC, Neil Manson, MD, MBBCH, FRCSC, Greg McIntosh, MSc,
Zhi Wang, MD, FRCSC, Jay Toor, MD, FRCSC, R. Andrew Glennie, MD, FRCSC,
Raphaële Charest-Morin, MD, FRCSC*

SYSTEMATIC REVIEW/META-ANALYSIS

Anterior vs posterior approaches in the management of multilevel degenerative cervical myelopathy: a
systematic review and meta-analysis 558
*Omar Kouli, MSc, Lana Al-Nusair, MBBS, Ashish Basnet, MBBS, Radek Kaiser, PhD,
Michael Fehlings, MD, PhD, Martin Wilby, PhD, Nisaharan Srikandarajah, PhD*

CLINICAL STUDIES

Postoperative function of lower extremity muscles and walking ability after total en bloc spondylectomy
for lumbar spinal tumors 571
*Satoshi Kato, MD, PhD, Yuki Kurokawa, PT, PhD, Noriaki Yokogawa, MD, PhD,
Takaki Shimizu, MD, PhD, Hideki Murakami, MD, PhD, Satoru Demura, MD, PhD*

Radiomics-powered radiographic image analysis for enhanced mechanical complications prediction and surgical planning in adult spine deformity	578
<i>Ferran Pellisé, MD, PhD, Sleiman Haddad, MD, PhD, FRCS, Susana Núñez-Pereira, MD, PhD, Caglar Yilgor, MD, Anika Pupak, PhD, Manuel Ramírez-Valencia, MD, Javier Pizones, MD, PhD, Ahmet Alanay, MD, Ibrahim Obeid, MD, Frank S. Kleinstueck, MD, Fabio Galbusera, PhD, Oleguer Sagarra, PhD, European Spine Study Group</i>	

Does age-adjusted pelvic incidence minus lumbar lordosis overcorrection truly increase the risk of proximal junctional failure? A confounder-adjusted multivariate analysis in adult spinal deformity	586
<i>Se-Jun Park, MD, PhD, Jin-Sung Park, MD, PhD, Dong-Ho Kang, MD, Chong-Suh Lee, MD, PhD</i>	

Mental health disorders in adolescent idiopathic scoliosis surgery: prevalence, postoperative outcomes, and opioid use.....	594
<i>Maya S. Abu-Zahra, BA, William J. Karakash, BS, Natalie Kistler, BS, David McCavitt, BA, Henry Avetisyan, MS, Daniel Rusu, BS, Aidan Lindgren, BS, Brandon Yoshida, MD, Jeffrey C. Wang, MD, R. Kiran Alluri, MD, Michael M. Safaee, MD, Raymond J. Hah, MD</i>	

Staged short-term modified halo-pelvic traction and posterior spinal fusion versus posterior vertebral column resection for severe rigid kyphoscoliosis: a multicenter comparative study.....	602
<i>Yiwei Zhao, MD, You Du, MD, Yang Yang, MD, Zheping Zhang, MD, Guanfeng Lin, MD, Chenkai Li, MD, Xiaohan Ye, MD, Dihan Sun, BS, Yu Wang, MD, Jianguo Zhang, MD, Shengru Wang, MD</i>	

Shifts in diversity along the spine surgery training pathway: racial, ethnic, and gender representation from medical school to fellowship	612
<i>Jason Silvestre, MD, Jaslyn A. Hernandez, Robert A. Ravinsky, MD, James D. Kang, MD, Hao Hua Wu, MD, Charles A. Reitman, MD, James P. Lawrence, MD</i>	

BASIC SCIENCE

NG2 glia promote injured spinal cord repair through neuronal transdifferentiation and keratins expression in juvenile mice	622
<i>Qing Zhao, MD, PhD, Pianpian Fan, MD, PhD, Qie Gu, MD, Haoran Yang, MD, Yongxu Xie, MD, Shuaishuai Xia, MD, Mingyu Lv, MD, Xuemei Tan, MD, Xiang Zhou, MD, PhD, Qingchu Li, MD, PhD</i>	

Passive neck stiffness and range of motion for males and females from early to late adulthood.....	633
<i>Mingyue Liu, PhD, Ryan D. Quarrington, PhD, William S.P. Robertson, PhD, Baptiste Sandoz, PhD, Claire F. Jones, PhD</i>	

CORRIGENDUM

Corrigendum to ‘P172. Rising use of plastics multilayered closure in posterior spinal fusion for adolescent idiopathic scoliosis without clear improvement in wound outcomes’ [The Spine Journal 25/11S (2022) S155]	642
<i>Anthony E. Seddio, MD, Sahir Jabbouri, MD, Gwyneth C. Maloy, BA, Jonathan N. Grauer, MD, Dominick A. Tuason, MD</i>	

ERRATUM

Erratum to 'Perioperative inpatient falls for anterior cervical discectomy and fusion patients are on the rise: risk factors associated with this "never event"' by Anthony E. Seddio et al' [The Spine Journal 25/5 (2025) 911-920]..... 643

Anthony E. Seddio, MD, Sahir S. Jabbouri, MD, Michael J. Gouzoulis, MD, Rajiv S. Vasudevan, MD, Scott J. Halperin, MD, MHS, Arya G. Varthi, MD, FAAOS, Daniel R. Rubio, MD, FACS, FAAOS, Jonathan N. Grauer, MD

Financial Conflict of Interest Disclosure Key

Level A. \$100 to \$1000	Level D. \$25,001 to \$50,000	Level G. \$500,001 to \$1 M
Level B. \$1,001 to \$10,000	Level E. \$50,001 to \$100,000	Level H. \$1,000,001 to \$2.5 M
Level C. \$10,001 to \$25,000	Level F. \$100,001 to \$500,000	Level I. Greater than \$2.5 M

All Volume Indexes from Volume 1, Number 1 to the present are available ONLINE at the journal's full-text website at www.TheSpineJournalOnline.com. Author Instructions are also available at www.TheSpineJournalOnline.com/authorinfo.

© 2026 Elsevier Inc. All rights are reserved, including those for text and data mining, AI training, and similar technologies. **Publishing Office:** The Spine Journal (ISSN: 1529-9430) is published monthly by Elsevier Inc., 1600 John F. Kennedy Boulevard, Suite 1600, Philadelphia, PA 1910, United States. Periodicals postage paid at New York, NY and at additional mailing offices.

POSTMASTER: Send address changes to The Spine Journal, Elsevier Health Sciences Division, Subscription Customer Service, 3251 Riverport Lane, Maryland Heights, MO 63043.

Photocopying: Single photocopies of single articles may be made for personal use as allowed by national copyright laws. Permission of the publisher and payment of a fee is required for all other photocopying, including multiple or systematic copying, copying for advertising or promotional purposes, resale and all forms of document delivery. Special rates are available for educational institutions that wish to make photocopies for non-profit educational classroom use.

Permission may be sought directly from Elsevier Rights & Permission Department, PO Box 800, Oxford O 0 × 5 1DX, UK; phone: (+44) 1865 843 830, fax: (+44) 1865 853 333. Requests may also be completed online via the Elsevier site (<http://www.elsevier.com/authors/obtaining-permission-to-re-use-elsevier-material>).

In the USA, users may clear permissions and make payment through the Copyright Clearance Center, Inc. 222 Rosewood Drive, Danvers, MA 01923, USA; phone: (978) 750-8400, fax: (978) 750-4744, and in the UK through the Copyright Licensing Agency Rapid Clearance Service (CLARCS), 90 Tottenham Court Road, London W1P 0LP, UK; phone: (+44) 171 436 5931, fax: (+44) 171 436 3986. Other countries may have a local reprographic rights agency for payments.

Derivative Works: Subscribers may reproduce tables of contents or prepare lists of articles including abstracts for internal circulation within their institutions. Permission of the publisher is required for resale or distribution outside the institution. Permission of the publisher is required for all other derivative works, including compilations and translations.

Electronic Storage or Usage: Permission of the publisher is required to store or use electronically and material contained in this journal, including any article or part of an article. Contact the publisher at the address indicated. Except as outlined above, no part of this publication may be reproduced, stored in a retrieval system or transmitted in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without prior written permission of the publisher. Address permissions requests to: Elsevier Rights & Permission Department, at the mail, fax and e-mail addresses noted above.

Notice: Journals published by Elsevier comply with applicable product safety requirements. For any product safety concerns or queries, please contact our authorized representative, Elsevier B.V., at productsafety@elsevier.com

Practitioners and researchers must always rely on their own experience and knowledge in evaluating and using any information, methods, compounds or experiments contained herein. Health care practitioners must exercise their professional judgement and make all treatment-related decisions based solely on the specific conditions of each patient. Because of rapid advances in the medical sciences, independent verification of diagnoses and drug dosages should always be made. The content is provided "as-is" and Elsevier makes no representations or warranties,

whether express or implied, as to the accuracy, completeness, or adequacy of any content. To the fullest extent permitted by law, Elsevier assumes no responsibility for any damages, adverse events, or liability arising from use of information contained herein including for any injury and/or damage to persons or property, whether as a matter of product liability, negligence or otherwise.

Inclusion of any advertising material in this publication does not constitute a guarantee or endorsement of the quality or value of such product or service or of any of the representations or claims made by the advertiser.

Customer Service (orders, claims, online, change of address): Elsevier Health Sciences Division, Subscription Customer Service, 3251 Riverport Lane, Maryland Heights, MO 63043. Tel: 1-800-654-2452 (U.S. and Canada); 314-447-8871 (outside U.S. and Canada). Fax: 314-447-8029. E-mail: journalscustomerservice-usa@elsevier.com (for print support); journalsonlinesupport-usa@elsevier.com (for online support).

For advertising orders and inquiries: North and South America: Aretha Gaskin, Elsevier Inc., 360 Park Avenue South, New York, NY 10010; Tel.: (212) 633-3681; fax: (212) 633-3820. For classified advertising, contact Adam Moorad, Elsevier Inc., 360 Park Avenue South, New York, NY 10010; Tel.: (212) 633-3122; fax: (212) 633-3820. International: Advertising Department, Elsevier, The Boulevard, Langford Lane Kidlington, Oxford O 0 × 5 1GB, United Kingdom, Tel.: (+44) (0) 1865 843565, fax: (+44) (0) 1865 843 967; e-mail: media@elsevier.co.uk. Japan: Advertising Department, Elsevier Japan, Tel.: (+81) (3) 5561 5033; fax: (+81) (3) 5561 5047.

Disclaimer Notice: Statements and opinions expressed in the articles and communications herein are those of the author(s) and are not necessarily those of the Editor(s), North American Spine Society (NASS) or Publisher, or indicative of NASS views, policy or editorial concurrence. The Editor(s), the NASS, and the Publisher assume no responsibility for any injury and/or damage to persons or property as a matter of products liability, negligence, or otherwise, or from any use or operation of any methods, products, instructions, or ideas contained in the material herein. No suggested test or procedure should be carried out unless, in the reader's judgement, its risk is justified. Because of the rapid advances in the medical sciences, medical practitioners should obtain independent verification of diagnoses and drug dosages. Discussions, views, and recommendations as to medical procedures, choice of drugs, and drug dosages are the responsibility of the authors. Consumers should consult with their own doctors about their individual health status before making any health decisions.

Although all advertising material is expected to conform to ethical (medical) standards, the appearance of advertising in The Spine Journal does not constitute a guarantee or endorsement by the journal and/or the North American Spine Society of the quality or value of such product or to the claims made for it by its manufacturer. The fact that a product, service, or company is advertised in The Spine Journal shall not be referred to by the manufacturer in collateral advertising.

This paper meets the requirements of ANSI Standard Z39.48-1992 (Permanence of Paper).

Printed by Sheridan at 69 Lyme Road, Hanover, NH 03755.