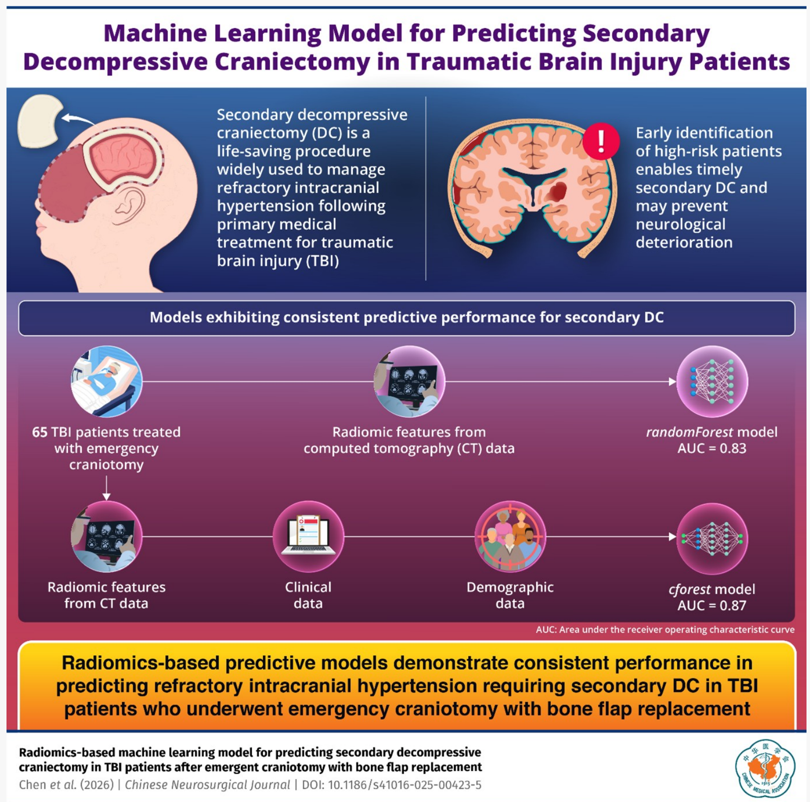
Chinese Neurosurgical Journal Study Develops Radiomics Model to Predict Secondary Decompressive Craniectomy

Researchers develop a radiomics-based machine learning model to identify patients with traumatic brain injury at risk of emergency decompressive surgery



Radiomics‐based machine learning model for predicting secondary decompressive craniectomy (DC)

CHINA, March 10, 2026 /EINPresswire.com/ -- Traumatic brain injury (TBI) can trigger dangerous swelling inside the skull, raising intracranial pressure to life-threatening levels even after emergency surgery. In some cases, patients who initially undergo craniotomy to remove a hematoma deteriorate later and require a second, more invasive operation called decompressive craniectomy (DC). Because this escalation often occurs suddenly, clinicians have limited time to respond. Identifying high-risk patients earlier could transform intensive care management, enabling proactive monitoring and timely intervention before irreversible damage occurs.

To address this challenge, a research team led by Dr. Zhongyi Sun from the Department of Neurosurgery, Central South University, China, explored whether advanced imaging analysis could identify high-risk patients earlier. The team focused on radiomics, a technique that converts medical images into quantitative data describing tissue shape, texture, and intensity patterns that may reflect underlying pathology invisible to the human eye. The study was published online in [Volume 12 of the Chinese Neurosurgical Journal] on January 08, 2026.

Rather than relying solely on conventional clinical indicators, the researchers analyzed preevacuation computed tomography (CT) scans from patients with TBI who underwent emergent craniotomy for hematoma evacuation and bone flap replacement. A total of 65 adult patients were included, some of whom later required secondary DC due to refractory intracranial hypertension. The team extracted more than one hundred radiomic features from each scan, capturing subtle structural and textural characteristics of intracranial hemorrhage and surrounding edema. Machine learning algorithms were then trained to determine whether these imaging signatures could predict the need for further life-saving surgery.

Models based only on demographic and clinical information performed poorly, highlighting the limitations of traditional risk assessment. In contrast, radiomic-based models demonstrated strong predictive ability, accurately distinguishing patients who later required secondary surgery. When imaging features were combined with selected clinical variables, performance improved further, suggesting that radiomics may complement rather than replace existing clinical judgment.

“Our goal was to move from reactive treatment to proactive risk identification. If clinicians can recognize which patients are likely to develop uncontrolled intracranial hypertension, they may intervene earlier and potentially prevent deterioration,” says Dr. Sun. Such early warning could influence decisions about monitoring intensity, timing of surgery, and allocation of intensive care resources.

Beyond immediate clinical implications, the research points to broader ripple effects for neurosurgical care. Integrating artificial intelligence with routine CT imaging could enable hospitals to standardize risk assessment, reduce variability in decision-making, and support collaboration between neurosurgeons, radiologists, and data scientists. In the short term, this approach may help clinicians identify vulnerable patients sooner, improving survival and reducing complications associated with delayed intervention. Over long term, advances in predictive modeling could reshape treatment pathways for brain injury, guiding personalized surgical strategies and improving recovery outcomes years after injury.

“TBI often affects young individuals and has lifelong consequences for patients and families. Developing tools that anticipate deterioration is essential for improving both survival and quality of life,” says Dr. Sun. The team hopes that future multicenter studies and automated imaging workflows will further refine the model and accelerate its translation into clinical practice.

Taken together, the findings underscore the growing role of artificial intelligence in neurosurgery and critical care. By transforming routine imaging into predictive biomarkers, radiomics may help clinicians stay one step ahead of rapidly evolving brain injury, shifting the focus from crisis response to prevention.

***

Reference

Title of original paper: Radiomics-based machine learning model for predicting secondary decompressive craniectomy in TBI patients after emergent craniotomy with bone flap replacement
Journal: Chinese Neurosurgical Journal
DOI: 10.1186/s41016-025-00423-5

About Central South University
Central South University (CSU), located in the historical and cultural city of Changsha, Hunan Province, China, is an ideal ground for academic pursuit. The University comprises 31 secondary colleges, boasting 3 large Class A tertiary comprehensive hospitals that are comparable to the Peking Union Medical College Hospital, namely Xiangya Hospital, the Second Xiangya Hospital and the Third Xiangya Hospital and Xiangya Stomatological Hospital. CSU has a rich history of over one hundred years as an educational institution. It actively responds to the reform of China's higher education system and advocates the principles of "Create Knowledge and Serve Society." Pursuing "Virtue, Truth, Perfection, Inclusiveness," CSU has made significant progress in its overall strength by adhering to its own operational characteristics and aligning with the major demands of the country and society.
Website: https://en.csu.edu.cn/index.htm

About Dr. Zhongyi Sun from Central South University
Dr. Zhongyi Sun is a neurosurgeon at the Department of Neurosurgery, Central South University, China. His research focuses on neurosurgery, including traumatic brain injury, cranial defects, and predictive modeling for diseases like nasopharyngeal carcinoma.

Funding information
This study was funded by the National Natural Science Foundation of China (No. 82371407), and the Natural Science Foundation of Hunan Province (No. 2025JJ50749).

Yi Lu
Chinese Neurosurgical Journal
1059978478 ext.
luyi617@sina.cn
