

Research Project

Name of Institution and department: Emergency radiology department, Center
for radiology, University Clinical center of Serbia

Link to website: www.kcs.ac.rs

City and Country of Institution: Belgrade, Serbia

RESEARCH GROUP

Our research group brings together extensive clinical expertise in multiplanar multidetector computed tomography (MDCT) interpretation, high-resolution spinal magnetic resonance imaging (MRI), and prospective intraoperative validation. Supported by strong academic ties to national imaging and surgical societies — including the National Association for the Use of Ultrasound in Medicine and Biology of Serbia (SECHO) and the Serbian Society of Emergency Surgery (SSES)—the research group is uniquely positioned to execute high-volume, rigorous clinical validation protocols. Equipped with advanced radiological workstations and dedicated statistical support, group is structured to bridge the gap between initial emergency room imaging and definitive surgical triage.

The mission of the our Research Group is to redefine the boundaries of first-line imaging in acute neuro-musculoskeletal trauma, driving clinical workflows toward faster, safer, and highly accurate diagnostic paradigms.

In the management of acute thoracolumbar trauma, the critical determinant of spinal stability and subsequent surgical intervention is the integrity of the Posterior Ligamentous Complex (PLC) (Bizdikian & El Rachkidi, 2021; Pizones et al., 2012). While MRI is universally recognized as the gold standard for directly visualizing soft-tissue ligamentous disruption, its real-world utility in the acute emergency setting is significantly constrained by limited round-the-clock availability, prolonged scan times, and the logistical challenges of monitoring hemodynamically unstable polytrauma patients (Dreizin et al., 2014; Utz et al., 2013). Consequently, delayed or missed diagnoses of PLC injuries remain a critical clinical vulnerability, leading to preventable post-traumatic kyphosis, hardware failure, and progressive neurological compromise (Bizdikian & El Rachkidi, 2021; Khurana et al., 2013).

To address this challenge, our group's mission focuses on three core pillars:

- **Maximizing First-Line Modality Utility:** To systematically extract high-precision, quantitative data from standard-of-care emergency MDCT scans. By identifying and validating indirect osseous and spatial markers of ligamentous instability, we aim to transform MDCT from a mere fracture-detection tool into a highly reliable predictor of soft-tissue failure (Khurana et al., 2013; Munera et al., 2012).
- **Enhancing Patient Safety and Workflow Efficiency:** To establish definitive, reproducible quantitative thresholds (such as precise indices for interspinous diastasis and facet joint splaying) that allow emergency clinicians to confidently predict an incompetent PLC directly from the CT console (Khurana et al., 2013; Pizones et al., 2012). This minimizes unnecessary or dangerous transfers of unstable trauma patients to the MRI suite, optimizes resource utilization, and slashes the time from emergency admission to definitive stabilization.
- **Standardizing Evidence-Based Trauma Classifications:** To seamlessly integrate objective MDCT markers into established international spinal classification frameworks, such as the Thoracolumbar Injury Classification and Severity Score (TLICS) and the AO Spine system (Khurana et al., 2013). By doing so, we seek to provide the global radiological and surgical communities with an evidence-based, CT-driven diagnostic protocol that reduces inter-observer variability and directly improves patient outcomes.

TITLE OF PROPOSED RESEARCH PROJECT

Diagnostic Accuracy of Indirect Multidetector Computed Tomography (MDCT) Signs for Predicting Posterior Ligamentous Complex (PLC) Disruption Injury in Thoracolumbar Trauma

OBJECTIVES

The integrity of the posterior ligamentous complex (PLC)—which includes the supraspinous ligament, interspinous ligament, ligamentum flavum, and facet joint capsules—

is the critical anatomical pivot that determines spinal stability following thoracolumbar trauma (Patel & Joaquim, 2013; Vordemvenne et al., 2009). Missing a PLC disruption can lead to progressive post-traumatic kyphosis, chronic pain, and delayed neurological deficits (Nandolia, 2025; Patel & Joaquim, 2013). While Magnetic Resonance Imaging (MRI) remains the gold standard for soft-tissue evaluation, Multidetector Computed Tomography (MDCT) is the ubiquitous, first-line screening modality in acute trauma settings (Munera et al., 2012; Raniga et al., 2014).

The primary overarching objective of this research project is to rigorously evaluate the diagnostic performance of indirect osseous and spatial signs on MDCT to predict PLC injury, using pre-operative MRI findings or intraoperative surgical validation as the reference standards.

The specific clinical and radiological objectives are:

- **Quantify Diagnostic Performance:** To calculate the sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall diagnostic accuracy of specific indirect MDCT markers. These markers include:
 - Widening of the interspinous distance (interspinous diastasis).
 - Splaying, subluxation, or diastasis of the facet joints (Raniga et al., 2014).
 - Avulsion fractures of the superior or inferior aspects of the spinous processes.
 - Local kyphotic angulation greater than 20 degrees (Vilà-Canet et al., 2016).
 - Horizontal or transverse fractures of the posterior neural arch elements (e.g., laminae, pedicles).
- **Establish Cut-off Thresholds:** To define objective, reproducible quantitative thresholds (e.g., millimeter measurements of interspinous widening relative to adjacent normal segments) that reliably correlate with a disrupted PLC.
- **Refine Triage Classifications:** To correlate indirect MDCT findings with the Thoracolumbar Injury Classification and Severity Score (TLICS) and AO Spine classification systems (Nandolia, 2025; Vilà-Canet et al., 2016), thereby optimizing the clinical triage flow between conservative management and prompt posterior surgical stabilization (Patel & Joaquim, 2013).

APPLICANT'S DUTIES

As the Principal Investigator/Lead Coordinating Institution, the applicant will assume full scientific and administrative responsibility for the execution of the protocol. The duties include:

- **Protocol Finalization & Ethical Approval:** Drafting the formal institutional review board (IRB) or ethical committee research protocol, securing timely approvals, and ensuring strict compliance with local data protection regulations and the Declaration of Helsinki.
- **Patient Enrollment & Cohort Selection:** Retrospectively or prospectively identifying eligible adult patients presenting with acute thoracolumbar trauma who underwent both high-resolution MDCT and subsequent spinal MRI or surgical stabilization within a defined timeframe.
- **Blind Image Analysis (Radiological Review):** Coordinating a multi-reader, double-blinded retrospective evaluation where independent emergency/trauma radiologists evaluate MDCT datasets for the presence of indirect signs without knowledge of the MRI or surgical outcome.
- **Data Aggregation & Statistical Modeling:** Compiling a comprehensive database containing quantitative radiological variables, neurological status, and reference standard outcomes. Performing advanced statistical analysis, including Receiver Operating Characteristic (ROC) curves, to determine the area under the curve (AUC) for each indirect MDCT sign.
- **Reporting & Scientific Dissemination:** Preparing interim progress reports for Bracco, authoring peer-reviewed scientific manuscripts for high-impact radiological journals (e.g., *Radiology*, *European Radiology*, *Insights into Imaging*), and presenting the research findings at key international congresses.

APPLICANT'S BENEFITS

- Participation on scientific outcomes of the project i.e. presentations to congresses or publications of papers
- **Academic Leadership & Scientific Visibility:** Establishing the applicant's department as a leading authority in emergency radiology and spinal trauma imaging. Publication of this research in indexed international journals will enhance the academic profile of the investigative team.
- **Infrastructure & Research Support:** Funding from Bracco will directly support the administrative and logistical costs of data collection, dedicated research

workstations, statistical consulting, and open-access publication fees, reducing the financial burden on the public healthcare institution.

- **Clinical Protocol Optimization:** The insights gained will directly optimize local clinical workflows, allowing for faster, safer, and more accurate triage of acute trauma patients directly from the emergency MDCT suite when MRI is delayed or contraindicated.
 - **Strategic Industry-Academia Collaboration:** Successful completion of this project strengthens the long-term partnership with Bracco, opening future avenues for collaborative research in contrast-enhanced imaging modalities (such as contrast-enhanced ultrasound or dual-energy CT) in emergency medicine and abdominal/musculoskeletal trauma.
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