The spinal cord's performance depends, among other factors, on the strength of the **dura mater** - the fibrous membrane that surrounds it. During incidents such as road crashes or falls, this membrane is exposed to very rapid stretches. Most current numerical Human Body Models (HBMs) simplify its behavior to that of a linear-elastic material, which does not accurately reproduce the tissue's real response and can lead to underestimating neurological-injury thresholds.

DURA-FORM seeks to create a comprehensive mechanical description of the human dura mater that reflects its anisotropy (different properties along and across collagen fibers), strain-rate sensitivity, and rheological effects. In practice, this means the model will distinguish between the membrane's response during slow spinal bending and its behavior during a sudden impact, such as the head striking an air bag. Researchers will take samples from the cervical, thoracic, and lumbar regions of five ethically donated spines, shape them into standard specimens, and subject them to a series of uniaxial tensile tests ranging from quasi-static ($0.004\ s^{-1}$) to dynamic (up to $50\ s^{-1}$) strain rates.

Cyclic tests will also be carried out to capture hysteresis - behavior that depends on the loading history - and the Mullins effect, a lasting softening that occurs after the first large load. Both phenomena are typical of hyperelastic materials but have rarely been measured for the dura. A digital image correlation (DIC) system will record full-field deformation, making it possible to calculate the apparent Poisson's ratio—the ratio of transverse narrowing to longitudinal extension.

Laboratory data will be filtered to remove noise, divided into characteristic regions (toe, linear, and pre-failure), and fitted to a fiber-reinforced visco-hyperelastic model that includes an Ogden-Roxburgh pseudoelastic branch to represent irreversible collagen slackening. The constitutive law will be coded as a UMAT routine in LS-DYNA and validated so that simulation results differ from experiments by no more than five per cent ($R^2 > 0.95$).

The outcome of DURA-FORM will be a verified material model ready for use in modern HBMs. With this model, crash simulations will show dural loading more accurately, helping designers of seat belts and air bags protect the spine more effectively. The derived failure thresholds will also aid neurosurgeons in planning procedures and assessing post-traumatic complications. By combining materials science, biomechanics, and medicine, the project lays the groundwork for more reliable predictions of spinal-cord injury and more effective preventive measures.