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Editorial

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Characterization of the Kidney and Liver Material Properties in Unconfined Compression and Probing Protocols with Special Reference to Varying Strain Rate

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The liver and kidneys are the most often damaged organs as a result of traumatic impact forces delivered to the abdomen, and they present a challenge to clinicians owing to the possibility of internal bleeding, which is difficult to identify. A greater knowledge of the process of damage will aid in diagnosis, therapy, forensics, and other disciplines. Finite element modelling is a technique that can help with this knowledge, but precise material properties, such as strain rate dependency and the possibility of utilizing animal tissue qualities instead of human tissue properties, are necessary. For both livers, the elastic modulus in a probing technique and the elastic modulus, failure stress, and failure strain in a compression procedure were discovered. At different strain rates, and kidney tissue from human and porcine specimens when comparing the unconfined compression and probing methods, increases in the elastic modulus were seen for both the human kidney and liver, but only for the porcine kidney. Strain rate dependence was discovered. For both the liver and kidney characteristics, and was found to have a greater saturation impact at higher rates for the failure stress than the elastic modulus. Overall, the material characteristics of intact liver and kidney were studied, and the strain rate dependency was numerically modelled. According to the study's findings, several kidney and liver material characteristics differ between human and pig tissue. As a result, using swine tissue material characteristics in computational or physical models of the human liver and kidney is not always suitable.

The severity of abdominal injuries suffered after impact events such as car accidents is notable. According to a research that evaluated data from the National Automotive Sampling Study of motor vehicle collisions in the United States from 1998 to 2004, abdominal organ injuries account for 13% of severe injuries although accounting for just a tiny fraction of overall traumas. Among abdominal injuries, the kidneys and liver are two of the most often damaged organs from impact forces, whether from a vehicle accident, explosion, or projectile hit. Because of the number of injuries and the potentially life-threatening consequences of these injuries, investigations into the injury mechanism have become increasingly prevalent in order to enhance understanding in a range of disciplines such as safety, forensics, diagnostic medicine, and so on. Although crash test dummies are frequently used to simulate human reaction during motor vehicle accidents and other impacts, developing physical abdominal organ models capable of measuring and predicting damage is challenging and time-consuming. Instead, finite element simulation is a method that is widely utilised to obtain understanding into the process of abdominal damage. A variety of models have been developed to help in the investigation of abdominal tissue damage. The model findings are dependent on the properties of the tissue material, and models in the literature employ properties determined from a variety of approaches that are not always representative of the model application. Because the mechanical properties of the tissue are reliant on the testing technique, using characteristics from incompatible tests may result in incorrect findings. Many organs, for example, display different characteristics when tested in tension vs compression, and most human tissue exhibits elastic modulus (E) and failure property dependency on loading rate.

There are numerous gaps in our understanding of the kidneys and liver's responses to compressive stress. First, the stress-strain behaviour, including failure characteristics, for complete organ testing has not been widely researched and published. Second, the strain a rate at which testing has been conducted are restricted, and little or no data at greater strain rates is available. Finally, the feasibility of employing pig organ findings as a surrogate for human organ characteristics has not been well investigated, particularly under compression and at strain rates of interest in many blunt trauma events. This is the first research to look at these subjects in depth and compare the outcomes using multiple testing techniques. The objectives of this study are to describe the material characteristics of the intact liver and kidney in compression utilising two procedures, complete unconfined compression and probing, at various strain rates for human and porcine tissues. The goals are to determine the feasibility of using porcine tissue as a model for human tissue, compare the results using the two testing protocols, assess the impact of using intact organs, and quantify the relationship between strain rate and the elastic modulus, failure stress, and failure strain of the liver and kidney separately. These parameters were chosen because they are essential for creating numerical models and evaluating injury outcomes. It is expected that there will be no changes in material characteristics between human and porcine tissues, and that increasing strain-rate will increase E, f, and f. Improved computational and physical models for a variety of dynamic loading scenarios will result from further defining the material characteristics of these organs.