

Extracting accurate strain measurements in bone mechanics: a critical review of current methods

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Published in: Journal of the Mechanical Behavior of Biomedical Materials, 2015

Osteoporosis is a bone disease which causes an increased risk of skeletal fractures (3.5 million recorded fracture cases in the EU in 2010). Medical treatment can strengthen bones and reduce the risk of fracture, but an accurate diagnosis is needed to target the right patients with the best treatment. It is important to understand the mechanical behavior of bones to increase the accuracy of the diagnoses. Therefore, mechanical experiments have been performed in the past on cadaver bones from human donors, to understand how bone reacts to mechanical load. Since it is difficult to obtain such cadaver bones, it is extremely importance to extract as much and accurate measurements as possible from each test. This paper reviews current scientific literature and report the four principal techniques used to measure bone deformation during mechanical tests. These are strain gauges, fibre Bragg grating sensors, digital image correlation, and digital volume correlation. For each technique, the differences in terms of accuracy, precision, time- and length-scale are analyzed, and the most important studies reported. This paper can help other researchers who are in the process of designing a new mechanical experiment on bone tissue to choose the most suitable method.