Spine biomechanics

Few studies have used optical full-field surface strain mapping to study spinal biomechanics. Kelly et al. used a commercial digital imaging correlation (DIC) system to (1) compare posterior surface strains on spinal rods with those obtained from conventional foil strain gauges, (2) quantify bony vertebral body and intervertebral disc (IVD) surface strains on 3 L3-S cadaveric spines during gold-standard flexibility tests (7.5-Nm flexion-extension and 400-N compression), and (3) report our experience with the application and feasibility of DIC to comprehensively map strain in spinal biomechanics. Spinal rods were tested under zero load and using ASTM F1717 standard. For rod strain measures, the largest mean bias offset and baseline noise standard deviation under zero load for DIC were 7.6 με and 33.7 με, respectively. For tissue measures, the largest mean bias offset was 8 με for ε1 and -55 με for ε2 with baseline noise standard deviations of 19 με and 26 με, respectively. On average, DIC rod strain measurements were 5.3% less than strain gauge measurements throughout the load range. Principal IVD and bony surface strains were consistently measurable and showed marked regional differences in strain patterns under different load conditions. Strains measured on spinal rods using DIC techniques reasonably agreed with standard strain gauge measurements. Subregional strain analyses on soft and hard spinal tissues during standard flexibility tests were feasible. Optical strain mapping is a viable, accurate, and promising measurement technique for novel spinal biomechanical studies [1].

Yagnick NS, Tripathi M, Mohindra S. How did Michael Jackson challenge our understanding of spine biomechanics? J Neurosurg Spine. 2018 Sep;29(3):344-345. doi: 10.3171/2018.2.SPINE171443. Epub 2018 May 22. PubMed PMID: 29785876.

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Kelly BP, Silva CR, Lehrman JN, Sawa AGU, de Andrada Pereira B, Godzik J, Turner JD. Use of digital imaging correlation techniques for full-field strain distribution analysis of implantable devices and tissue in spinal biomechanics research. J Biomech. 2022 Feb 28;135:111025. doi: 10.1016/j.jbiomech.2022.111025. Epub ahead of print. PMID: 35259657.