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ESTIMATION OF LOADS ON HUMAN LUMBAR SPINE-A CRITICAL REVIEW OF PAST IN VIVO AND COMPUTATIONAL MODEL STUDIES

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Summary: Excessive and repetitive loads on human lumbar spine during diurnal activities are recognized to play a major role in the etiology of back disorders and pain. A comprehensive knowledge of these loads in static and dynamic activities is a prerequisite for proper management of various spinal disorders, effective risk prevention and assessment in workplace activities, sports and rehabilitation, realistic testing of spinal implants as well as adequate loading in in vitro and in silico studies. During the last five decades, a variety of in vivo techniques have been employed to estimate spinal loads by measuring surface electromyography activity in limited trunk muscles, changes in the body height, the intradiscal pressure or forces and moments transmitted via instrumented implants. In addition, computational models have been employed as alternative powerful means to directly compute spinal loading and tissue-level stresses-strains under various static and dynamic activities. Limitations and invasiveness in the former and assumptions in the latter remain as major concerns in these investigations.

This work aims to systematically review, compare and critically evaluate the existing literature on in vivo measurement and computational model studies of lumbar spinal loads. Towards this goal, models dealing with static postures (standing, sitting, lying), slow dynamic tasks (walking, stair climbing, lifting) as well as faster dynamic activities (lifting, sudden perturbations vibrations and impact) are separately evaluated. Validation of model predictions with recorded electromyography, maximum voluntary exertion moments and intradiscal pressures is treated. The findings are beneficial in many areas in work place design and ergonomics, biomechanics, and clinical environments.