Kinematics

Kinematics is the branch of classical mechanics which describes the motion of points (alternatively “particles”), bodies (objects), and systems of bodies without consideration of the masses of those objects nor the forces that may have caused the motion.

Kinematics as a field of study is often referred to as the “geometry of motion” and as such may be seen as a branch of mathematics.

Kinematics is the method of observing or measuring the position. of joints and segments through each. phase of gait

Kinematics begins with a description of the geometry of the system and the initial conditions of known values of the position, velocity and or acceleration of various points that are a part of the system, then from geometrical arguments it can determine the position, the velocity and the acceleration of any part of the system. The study of the influence of forces acting on masses falls within the purview of kinetics. For further details, see analytical dynamics.

With fusion the kinematic behaviour of the spine is altered. Fusion and/or stabilizing implants carrying considerable load and prevent rotation of the fused segments. Associated with these changes, a risk for accelerated disc degeneration at the adjacent levels to fusion has been demonstrated. However, there is yet no method to predict the effect of fusion surgery on the adjacent tissue levels, i.e. bone and disc. The aim of this study was to develop a coupled and patient-specific mechanoregulated model to predict disc generation and changes in bone density after spinal fusion and to validate the results relative to patient follow-up data. To do so, a multiscale disc mechanoregulation adaptation framework was developed and coupled with a previously developed bone remodelling algorithm. This made it possible to determine extra cellular matrix changes in the intervertebral disc and bone density changes simultaneously based on changes in loading due to fusion surgery. It was shown that for 10 cases the predicted change in bone density and degeneration grade conforms reasonable well to clinical follow-up data. This approach helps us to understand the effect of surgical intervention on the adjacent tissue remodelling. Thereby, providing the first insight for a spine surgeon as to which patient could potentially be treated successfully by spinal fusion and in which patient has a high risk for adjacent tissue changes [1)].

1)

Rijsbergen MV, van Rietbergen B, Barthelemy V, Eltes P, Lazáry Á, Lacroix D, Noailly J, Ho Ba Tho MC, Wilson W, Ito K. Comparison of patient-specific computational models vs. clinical follow-up, for adjacent segment disc degeneration and bone remodelling after spinal fusion. PLoS One. 2018 Aug 30;13(8):e0200899. doi: 10.1371/journal.pone.0200899. eCollection 2018. PubMed PMID: 30161138; PubMed Central PMCID: PMC6116979.