Timing phases of the sit-to-walk movement: Validity of a clinical test
Kerr A, Rafferty D, Kerr K.M, Durward B: School of Health & Social Care, Glasgow Caledonian University, and University of Nottingham, UK

The sit-to-walk (STW) movement is a functional task that challenges balance and co-ordination. There is a paucity of literature investigating the phases of this movement and its significance in a clinical rehabilitation context. Measuring phases of this movement may provide clinically applicable data for screening subjects for mobility problems and evaluating interventions. Fifty-six subjects from three groups; young (<65 years old), elderly (>65 years old) and elderly at risk of falling (EARF), performed the STW movement freely from a chair. Switches placed on the backrest, chair seat and two on the floor identified the times of movement events: onset, seat-off, swing-off and stance-off. These events defined three phases: flexion, extension and stance. Timing of events and phase duration data derived from this switch system were correlated with those taken from a three-dimensional motion analysis system. All switch events closely matched the motion analysis events with ICC (model 2.1) scores ranging from 0.93 to 1.00. Duration of all STW phases were statistically longer in the EARF group compared to both unimpaired groups (p < 0.05). Data from the four switch configuration demonstrated excellent concurrent validity when associated with data from a three-dimensional motion analysis system in identifying the phases of STW. Measurement of the phases of the STW task has potential in screening those at risk of falling and informing care strategies to prevent falls.


Virtual interactive musculoskeletal system (VIMS) in orthopaedic research, education and clinical patient care
Chao E.Y.S, Armiger R.S, Yoshida H, Lim J, Haraguchi N: Bied Consulting, Filaree, USA, Department of Bioengineering, Johns Hopkins University, Baltimore, Digital Human Center, National Institute of Advanced Industrial Science and Technology, Aomi, Koto-ku, Tokyo, Japan, Department of Orthopaedics, Tokyo Police Hospital, Tokyo, Japan and Orthopaedic Biomechanics Laboratory, Johns Hopkins University, Baltimore, Maryland, USA

The ability to combine physiology and engineering analyses with computer sciences has opened the door to the possibility of creating the "Virtual Human" reality. This paper presents a broad foundation for a full-featured biomechanical simulator for the human musculoskeletal system physiology. This simulation technology unites the expertise in biomechanical analysis and graphic modeling to investigate joint and connective tissue mechanics at the structural level and to visualize the results in both static and animated forms together with the model. Adaptable anatomical models including prosthetic implants and fracture fixation devices and a robust computational infrastructure for static, kinematic, kinetic, and stress analyses under varying boundary and loading conditions are incorporated on a common platform, the VIMS (Virtual Interactive Musculoskeletal System). Within this software system, a manageable database containing long bone dimensions, connective tissue material properties and a library of skeletal joint system functional activities and loading conditions are also available and they can easily be modified, updated and expanded. Application software is also available to allow end-users to perform biomechanical analyses interactively. Examples using these models and the computational algorithms in a virtual laboratory environment are used to demonstrate the utility of these unique database and simulation technology. This integrated system, model library and database will impact on orthopaedic education, basic research, device development and application, and clinical patient care related to musculoskeletal joint system reconstruction, trauma management, and rehabilitation.
Three-dimensional measurement of intervertebral kinematics in vitro using optical motion analysis.

Holt CA, Evans SL, Dillon D, Ahuja S: School of Engineering, Cardiff University, UK.

Measurement of the stiffness of spinal motion segments is widely used for evaluating the stability of spinal implant constructs. A three-dimensional motion analysis technique has been developed that allows accurate measurement of the relative movement of the vertebral bodies about a well-defined anatomical axis system. The position of marker clusters on each vertebra is tracked using digital infrared cameras (Qualisys AB, Gothenburg, Sweden). Landmarks are identified using a marked pointer, and an anatomical coordinate system is defined for each vertebra. The transformation relating the upper and lower vertebrae is calculated, using the joint coordinate system approach of Grood and Suntay to find the rotations and translations in each anatomical plane. The stiffness of vertebrectomy constructs was investigated using a Synex vertebral body replacement and an anterior rod with one or two screws in each vertebral body, with or without damage to the posterior longitudinal ligament (PLL). A moment of 2 N m was applied about each anatomical axis, and the range of motion about each axis was calculated. The range of motion in flexion-extension and lateral bending was significantly greater with only one screw. When the PLL was cut, there was no significant increase in the range of motion.

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St. Jozef Instituut Department of Rehabilitation, ANTWERP: BELGIUM

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