Fall Detection

Properties of the 'Timed Up and Go' Test: More than Meets the Eye.
Authors evaluated psychometric properties of the 'timed up and go' test (TUG) in healthy older adults between 70 and 90 years of age (n = 265) in comparison to the Berg balance test (BBT) and the Dynamic Gait Index (DGI). The TUG was normally distributed and did not suffer from ceiling or floor effects in healthy older adults. Conversely, the two other commonly used tests of mobility and fall risk, the BBT and the DGI, suffered from ceiling effects which is consistent with previous findings in highly functioning older adults. Authors also observed small, but significant, associations between the TUG and tests of executive function that were not seen when examining the relationships between these tests and the BBT or the DGI.

Assessing falls in the elderly: should we use simple screening tests or a comprehensive fall risk evaluation?
This paper summarizes information to help guide the clinician in choosing the most appropriate currently available tool. Authors point out that as many of these measures are similar in their sensitivity and specificity, decisions on which approach to take in many cases may have to be informed also by the clinic setting and existing resources available to the clinician.

Balance perturbation system to improve balance compensatory responses during walking in old persons.
This paper describes the Balance Measure & Perturbation System which is a system that provides small, controlled and unpredictable perturbations during treadmill walking. It is hypothesized that providing perturbation will improve compensatory postural responses in older adults.
http://www.jneuroengrehab.com/articles/browse.asp

Smart carpet. Developing a sensor system to detect falls and summon assistance.
Wearable devices such as necklaces or bracelets may not be ideal for some older adults as they must choose to wear them, remember how to use them, and be conscious after falling. The Smart Carpet consists of an array of sensors placed under an expanse of carpeting. Walking or falling on the Smart Carpet transmits signals to a central processing computer. Fall detection messages from the central computer alert caregivers. After development of a Smart Carpet prototype, 11 volunteers participated in tests to measure sensitivity of sensors embedded in the Smart Carpet. The embedded sensors were not perceptible to the volunteers as they walked across the Smart Carpet and successfully detected gait characteristics. Findings confirmed the feasibility of fall detection. Measurements obtained of gait characteristics will be used in development of more advanced versions of the Smart Carpet.
A retrospective analysis of balance control parameters in elderly fallers and non-fallers.
Ninety-nine older adults (65-91 years) from two self-care residential facilities were included in this study to better understand postural control mechanisms in individuals prone to falls. Foot center-of-pressure (CoP) displacement data were collected during narrow base upright stance eyes closed conditions and analyzed using summary statistics and Stabilogram-Diffusion Analysis (SDA) for mediolateral (ML) and anteroposterior (AP) directions. Subjects were instructed to minimize body sway. The SDA showed significantly higher short-term diffusion coefficients and critical displacements in fallers in the ML but not the AP direction. Mean sway area and ML-CoP sway range were also larger in fallers. Authors conclude that short-time ML postural sway during narrow base standing with no visual input can effectively and successfully reveal postural control mechanism declines associated with falls in the elderly; however, this study has several limitations. Further study should involve larger sample sizes, prospective designs, and less healthy populations of older adults.
http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6T59-50R63PG-4&_user=1067472&_coverDate=08%2F08%2F2010&_rdoc=1&_fmt=high&_orig=search&_sort=d&_docanchor=&view=c&_searchStrId=1443651153&_rerunOrigin=google&_acct=C000051251&_version=1&_urlVersion=0&_userid=1067472&md5=16ccfe978e645fc4817ed8835af57bc

Adaptability to perturbation as a predictor of future falls: a preliminary prospective study.
This preliminary prospective study examined the relationship between older adults’ (>64 years) future fall risk and their reactive responses and adaptations to repeated slips, and their functional status. Thirteen healthy, community-dwelling adults were exposed to a session of repeated slips induced at seat-off during a sit-to-stand task by computer-controlled release of 2 sliding platforms beneath the participant’s feet. About 30 months later, self-reported falls experience data were collected for the preceding year from these participants. Slip outcome (fall, loss of balance, or recovery), slip score (weighted sum of slip outcomes), Timed Up and Go scores, and future falls were recorded. Four participants who reported at least 1 fall had significantly higher slip scores than the rest. In contrast, neither failed recovery on the first slip nor a higher TUG score predicted greater odds of future falls. Authors conclude that community-dwelling older adults’ adaptability to externally imposed perturbations may reveal their future fall risk.

Consequences of lower extremity and trunk muscle fatigue on balance and functional tasks in older people: A systematic literature review.
This systematic literature review summarizes knowledge of the effects of lower extremity and trunk muscle fatigue on balance and functional tasks in older people. Seven out of 266 studies met the inclusion criteria. Despite variations in study design, populations,
fatigue protocols, and outcome measures, findings were fairly consistent in that fatigue of the lower extremity and trunk muscles impairs balance and performance of functional tasks. This suggests that fatigue protocols could be useful in the prediction of falls; however, more studies are required to decide whether muscle fatigue should be included in routine clinical fall risk assessments. Authors conclude that future studies should assess whether fatigue is related to increased risk of falling and whether exercise interventions may decrease fatigue effects.
http://www.biomedcentral.com/1471-2318/10/56

Mobility in Older Adults: A Comprehensive Framework.
In this new theoretical framework, authors define mobility as the ability to move oneself (e.g., by walking, by using assistive devices, or by using transportation) within community environments that expand from one's home, to the neighborhood, and to regions beyond. They portray the concept of mobility through 5 categories of determinants (cognitive, psychosocial, physical, environmental, and financial), with gender, culture, and biography (personal life history) conceptualized as crosscutting influences. Each category of determinants consists of an increasing number of factors, demonstrating greater complexity, as the mobility environment expands farther from the home. The framework illustrates how mobility impairments can lead to limitations in accessing different life-spaces and stresses the associations among determinants that influence mobility. Authors suggest that research needs to be more interdisciplinary, that current mobility findings should be interpreted more comprehensively, and that new more complex strategies should be developed to address mobility concerns.

Reliability and validity of a clinical test of reaction time in older adults.
Growing evidence indicates that cognitive processing required for reaction time tasks, is associated with balance and falls risk. Authors examined the reliability and validity of the response speed subtest of the Bruininks-Oseretsky Test of Motor Proficiency (BOT) as an indicator of reaction time in older adults using a volunteer sample of 30 community-dwelling men and women over the age of 65 years. This test consists of a response speed stick (a 61-cm long stick that resembles a ruler) that is held against a wall and dropped by an examiner and the subject must use his/her thumb to stop the descent of the stick along the wall as quickly as possible. Reaction time is represented by the distance the stick falls before being stopped by the subject. Although inter-tester reliability was excellent, test-retest reliability for the BOT response speed subtest was not in an acceptable range.
A Method for Automatic Fall Detection of Elderly People Using Floor Vibrations and Sound - Proof of Concept on Human Mimicking Doll Falls.
Authors presented and provided evidence for a proposed automatic fall detection system which is based on floor vibration and sound sensing and uses signal processing and pattern recognition algorithm to discriminate between fall events and other events. The proposed system does not require the person to wear anything. A human mimicking doll was used to test the system. This preliminary research showed that the proposed system detected the human mimicking doll’s falls with a sensitivity of 97.5% and specificity of 98.6%.

Fall detection of elderly through floor vibrations and sound.
This fall detection technology has been developed to facilitate an effective response and rescue time after a fall. This low-cost system can detect human falls with high precision for distances up to 5 meters without the user having to wear any special equipment. The solution is based on floor vibration and acoustic sensing, and uses a pattern recognition algorithm to discriminate between human or inanimate object fall events. It can be calibrated to any kind of floor and room acoustics. A limitation of the system is that it may not be sensitive to low impact falls.

Fall detection using multiple cameras.
This fall detection technology using a multiple cameras system has been developed to facilitate an effective response and rescue time after a fall. The technology uses image analysis to localise people and reconstruct their 3D shape and position. This experimental results showed that analysing the evolution of vertical distribution of the body volume was efficient to detect falls. The next goal will be to reduce the number of cameras and evaluate optimal camera positions.

Testing of a long-term fall detection system incorporated into a custom vest for the elderly.
This fall detection system uses a tri-axial accelerometer attached to a custom vest worn under clothing to detect impacts and monitor posture. The vest, fall algorithm, fall detection sensor, and fall message transmission algorithm were tested by two teams of 5 elderly subjects who wore the sensor system in turn for 2 weeks each and were monitored for 8 hours a day. Results showed that significant improvements in ensuring robust and reliable communication were required. Authors also indicate that further development will include a more accurate fall detection algorithm, a more suitable attachment method (modifications or elimination of the vest), and a lighter and smaller fall-sensor.