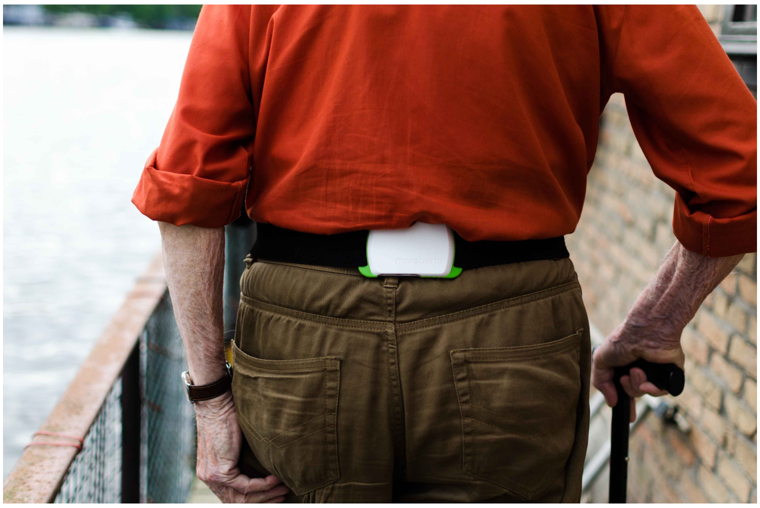
DynaPort MoveMonitor

Device Positioning and Wearing Compliance



Typically the position of a physical activity monitor is fixed to a certain part of the body for it enables increased relevance of outcome interpretation. The position of the monitor relative to the body is important because this largely determines the type of physical activity outcomes that can be captured. Several positions are used to attach the monitor to the body. The 3 locations most commonly used for positioning of physical activity monitors are the trunk, the upper extremities and the lower extremities. Each position has it's pro's and it's con's.

Physical Activity Monitor Positioning

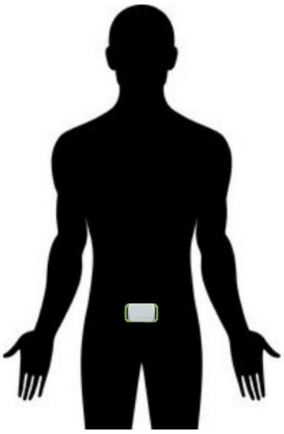
Lower Extremities

Analysing walking behaviour through accelerometry of course is most convenient when data of lower extremity movement is collected. However, positioning the device on the lower extremities also has some major disadvantages. Distinction between lying and sitting is a problem. Instrumenting one leg implies restriction to less detailed analysis. For more detailed analysis of gait, like for example gait symmetry, multiple devices are needed to instrument both legs. Set-ups with multiple devices always results in increased risk of failed measurements. The tapered shape of the thigh often leads to displacement of the sensor when using a belt. A possible solution is fixation using tape or glue which in its turn limits intermittent dismounting of the device during the measurement period.

Upper Extremities

Fixation to the wrist is the most common and accepted way of device positioning since we are used to wearing accessories on the wrist. Another advantage is the possibility to measure physiological parameters. However, there are some limitations regarding physical activity monitoring especially for older adults and for patients with chronic diseases. For instance when arm swings are absent during locomotion due to a rollator, wrist worn devices are unable to detect locomotion. Arm movement unrelated to locomotion are sometimes classified as locomotion. Also classification of body position is prone to errors due to arm movements.

Trunk



Typically several locations on the trunk are used for positioning physical activity monitors. The MoveMonitor (McRoberts BV, The Hague, The Netherlands) is positioned on the lower back using an elastic strap. This location is close to the Centre of Mass (CoM) which might better represent whole body movement than other locations [1]. Movements around the hip are crucial for classification of body positions. In that light the lower back location is also more convenient for analysing movement around the hip joint as compared to more cranially positioned devices. This way, less influence of spinal flexion and extension can be expected. Fixation around the thorax is more complicated because substantial downwards displacement is a risk. Next to that devices positioned on the thorax are more visible and more obtrusive, especially for women. On the other hand, wearing a belt around the lower waist is not very different from daily life which, from our experience, results in low awareness. It has been shown that gait characteristics are robust against limited vertical sensor displacements (between L3 and L5) [2]. Horizontal displacement should be avoided though.

Wearing Compliance

Non-Wearing Detection

Subjects are often instructed to wear the monitor for one or two weeks continuously and only remove the monitor during water related activities like taking a shower. Often researchers or clinicians unexperienced in using the MoveMonitor doubt if people are willing to comply with such wearing time requirements.
In order to control for wearing compliance, a non-wearing detection has been developed and validated [3]. The figure below represents accelerometer data from a device being worn (green) and non-wearing data (grey). Valid days are proposed with a minimum wearing duration of 22.5 hours per day [5].

Publications on Wearing Compliance

Several examples of wearing compliance of waist worn measurement devices like the DynaPort MoveMonitor have been published. In a study comparing physical activity of asthma patients with healthy control subjects, 226 out of 236 asthma patients (96%) and 201 out of 216 control subjects (93%) complied with the norm for wearing time (22,5 hours a day for a minimum of 5 out of 7 days) [4]. Six subjects out of the total subject group did not comply because of an unexplainable device malfunction.. The number of days with a valid registration of PA did not differ significantly between asthmatics and controls (P = 0.90).

In a study on reliability of accelerometer measurements in older adults from Van Schooten et al. (2015) a norm for wearing time of 18 hours a day for 4 consecutive days is advised [6]. From the total subject group, 91% and 89% complied with this norm for measurement periods 1 and 2 respectively. This indicates that measuring physical acitivity in daily life using trunk-mounted accelerometers is feasible in the older population.

Testimonials

"Since 2012 we have collected over 1000 weeks of gait and activity of daily living data using McRoberts devices with excellent (99%) compliance," says Professor Stephen Lord, Senior Principal Research Fellow – Falls, Balance and Injury Research Centre – at Neuroscience Research Australia.
"Company founder Dr. Rob van Lummel's understanding of our research needs comes in part from his own research experience in this area, and we have found his team of engineers responsive to our changing requirements."

Lord continues, "Over the next three years we will collect several thousand more weeks of data with McRoberts devices in people with Parkinson's Disease, MS and cervical cancer and older people taking part in fall prevention exercise programs. We will use the wearable devices to measure gait impairments, fall risk, changing activity levels and to elucidate predictors of longer term health outcomes."

Stephen Lord, PhD

References

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