Digital Mobility Biomarkers for Diagnosis and Outcome Assessment of Knee Osteoarthritis: Status Quo and Opportunities.

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The prevalence of osteoarthritis, in particular of the lower limbs including the knee, is rising due to physical inactivity and sedentary lifestyles, nutrition and obesity as well as changing demographics. The early and increasing effects of (knee) osteoarthritis on disabling physical activity behaviour are evidently a trigger and contributor to major non-communicable co-morbidities such as diabetes, cancer or neurodegenerative conditions. Thus, early, possibly pre-symptomatic diagnosis of knee osteoarthritis would be valuable to indicate patients for timely interventions. This includes in particular regenerative methods with high effectiveness especially during earlier stages of osteoarthritis. At the same time a large variety of novel regenerative treatments are proliferating requiring patient-centric evidence for their efficacy and optimal formulation or delivery. Thus outcome assessment methods and metrics are needed which go beyond subjective patient self-reports with low ceilings and which are non-invasive as well as low cost.

Digital mobility biomarkers collected by wearable sensors or other digital tools capturing physical activity behaviour and qualitative metrics of human movement and context in daily live are promising candidates for early diagnosis and objective outcome assessment of osteoarthritis in this context. This lecture presents why and how wearable devices and activity monitors can innovate diagnosis and outcome assessment of knee osteoarthritis and related treatments. Sensor options and available device choices are reviewed. The algorithmic approaches towards activity classification and digital mobility parameters are presented in particular related to knee osteoarthritis.

Clinical applications, examples of orthopaedic studies, reference data and new insights are demonstrated to showcase how these novel methods and digital mobility biomarkers can serve now in orthopaedics and related to knee osteoarthritis and explain where the future opportunities are. This shall trigger an open discussion about the most promising target candidate for developing knee osteoarthritis specific digital mobility biomarkers. In the spirit of ICORS, the International Combined Orthopaedic Research Societies as a global alliance, aspects of ecological validity and usability are highlighted.