Assessing Fall Risk Through Comprehensive Data Collection and Evaluation of Biomechanical Parameters in Elderly Patients with Knee Osteoarthritis

Paolo Riccioni[1], Giorgio Davico[3], Giuseppina Farella[2], Roberta Fognani[1], Massimiliano Baleani[1], Lisa Berti[2]
[1]Medical Technology Laboratoy, IRCCS – Istituto Ortopedico Rizzoli, Bologna, Italy
[2]Physical Medicine and Rehabilitation Unit, IRCCS – Istituto Ortopedico Rizzoli, Bologna, Italy
[3]Department of Industrial Engineering, University of Bologna, Bologna, Italy
Email: paolo.riccioni@ior.it

Summary

The PowerAging project, part of the DARE initiative, set out to investigate and understand the relationship between (the decline in) muscle strength, muscle power, mobility and motor control with the risk of falling. A longitudinal study on elder adults with knee osteoarthritis has been designed (and is due to start) to address this problem, where quantitative measures (including instrumented medical imaging, gait analysis, dynamometry testing and mobility monitoring) and clinical questionnaires will be taken at different time points.

Introduction

Falls are a health risk and cause significant injuries (including fracture, subsequent surgical intervention, and postoperative course) which can further limit a person's ability to perform their daily activities. Studies suggest that in the presence of knee osteoarthritis (OA), the risk of falling increases (+30%) [1]. OA is in fact associated to knee instability, and muscle weakness. While various biomechanical parameters, such as muscle strength, muscle power, motor control, quality and quantity of mobility, are known to contribute to (the risk of) falling, it is still unclear which one is the best predictor of a fall event. To the authors' knowledge, there are no studies who have comprehensively looked at all the above parameters in the context of fall prediction. To address this gap, we developed a clinical protocol to monitor muscle power, muscle force and real-world mobility over time in an elderly population with knee OA.

Methods

The target population comprises of 50 subjects with knee OA, aged 65 to 80 years old, who are at a higher risk of falling [1]. We will monitor participants over a period of 18 months (for a total of 4 visits, every 6 months). All subjects will undergo a comprehensive assessment where we will measure (1) muscle power and muscle force, via isokinetic and isometric tests on a dynamometer, and a instrumented stairs ascent and descent test; (2) the subjects' motor function through a gait assessment; and (3) the level of mobility in the real world via the continuous monitoring over 5 days with a single waist-worn inertial sensor [2]. At first and last visits, a full lower limb MRI scan will be acquired to gather additional information on the muscular tissue. Clinical questionnaires and a bioimpedance analysis will complement the protocol. After each visit, the data will be processed and analyzed to establish correlations between parameters and determine their decline over time. Furthermore, musculoskeletal models will be developed to estimate biomechanical quantities (e.g., muscle forces and joint contact forces), exploiting traditional methods (e.g., inverse approach) and novel tools to enable predictive simulations of human movement.

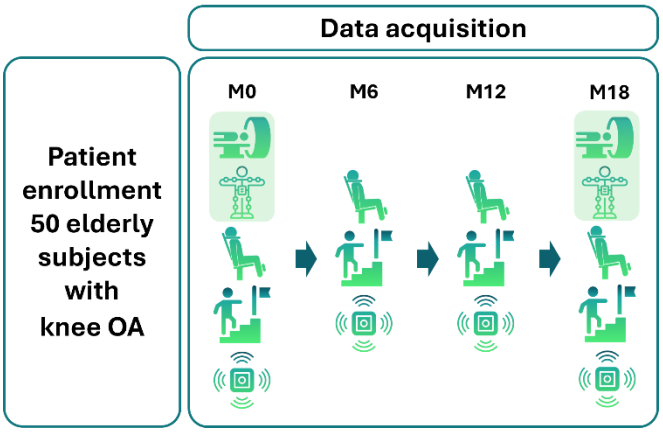

Figure 1: Protocol overview. Muscle power and force assessments, and a 5-days mobility monitoring will be performed at all visits, and complemented with MRIs and a gait analysis at M0 and M18.

Results and Discussion

The PowerAging study has been approved by the local Ethical Committee, and – while patient recruitment is ongoing - the data collection is due to start. The first patient's first visit has been scheduled. We expect to complete the baseline data collection by June, and to concurrently start the data curation, analysis and interpretation. The resulting dataset will provide clinicians and researchers with a better understanding of the mechanisms behind the (risk of) falling and will enable the development of novel tools to predict and prevent falls.

Conclusions

The PowerAging study is designed to acquire knowledge and inform future strategies for the primary prevention of falls.

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