Facilitating rehabilitation after a total hip arthroplasty by design

Armagan Albayrak, PhD, Faculty of Industrial Design Engineering, Delft University of Technology, THE NETHERLANDS

Marit Möhlmann, MSc, Faculty of Industrial Design Engineering, Delft University of Technology, THE NETHERLANDS

Marijke Melles, PhD, Faculty of Industrial Design Engineering, Delft University of Technology, THE NETHERLANDS

Hilbrand Bodewes, Biomet, THE NETHERLANDS

Stephan Vehmeijer, MD PhD, Reinier de Graaf Hospital Delft, THE NETHERLANDS

Introduction: Osteoarthritis (OA) of the hip or knee is a common joint disorder resulting from degradation of cartilages present between knee and hip joints (1). OA can be caused by a complex set of factors, related to genetics, metabolism, biochemistry and biomechanics. More specifically by risk factors related to aging, occupation, and trauma, overweight and repetitive small injuries in the joint (1). It is estimated that OA is a joint disorder that causes most pain of all and is very common in ages over 40 years (1).

Eventually increased pain starts to affect the daily life and the physical condition of the patient. Pain, limited range of motion, and deformity of a joint associated with OA can cause abnormalities in the gait. A walking abnormality closely related to OA in the hip is the Trendelenburg gait (2). In the matter of Trendelenburg gait, the centre of gravity is shifted to relieve the bad side of the hip from forces caused by the weight of the body. Instead of bearing weight on both legs equally in a normal situation, the healthy site is overloaded (3).

The OA is the most common cause leading to a total hip arthroplasty (THA). In the Netherlands each year around 20.000 THA are performed and it is expected that this number in the coming 20 years will increase up to 50.000 THA patients per year (Orthopedie.nl, 2014). After surgery, the patients go home and start to rehabilitate, which take approximately 6-8 weeks. In consultation with the orthopaedic surgeon, some of the patients get a referral to a physiotherapist. Not all of these patients are obey the medical advice. The reasons can vary from not seeing a benefit to not being covered by their insurance company. For this group of patients it means they will only see a medical specialist at the end of the recovery phase (6-8 weeks after surgery). This situation can lead to several problems related to an isolated recovery process; preserving the gait abnormality, non-compliance to therapy, quality of the therapy, and how to combine it with ‘normal’ lifestyle activities (4). The aim of this study is to design a solution that supports the patient to create a healthy gait during daily life, and provide the patient with a feeling of medical certainty while giving information, inspiration and feedback. The focus is on home rehabilitation without the need of physical involvement of a physiotherapist.

Method: The product design process of Roozenburg and Eekels has been followed (5) and different research methods like; literature research, interviews & observations with specialist and patients, and some of the creative problem solving techniques has been used to explore the topic and gain insights (6). This all together has resulted in design opportunities of which one concept is elaborated further into a design proposal the so-called BioStep (4).
Results: BioStep provides the patient a new way of rehabilitation by making their daily life activities a part of the program. BioStep is a smart insole with an app and aims to create a healthy gait by tracking the gait of the patient. When an abnormality in the gait is measured the patient gets feedback by means of a vibration and a message on their smartphone. By opening the app the patient, sees an explanation of the measurements and suggestions how to improve their gait. The app also provides other functionalities like setting goals, sharing information with peers, etc.

Discussion: Of this final design, a working prototype was build and evaluated with users. Most of the participants acknowledged the value of removing the physiotherapist from the process of recovery, which allows them to recover at home on their own way. The medical uncertainty in case of home rehabilitation is covered in the app by visual explanation of the measurements, what this means for the progress of the patient and giving advice on how to improve the gait. Different participants evaluated the concept of BioStep positively. Further research should be done to explore the possibilities to measure the gait on a more unobtrusive way instead of wearing the insoles.

Keywords: DESIGN, ERGONOMICS, REHABILITATION, GAIT, HIP ARTHROPLASTY

References


