Uporaba vidne povratne informacije na sistemu Lokomat pri pacientih z nepopolno okvaro hrbtenjače – pregled literature

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Uvod: Vadba hoje na tekočem traku z delno razbremenitvijo telesne teže je v rehabilitaciji pacientov z nepopolno okvaro hrbtenjače stalna praksa. Pri hoji pacientu pomagata dva, včasih trije fizioterapevti, ki morajo opravljati ergonomsko zahtevno delo. Fizioterapevt pomaga pacientu pri izvedbi korakov, hkrati pa z rokami zaznava njegovo aktivno sodelovanje in mu lahko zaradi tega posreduje primerne napotke za dosego učinkovite vadbe. Napredek tehnologije je v zadnjih desetih letih omogočil razvoj robotskih sistemov za vadbo hoje. Eden takih je Lokomat. Prednosti vadbe hoje z njim so dolgotrajnejša obdobja vadbe, pravilen vzorec hoje in zmanjšanje števila potrebnih fizioterapevtov. Ena izmed slabosti je odsotnost fizioterapevtovega vodenja z dotikom. Lokomat ima v pogone za kolka in koleni vgrajene senzorje sil, ki ves čas med hojo zaznavajo pacientovo aktivno sodelovanje ali njegovo odsotnost. Pacient na zaslonu pred seboj dobiva povratne informacije o izvedbi korakov v smeri fleksije in ekstenzije kolkov in kolen v različnih oblikah, ki jih izbere s fizioterapevtom. **Metode:** Pregledali smo literaturo s področja uporabe Lokomata v kombinaciji z vidno povratno informacijo pri pacientih z nepopolno okvaro hrbtenjače. Iskali smo jo s podatkovno bazo PubMed. **Rezultati:** Ugotovili smo, da je literature z omenjenega področja malo. Splošno sprejeto je, da povratna informacija učinkovito pospeši motorično učenje, naj jo zagotovi strokovnjak ali naprava (1). Mišična aktivnost, opazovana z elektromiografijo, se poveča z upoštevanjem povratnih informacij o izvedbi korakov, ki jih pacienti dobijo na zaslonu, pri uporabi ogledala, pri hoji v navideznem okolju ali z verbalnimi spodbudami (2). Raziskovalci ugotavljajo, da je učinkovitost vadbe hoje z vidno povratno informacijo v obliki grafov enakovredna verbalnim spodbudam (3). Vendarle pa z vrednostmi, ki jih pacienti dosežejo na zaslonu, ni mogoče zaznavati napredka pri hoji (4). **Zaključki:** Koncept k nalogi usmerjene ponavljajoče se vadbe predlaga, da bi bile povratne informacije podajane med funkcijskimi aktivnostmi (5), kar nam Lokomat omogoča. Potrebne so nadaljnje raziskave, ki bi potrdile ali ovrgle hipotezo, da je sistem za podajanje vidnih povratnih informacij, ki je dodan k Lokomatu, učinkovit pripomoček za izboljšanje različnih vidikov hoje.

Ključne besede: hoja, robotika, povratna informacija, poškodba hrbtenjače, rehabilitacija.

The use of visual feedback with the system Lokomat in patients with incomplete spinal cord injury – literature review

Background: Treadmill training with partial body weight support is a common practice in rehabilitation of patients with incomplete spinal cord injury. A patient needs assistance of two or three physiotherapists that need to do ergonomically demanding task. A physiotherapist helps the patient during walking and at the same time feels his participation. That is how adequate guidance can be provided to the patient to achieve effective training. Advances in technology in past ten years enabled development of robotic systems for gait training. Lokomat is one of them. Advantages of gait training with the Lokomat are longer training periods, regular gait pattern and fewer physiotherapists needed for training. One of the disadvantages is absence of physical contact between a patient and a physiotherapist. Lokomat has built-in force sensors that perceive active participation of the patient or absence of it. On the screen in front the patient receives feedback about active participation in hip and knee joints in flexion and extension. The feedback comes in different forms that are selected in cooperation with the patient. **Methods:** We reviewed literature about the use of Lokomat in combination with visual feedback in patients with incomplete spinal cord injury. We searched it with database PubMed. **Results:** We found out the lack of literature. It is generally accepted, that feedback effectively facilitates motor learning, if provided by an expert or a machine (1). Muscle activity observed with electromyography is increased with feedback about gait, no matter what the form of the feedback is; on the screen, with mirror, in virtual reality or with verbal stimulus (2). The effectiveness of gait training is the same comparing visual feedback in the form of graphs and verbal stimulus (3). However, the values reached by the patient on the screen cannot be a measure of progress in gait training (4). **Conclusions:** The concept of task-oriented training suggests that the feedback should be delivered to the patient during functional activities (5). This is what the Lokomat enables. There is the need for further research, which would confirm or deny the hypothesis, that the Lokomat with integrated feedback system is an efficient tool for improving different aspects of gait.

Keywords: gait, robotics, feedback, spinal cord injury, rehabilitation.

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