Impairments and walking disabilities in incomplete Spinal Cord Injured persons - a survey

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Abstract

In order to determine research priorities in developing mobility support systems for incomplete SCI patients, insight is required concerning the relative importance of factors that affect the gait pattern in this group of patients.

To achieve this goal, a survey amongst experienced physiotherapists was carried out using a semi-structured questionnaire. It was found that impairments such as inadequate hip extension during stance, lateral shift of the pelvis during swing and insufficient knee extension during stance are frequently encountered impairments of gait. The clinicians also indicated that more research regarding these items is important in order to realise functional improvements in walking. Additionally, although very few therapists actually use FES, they see a high potential in the use of FES for gait support.

Introduction

Functional Electrical Stimulation (FES) is often considered in the treatment of patients with an incomplete Spinal Cord Injury (SCI). In setting research priorities regarding the design of FES systems it is important to know which aspects of the impaired locomotor system need to be improved. In the past many studies have been performed to improve gait in SCI patients \cite{1,2,5,8}. Most studies use a combination of supporting the stance function and swing function of the leg(s) with FES. However, it is neither described nor justified why certain FES applications have been chosen. A good knowledge on the impairments and disabilities of the gait in these patients is needed to know which impairments should be improved to enhance walking performance. Maxwell and colleagues \cite{7} described the user needs in SCI and tried to derive demands for FES-systems in SCI patients. Their study was very generic in nature and was carried out in 514 patients who were members of the spinal injuries associations in the Netherlands and Scotland.

They asked the respondents which clinical problems, like bladder management and walking quality, affected their quality of life most. Their analysis showed a relatively low demand for improvement of walking in the whole group of SCI patients. However, subgroup analyses showed very different results. In marginal walkers improving walking quality was rated much higher. Among 79 marginal walkers it was found that more than 70 percent found ‘improvement in walking quality’ and ‘walking for exercise’ more than or equal to important \cite{6}. These items were indicated as most important of 21 items. Walking was found to be even more important than hand function, bowel-/ bladder management or spasm reduction. Thus it is clear that gait improvement is an important need in these patients.

Several articles have described the influence of specific impairments, e.g. spasticity \cite{3} on the gait pattern. However, still studies are lacking to investigate the impact of different impairments on the quality of walking of marginal walkers.

The present study was carried out to gain such insight in the most disabling motor dysfunction in incomplete spinal cord injury. A survey was performed amongst physiotherapists working with SCI-patients. Secondly, the survey was intended to determine the state of the art in FES use in clinical settings.

Methods

A semi-structured questionnaire was developed in several subsequent phases. Firstly, a brainstorm session was organised with both a resident in physical medicine and rehabilitation (PMR) and a physiotherapist. Both had at least 8 years of experience in working with SCI patients. In the brainstorm phase the items for the questionnaire were
determined. 5 items were selected (see below). Secondly, questions for the selected items were constructed and discussed with the PMR-physician and physiotherapist in several sessions. The questionnaire was then filled in by one physiotherapist, who was not involved in the construction. The therapist was asked if the questions were clear and understandable.

The questionnaire included questions about:

- the number of complete-incomplete SCI patients the clinicians either had treated or were actually treating,
- the distribution of walkers and non walkers,
- the use of orthosis and walking aids (including FES),
- their opinion about the use of FES in incomplete SCI and
- the impairments and motor dysfunctions that affect gait performance.

With respect to the latter, respondents were asked to fill in the items they thought were disabling. 18 disabilities and impairments were described in the questionnaire and the respondents were also able to add extra items. In addition, the respondents were asked to give a priority score on a 6-point scale for each of these items. The respondents scored 6 items from high priority to low priority. The data were then analysed by multiplying the item with the priority score (highest priority = 6).

Respondents were also asked about their actual use of FES systems to improve gait in spinal cord injury. Additionally the respondents' opinion about FES use for gait support was asked. For that several phrases were given to which the respondents could respond whether they agreed with it or not.

The semi-structured questionnaire was send to 11 physiotherapists in the Netherlands and Belgium. These therapists were members of the ‘Dutch/ Flemish SCI-society’. All the therapists worked in a spinal unit of a specialised rehabilitation centre. These physiotherapists were asked to participate in the survey, because of their clinical experience.

Results

All 11 physiotherapists returned the questionnaire. The results of the impairments in the gait were divided into different phases of a stride: stance phase, swing phase, pre-positioning of the foot and step-length. The respondents indicated that the stance phase is most often impaired in marginal walkers.

The impairments, most frequently mentioned as ‘often’ or ‘very often’ impaired, are included in figure 1.

- hip extension during the stance phase,
- the knee extension during the stance phase,
- lateral shift of the pelvis during the swing phase,
- decreased dorsal flexion of the foot during the swing phase,
- hip flexion during the swing phase,
- occurrence of a clap-foot during pre-positioning of the foot and
- hip contractures decreasing the step-length.

The priority for research (see figure 2) indicated by the clinicians, shows a very high priority (29 mentioned by 6 respondents) for assisting hip extension during the stance phase. The lateral shift of the pelvis during the swing phase

![Figure 1: Number of respondents (n=11) indicating the item for having an important impairing impact on the gait.](image1)

![Figure 2: Priority scores for research needed to improve gait, indicated by clinicians.](image2)
is indicated by a priority score of 25, mentioned 5 times. The knee extension during the stance phase has a priority score of 21, indicated by 5 respondents. The next two, spasticity and trunk stability, were mentioned in the ‘others’ item, meaning that the item was not printed in the questionnaire. Nevertheless 4 respondents mentioned trunk stability (priority score 15) and 3 mentioned spasticity (priority score 15) as an important field for research.

Discussion

In a recent study by Kilgore and colleague’s [4] consumer priorities for research directions were determined in a panel of 9 FES-users and non-users. It was concluded that independence, ease of movement and ease of control were important items for research focusing. Studies like this indicate that research in users needs is important. The results of our study provide an overview of clinically relevant fields for gait improvement, not only for the use of FES but also for other treatments. This does not mean that solving the major problems will cause a perfect gait. There will always remain unsolved impairments. In addition, only a study in many patients measuring the kinetics and kinematics would give real insight in the motor dysfunction. The present survey must therefore be seen as an indication. However, It is assumed that physiotherapists know very well the cause of gait dysfunction’s, because of their extensive experience in the daily treatment of these marginal walkers.

Only 2 respondents indicated that their patients sometimes used FES for gait support, i.e. peroneal nerve stimulation. However, the respondents thought that use of FES to improve gait could be beneficial. Most of the therapists even indicated that FES may have a (re-) learning effect on movements.

Conclusion

The present study was conducted to set priorities for FES research in enhancing walking performance in incomplete spinal cord injury. Several impairments in the gait were pointed out by physiotherapists. In terms of clinical relevance, it is concluded that the FES research should be focused as much as possible on these items. In a clinical setting FES could be used for that purpose, but therefore it should be more commonly practised by clinicians. It is challenging to know that the general opinion of physiotherapists about FES use in gait is very positive, which obviously is in contrast with the limited use.

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References