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Influence of Active Rehabilitation For Locomotion Efficiency in a Wheelchair at Males after Cervical Spine Cord Injury. A Pilot Study

KEYWORDS: Active Rehabilitation, Cervical Spine Cord Injury, the Efficiency of Locomotion in a Wheelchair, Test Driving Techniques, males.

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ABSTRACT *The aim's to compare the efficiency of locomotion in a wheelchair (ELW) before and after 2-week Active Rehabilitation (AR) in men after cervical spinal cord injury (CSCI). ELW's measured by Test Driving Techniques (TDT) on 0-2 scale. Evaluated – balance in a wheelchair; overcoming thresholds of low, medium, high; entrance to the ramp, exit ramp; driving on uneven surfaces on 0-2 scale. To measure the statistical significance of differences in ELW before and after AR we used a one-way analysis of variance ANOVA, the value of the function F Snedecor and adopted the level of significance $p < 0.05$. We found improvement in ELW after the AR ($p < 0.05$) in men with CSCI. AR is an important step in improving ELW patients after CSCI. Long-term studies are needed assessing the impact of AR on the ELW of the CSCI.*

Introduction

The development of mechanization of industry, agriculture, automotive led to increasing of the amount of CSCI. The most common cause of CSCI are road accidents (33-75%), falls from heights (12-44%) and sports injuries (3,5-18%).[1] CSCI causes motor and sensory deficits that impair functional efficiency and significantly reduce the quality of life. Treatment of patients with CSCI requires an interdisciplinary and comprehensive model of rehabilitation. An important element of it is the AR. Its task is to train a patients optimum physical independence, achieving a high level of self-service. AR completes the standard clinical physiotherapy, fills the gap between the treatment and the return to life in society and often determines the final effect of the comprehensive rehabilitation of such a disable people group.[2,3,4,5,6,7]

Objective

The aim's to compare the ELW before and after 2-week AR in men after CSCI.

Methods

The study involved 40 men (28-42 years old) after the CSCI level C_6-C_7 rehabilitated for the first time in the framework of AR in Kielce-Piekoszów in July-August 2014. The period of disability was 2-5 years. The average age was 34.6 ± 4.8. All the patients were directed to the AR by a neurologist. ELW studies were performed before and after the AR. All patients were informed about the method of testing, purpose and destiny. All men voluntarily agreed to participate in the research. The patients practiced for 2 weeks ELW. Completing with the classes of swimming, archery, table tennis and keep-fit exercises. ELW evaluated TDT (balance in a wheelchair; overcoming low thresholds – 6 cm, medium – 9 cm high – 12 cm; entry on the ramp, exit ramp, drive on uneven ground). The scale used: 0 – no skills; 1 – some skills with a tutor help; 2 – full self-service skills.

We examined the characteristics of the analyzed statistical distributions by Kolmogorov-Smirnov test. It demonstrated that the investigated variables were normally distributed. We calculated the arithmetical means, SD of selected locomotion activities in wheelchair in men after CSCI. To evaluate the statistical significance of differences ELW before and after the AR we used one-way ANOVA. In the individual rankings, we valued the function F Snedecor and accepted the level of statistical significance $p < 0.05$. The calculations were performed in the Department of Computer Science Holy Cross Cancer Center in Kielce software MedCalc – version 11.4.3.0, licensed for Holy Cross Cancer Center.

Results

There was a significant improvement of ELW in men with CSCI after AR, $p < 0.05$. Balance in a wheelchair before the AR was 0.8 points and after it 1.2 ($p = 0.002$). Overcome efficiency low threshold before the AR was 0.7 points and 1.1 after it ($p = 0.000$). In the case of overcoming thresholds medium and high values before and after the AR were – 0.6 points and 1.2, and 0.5 points and 1.1 ($p = 0.000$). The entrance to the platform before the AR was 0.9 points, while after the AR – 1.4 ($p = 0.000$). Exit the platform was before the AR 1.2 points and 1.5 after it ($p = 0.030$). Drive on uneven ground before the AR was 1.3 points, and after it – 1.5 ($p = 0.033$) (Table 1).

Table 1. The efficiency of locomotion in a wheelchair (ELW) in the following Terms of Examination

Test	mean ± SD	F-Value	P-Value
Balance cart Before AR	0.8 ± 0.7		
Balance cart After AR	1.2 ± 0.4	9.846*	0.002
Overcoming low thresholds Before AR	0.7 ± 0.6		
Overcoming low thresholds After AR	1.1 ± 0.3	14.222*	0.000
Overcoming medium thresholds Before AR	0.6 ± 0.5		
Overcoming medium thresholds After AR	1.2 ± 0.4	35.122*	0.000

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Overcoming high thresholds Before AR	0.5 ± 0.8		
Overcoming high thresholds After AR	1.1 ± 0.3	19.726*	0.000
Entrance to the ramp Before AR	0.9 ± 0.7		
Entrance to the ramp After AR	1.4 ± 0.5	13.514*	0.000
Exit the ramp Before AR	1.2 ± 0.7		
Exit the ramp After AR	1.5 ± 0.5	4.865*	0.030
Driving uneven ground Before AR	1.3 ± 0.5		
Driving uneven ground After AR	1.5 ± 0.3	4.706*	0.033

The P values represent result of testing with analysis of variance, F values represent coefficient Snedecor
***Significant 0.05**

We also compared the frequency of ELW category on a scale 0-2 points before and after the AR in males with CSCI. Before the AR 45% of men were unable to independently perform locomotion in a wheelchair (0 points), while 55% needed partial assistance (1 points). After the AR 80% of men improved ELW (1 points – 37,5%, 2 points – 42,5%), 20% of the results didn't change (0 points – 7,5%, 1 points –12,5%) (Table 2).

Table 2. The frequency of ELW categories on a scale 0-2 points

Overall efficiency in points	Before AR		Overall efficiency in points	After AR	
	n	%		n	%
0	18	45	Unchanged – 0 points		
1	22	55		3	7,5
2	—	—	Improvement from 0 to 1 points	15	37,5
			Unchanged – 1 points	5	12,5
			Improvement from 1 to 2 points	17	42,5
Total	40	100	Total	40	100

Discussion

People, after CSCI lose independence and self-sufficiency, and self-esteem dramatically changes. Lack of physical activity leads to apathy, physical pain and social isolation of the disabled.[8, 9, 10, 11, 12, 13, 14] Therefore, an integrated system a part if which is an outside the hospital AR improves the locomotion efficiency, helps to accept the own disability and causes good feeling and active participation in social life. Lawton et al.[15] in CSCI patients conducted a 3 times test: before the rehabilitation beginning, after 12 and after 26 weeks. He showed a significant improvement in functional recovery between the first and the second examination. The results of the third test showed a very low recovery. Itzkovich et al.[16] carried the evaluation of functional capacity assessment and locomotion before and after 4-weeks rehabilitation in 78 patients with tetraplegia. The study was performed using a scale Spinal Cord Independence Measure (SCIM). The greatest improvement was found in the area of self-service and moving inside the room, a little less in the area of service defecation (bladder and bowel management). Ackerman et al.[17] studied the functional and locomotion efficiency of people with CSCI after 6-weeks' rehabilitation. The patients were divided into subgroups (C_1-C_3, C_{4-C5}, C_6,-C_7, Th_1-Th_6 and Th_7-Th_{12}) based on motor damage classification proposed by the American Spinal Injury Association (ASIA). After the completed rehabilitation there was a significant improvement in the functional status of patients in all subgroups except for damage to the amount of C_1-C_4. Tasiemski[6] examined the effect of AR on locomotion efficiency of 57 people with tetraplegia. All the patients showed the improvement of ELW. Bolach[18] stated that AR significantly improves the ELW and social reintegration of the people with CSCI. Bolach and Czajkowska[19] found that swimming training improves the efficiency of self-service and ELW in patients with CSCI.

Our own studies show that AR significantly improves the ELW in men with CSCI. The AR tour adds the disabled faith in themselves, in their abilities, which help to break down physical barriers and mental inhibitions. The individual benefits include all the newly-gained or improved locomotion efficiencies. The studies show the desirability and the need to organize the AR tours. They improve the quality of life, facilitate overcoming of physical barriers and allow greater mobility in cooperation with the environment and participation in professional life.

Conclusions

We noted a statistically significant improvement in men ELW CSCI after the AR, as $p < 0.05$. The results indicate that AR effectively supports the clinical rehabilitation of the CSCI. Our own results give hope that they will become a contribution to further studies and subsequent efforts to improve and modify the active rehabilitation programs, for faster re-integration with the surroundings of the CSCI and gaining their independence in everyday life. In addition, our own pilot study indicates the need for long-term studies evaluating the impact of AR on ELW of the patients with CSCI.

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