CAN WE ASSUME THAT THE INDIVIDUALS WITH INCOMPLETE SPINAL CORD INJURY HAVE A SYMMETRICAL GAIT PATTERN?

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INTRODUCTION

One of the most important goals for individuals after a spinal cord injury (SCI) is the recovery of safe, symmetrical and effective reciprocal gait pattern. Results of animal studies and randomized control trials have led to intensive locomotor training being implemented in rehabilitation units to enhance gait recovery in this population (Dobkin et al., 2007). Astonishingly, available biomecha-nical gait data about the gait pattern of these subjects is limited: more often data is reported for only one side of the body (Leroux et al., 1999). The main purpose of this study was to determine whether the natural gait pattern of individuals with incomplete SCI (ISCI) is less symmetrical than that of healthy subjects walking at a matched cadence.

METHODS AND PROCEDURES

Fourteen men with chronic traumatic ISCI (ASIA D; mean age: 46.9± 13.5 yr) able to walk 50 m independently and 14 healthy subjects (7 women, 7 men; mean age: 46.0 ± 13.3 yr) participated in the study. Kinematic gait parameters were measured bilaterally with an infrared movement analysis system (Optotrak) using 3D coordinates obtained from markers placed on the body segments. Ground reaction forces were recorded using force plates. The net moments and powers at the hip, knee and ankle joints were calculated using an inversed dynamic approach. The stride characteristics of each gait cycle were computed with foot-switches. For the ISCI group, the less (healthy: dominant) and more (healthy: non-dominant) involved lower limbs were identified using the clinical data (lower extremity motor score [LEMS; sum of the ASIA motor score of 5 key muscles (L2, L3, L4, L5, and S1) per extremity, and neurological sensory score of the ASIA]. The mean asymmetry (absolute difference) in the angular displacements, moments and power parameters were obtained by computing the absolute difference between sides (less affected or dominant – more affected or non dominant) at each 5% of the gait cycle and then averaging the results over the number of intervals (n=21). The differences between sides were also examined for the time-distance parameters and for the peak values of moment and power during the energy generation phases of gait (A2, H1 and H3) in ISCI to characterize the pattern of asymmetry. The results of the ISCI and healthy subjects were compared at matched cadence using descriptive statistics and independent Student t-test ($p<0.05$).

RESULTS

The mean natural gait speed of the ISCI was 0.78m/s (SD: 0.34) and the cadence 84 steps/min (SD: 14). The mean LEMS was different between sides (less affected vs. more affected: 22.7 vs. 21.7/25; $p<0.05$). Three participants did not present a difference between sides in the LEMS; in those cases, the more affected side was identified by referring to the ASIA sensory score. Except for the time-distance parameters and the gait parameters at the ankle, the differences

between sides were greater for the ISCI group and they tended to increase from distal to proximal joints (hip > ankle; Table 1).

Table 1: Mean absolute differences

Gait Parameters	ISCI	Healthy	*P*-value
Time-distance	Mean(SD)	Mean(SD)	
Stride length*	2.3 (2.0)	2.5 (2.5)	NS
SSupport (%)	2.2 (1.2)	2.8 (2.6)	NS
Support(%)	2.2 (1.2)	2.8 (2.7)	NS
Angular displacements (º)			
Ankle	2.9 (1.4)	2.5 (0.9)	NS
Knee	6.3 (3.6)	4.2 (1.7)	0.03
Hip	8.3 (4.5)	4.3 (1.7)	0.00
Joint moments (Nm/kg)			
Ankle	0.10 (0.05)	0.09 (0.05)	NS
Knee	0.11 (0.05)	0.08 (0.03)	0.02
Hip	0.13 (0.05)	0.09 (0.06)	0.01
Joint powers (W/kg)			
Ankle	0.14 (0.08)	0.13 (0.07)	NS
Knee	0.14 (0.06)	0.09 (0.03)	0.02
Hip	0.22 (0.10)	0.16 (0.05)	0.06

* Stride length normalised to height.

Respectively, six (42%) and seven (50%) participants with ICSI had a longer stride length and a longer single support (SSupport or support) duration on the more affected side than on the less affected one. The peak moments and powers at the ankle did not differ between sides. For the hip extensors and flexors, the moment and power values were generally greater on the less affected side during the H1 and H3 phases of gait. As example, over 70% of the subjects presented power values near or higher than zero on the less affected side.

DISCUSSION

As expected, the gait speed of the ISCI was reduced and corresponds grossly to 70% of the natural speed of healthy controls. It was important to compare the two groups at a similar cadence to control for effects of the magnitude of the moments and power values on the difference between sides. Overall, the biomechanical parameters of gait are less symmetrical in ISCI individuals than in healthy subjects walking at a similar cadence. Interestingly, we found that the ankle gait parameters are similar between sides whereas significant differences were noted at the hips. This finding might reflect different levels of impairments or recovery patterns for distal and proximal muscles groups in this population. The results also revealed that the gait asymmetry did not follow the clinical pattern of asymmetry closely for the time-distance parameters or the ankle power (A2 peak values). Thus, no specific locomotor characteristics can be identified for the less and more affected sides, except at the hips where the less affected side can be said to generate more energy.

SUMMARY

This study assessed the level of asymmetry of gait parameters in 14 individuals with ISCI walking at preferred speed. Results revealed that these participants could not be considered as having a symmetrical gait pattern, with greater differences between sides at the hip than at the ankle. Moreover, the results revealed that, in general, clinical asymmetry of motor and sensory scores can not be used to infer on the asymmetry of the gait parameters, except at the hip.

REFERENCES

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