INTRODUCTION
Individuals with a spinal cord injury (SCI) perform sitting pivot transfers (SPTs) about 20 times per day on average. While performing SPTs, these individuals generally minimize the distance separating the initial and target seat in an attempt to reduce upper limb (U/L) loads. However, the physical environments in which SPTs are performed often restrict the ability to bring these two seats close to one another. This increased distance between the initial and target seat is believed to increase U/L loads and, consequently, risk of secondary U/L impairments. While a few biomechanical studies have focused on the effects of target seat height on U/L demand during SPTs over the past decade [1,2], no study has yet investigated the effect of the distance separating initial and target seats during SPTs. The purpose of this study is to investigate the effects of increasing the distance between an initial and target seat on shoulder loads during SPT in individuals with SCI.

METHODS
Twenty-seven individuals who sustained a complete or incomplete sensorimotor SCI (42.3±11.4 years old; 1.77±0.09m; 78.5±15.6 kg; 10.3±10.9 years since injury; T5-L4) participated in this study. During a laboratory assessment, participants performed two SPTs between an initial and a target seat separated by 2 cm (near condition) and two additional SPTs with a distance of 12 cm between the initial and target seat (far condition). During all SPTs, the right U/L assumed a leading role, whereas the left U/L assumed a trailing role. Three-dimensional (3D) kinetics and kinematics during all SPTs were recorded during all SPTs to compute 3D net shoulder joint moments using a recursive Newton-Euler approach. The resultant net moment (main outcome measure), that reflects the vector sum, was calculated before being time-normalized to 100 data points and amplitude-normalized to body weight [3]. Peak resultant net moments were documented for each of the four SPT phases and the entire SPT cycle and compared using paired student t tests (p < 0.05).

RESULTS
Significantly higher peak resultant net joint moments were found at the leading shoulder during the far condition for the pre-lift and lift-pivot phases as well as for the entire SPT cycle when compared to the near condition. At the trailing shoulder, significant lower joint moments were reported during the post-lift phase of the far condition when compared to the near condition. Irrespective of the near or far conditions, peak resultant net shoulder joint moments computed at the trailing shoulder were higher compared to the leading shoulder during all SPT phases, except during the post-lift phase. Additionally, the highest peak resultant net shoulder joint moments occurred during the U/L loading phase at the trailing shoulder and during the lift-pivot phase at the leading shoulder.

DISCUSSION AND CONCLUSIONS
This study confirms that widening the distance between the initial and target seat predominately increases the load sustained at the leading shoulder, while almost no effect was found at the trailing shoulder. This study also highlights that greater net joint moments are generated at the trailing shoulder during SPTs compared to the leading shoulder, independently of the distance between the seats. This new evidence-based knowledge will strengthen clinical practice guidelines aimed at preserving U/L integrity and optimizing SPT performance in individuals with SCI. Future studies focusing on the EMG of key shoulder muscles may allow one to refine the interpretation of the current net joint moments as substantial shoulder agonist and antagonist efforts may occur during SPTs.

REFERENCES

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