KINEMATIC ANALYSIS OF DIFFERENT PROPULSION PATTERNS OF WHEELCHAIR

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INTRODUCTION

Wheelchairs are the main and most common device used by people with locomotion disabilities. In that context, it is important to understand the wheelchair users' biomechanics. The Biomechanics and Motor Control Laboratory at UFABC is endeavor to work with wheelchair users, offering them a place where a variety of analysis can be done in order to give the users the information needed to improve their quality of life by reducing the risk of injury. Here we present a preliminary study to analyze the handrim propulsion techniques described in the literature.

METHODS

A non-wheelchair user pushed a wheelchair simulating four different patterns of propulsion [1, 2]: semi-circular (SC), single looping over propulsion (SLOP), double looping over propulsion (DLOP), arcing (ARC). In addition, the person pushed the wheelchair without any instruction, called self-pattern. In total, we recorded 15 trials, 5 patterns; each pattern was repeated three times. The recording was done using a digital video camera (JVC, GR-DV-L9800) and the video was digitized with the SkillCapture and SkillSpector software (http://video4coach.com/). We used five markers for the tracking, all positioned in the right side. One on wheel axel, w_axis, a second on the distal portion of the 3rd metacarpal bone, 3MP, the other three markers were positioned on the wrist, elbow joint over the humerus' lateral epicondyle, and on the shoulder joint over the acromial process. The trajectory of the 3MP marker was used to describe the propulsion pattern. The data of each trial was normalized from 0 to 100% of the cycle, where a cycle was defined as the events between two successive initial touches of the left hand to the handrim, obtaining 101 values for each waveform. The mean and the standard-deviation values were calculated.

OUTCOMES AND DISCUSION

Figure 1 shows the horizontal vs. vertical displacement of the 3MP marker for each pattern. Compared with similar data from the literature, the resultant waveforms were satisfactory to the outcomes expected. The self-pattern was classified as an arcing pattern. This preliminary study serves to understand the handrim propulsion patterns of wheelchair users and allows us to anticipate possible obstacles for further research. For example, more than three trials are needed in order to classify accurately the propulsion pattern. In addition, to record the DLOP pattern is needed a wider visual field than for the other patterns.

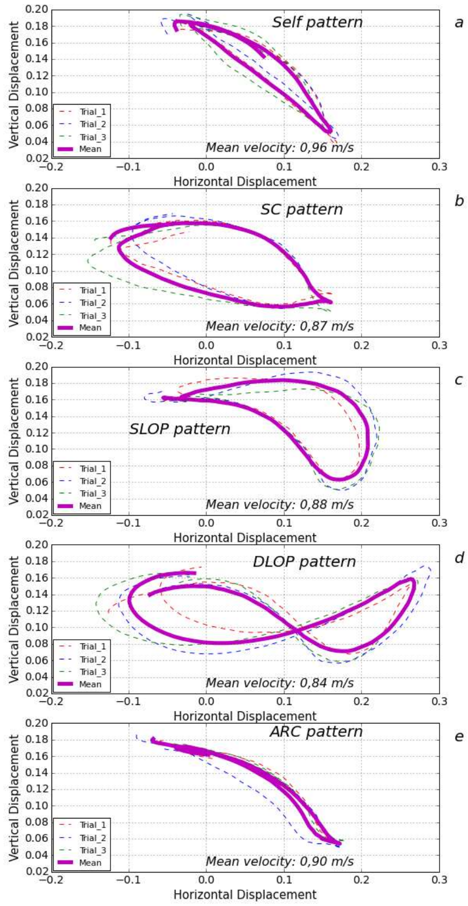

Figure 1. Kinematic Patterns of wheelchair propulsion. (a) self-pattern. (b) SC. (c) SLOP. (d) DLOP. (e) ARC.

We will do further research on this field, in addition with kinetic data and study of the shoulder biomechanics on a study that proposes to determine the effect of the speed and propulsion technique on the mechanical demand of the upper limb.

CONCLUSIONS

This preliminary study succeeded in reproducing the propulsion patterns. The method and equipment needed are simple and practical therefore is easy for research groups in Brazil to duplicate it and analyze this feature. For relevant outcomes it is necessary to study a representative sample of manual wheelchair users.

REFERENCES

1. Shimada et al. J. Rehabil. Res. Dev. (35):210-18, 1998
2. Boninger et al. Arch Phys Med Rehabil. (83):718-23, 2002