Kinetic Gait Analysis of Powered Gait Orthosis using Fuzzy logic Controller

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INTRODUCTION

At KOREC, a prototype of a powered gait orthosis has been developed to reduce the energy consumption and the muscle fatigue. Each hip joint of the PGO is flexed by an air muscle operated by pressurized air enabling the patient to walk. The air muscle behaves like a human muscle and connects one side of the torso section to the upper part of the same side of the brace. The role of artificial muscle is to assist hip flexion during swing phase. Therefore, the patient can walk with less energy expenditure by using a PGO than using an RGO.The PGO a modification of an RGO[1] incorporating two pneumatic muscle actuators(PMA), a compressed air system,pressure and joint angle sensors.
In the present study, PGO which controlled by fuzzy algorithm for hip flexion and analyzed for SCI patients who used the developed PGO with the three-dimensional motion analysis system.
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METHODS

The concept of the PGO driving system is to couple the right and left sides of the orthosis by specially designed hip joints and pelvic section. The driving system of powered gait orthosis(PGO) consists of the orthosis, sensor, control system. An supply system is composed of an air compressor, 2-way solenoid valve(MAC, USA), accumulator, pressure sensor. Role of this system provide air muscle with the compressed air at hip joint constantly(Fig. 1). PGO which controlled by fuzzy algorithm for hip flexion.

Two subjects(39±2.8 years) who were two adult normal male and one paraplegic male participated in this study. Subjects were recruited from the laboratory staffs and patient of the hospital. Their heights and weights ranged from 170±1.7 ㎝, 60.5±7.5kg, respectively.

Subjects were performed the gait analysis five times per one month after gait training on PGO during about three months.

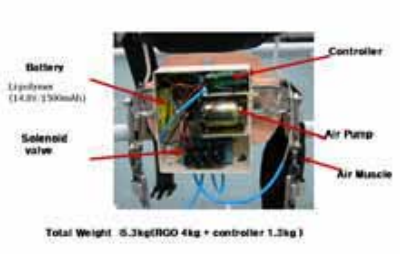

Figure 1: PGO system

RESULTS AND DISCUSSION

This figure 2 shows the sagittal plane internal joint moment during a single gait cycle. As a results, the maximum hip flexion angles PGO's gait was 57° during swing phase and maximum hip flexion moment was 0.86Nm/kg. Maximum knee flexion/extension moments were about 0.89Nm/kg and 0.68Nm/kg. Maximum ankle dorsiflexion moments is 1.08Nm/kg. PGO's moment curve was similar to normal gait. The ratio of the duration of the swing phase of fuzzy controlled PGO gait shows 40.4% as an approximation to the normal gait.

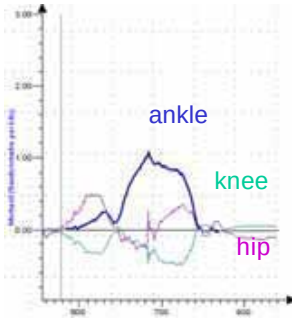

Figure 2:Hip, Knee, Ankle moment

CONCLUSIONS

We are proposed fuzzy controlled PGO's system using air muscle of hip joints for SCI patients. This PGO controlled by fuzzy controller looks like a excellent device comparative of others. Because the ratio of the duration of the swing phase of fuzzy controlled PGO was similar to the characteristic curve of normal gait. it directly became the causes to increase the gait speed of PGO.

REFERENCES

1. Douglas R, Larson PF, DAmbrosia R, McCall RE. ,"The LSU reciprocation gait orthosis", Orthopedics.,Vol.6,pp 834-839, 1983

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