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Changes in muscle activity according to the training mode of gait-assistive robots for children with cerebral palsy

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Objective

➢ In pediatric physical therapy, muscle contraction through voluntary and active movement is crucial.

➢ Gait training using robots allows for repeated training of normal walking movements, and it also enables passive movement with the robot's assistance.

➢ However, research is still limited on the training modes of robot-assisted gait training.

➢ This study aimed to examine changes in muscle activity according to the training mode combinations of a gait-assistance robot for children with cerebral palsy in order to determine the most effective training method.

Materials and Methods

➢ **Inclusion**
 - Cerebral palsy, GMFCS Ⅲ~Ⅴ

➢ **Training mode(Lokomat pro, Hocoma, Switzerland)**
 - 8 combination modes (2 speed x 2 BWS x 2 GF)

Mode	Walking speed	Body weight support	Guidance force
A	0.5km/h	80%	100%
B			50%
C		50%	100%
D			50%
E	1.0km/h	80%	100%
F			50%
G		50%	100%
H			50%

 - 5 minutes for each training mode and 2 minutes of rest between modes (54 minutes total)
 - Applied to each child in randomized order (taken three times within three weeks)

➢ **Measurement**
 - Muscle activity of the lower extremity
  ▶ Amplitude using a surface EMG device (Trigno Wireless EMG ®, Delsys, U.S.A.)

➢ **Compared muscle activities** in terms of the variations in Walking speed, BWS, GF

Results

➢ 5 children with cerebral palsy were enrolled(Table 1).

Table 1. General characteristics of children with cerebral palsy

	Age(years)	Gender	GMFCS level
1	5	Female	Ⅲ
2	5	Female	Ⅲ
3	12	Female	Ⅳ
4	13	Female	Ⅲ
5	6	Female	Ⅲ

➢ Most children showed increased gluteus medius and vastus medialis activities during the stance phase at faster walking speeds (Table 2).

Table 2. Number of children with increased lower limb muscle activity at a fast walking speed

Stance	Gmax	Gmed	VM	BF	TA
Left	1	**3**	**3**	2	2
Right	3	**3**	**4**	4	2
Swing	Gmax	Gmed	VM	BF	TA
Left	2	3	3	3	2
Right	2	1	2	2	2

➢ With low body weight support, most children showed increased vastus medialis activity during the stance phase (Table 3).

Table 2. Number of children with increased lower limb muscle activity at a fast walking speed

Stacne	Gmax	Gmed	VM	BF	TA
Left	1	1	**3**	3	3
Right	1	1	**3**	1	1
Swing	Gmax	Gmed	VM	BF	TA
Left	2	1	1	1	2
Right		1	1	1	1

➢ There were no significant differences in muscle activities according to guidance force.

Conclusion

➢ This study showed that the muscle activity of the lower limbs varied according to the walking speed and level of body weight support in the robot-assisted gait training mode.

➢ This indicates that adjusting the robot's walking speed and body weight support can lead to lower-limb muscle activation in children. In other words, the combination of training modes can affect the effectiveness of the gait-assistive robot.

➢ Studies should continue to explore the optimal training mode combinations that increase lower limb muscle activities.

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