OP4-1-4

Quantitative assessment of associated reactions in the children with spastic cerebral palsy

Seung Ki Kim[1*], Eun Sook Park[1†], Jae Eun Park[1], Beom Ki Yoo[1], Da In Shim[1], Han Kyul Park[2], Myung Eun Yoo[3]

Yonsei University College of Medicine, Department and Research Institute of Rehabilitation Medicine[1], Seoul Rehabilitation Hospital, Department of Rehabilitation Medicine[2], Gangnam Severance Hospital, Yonsei University College of Medicine, Department of Rehabilitation Medicine[3]

Objectives
To quantify the associated reaction (AR) of upper limb and its impact on upper arm function in children with cerebral palsy (CP).

Participants and Methods
On thirty five children with CP (unilateral CP:21, bilateral CP:14) were recruited for this study. Their mean age (SD) was 9.6 years (3.7 years). Manual ability Classification system (MACS), Upper Limb Physician's Rating Scale (ULPRS), Modified House functional classification scale (MHFCS), Melbourne Assessment 2 (MA-2) and also the AR of upper limb while performing three tasks (of 1) opening and clenching of the fist, 2) finger opposition to thumb, 3) tapping with four fingers excluding the thumb) with the other hand, was quantified. The AR was scored into 0 to 4 (0; no clear imitative movement to 4; movement equal to that expected for intended hand). In addition, the surface electromyography (SEMG) were used to assess the root mean square (RMS) values of firing muscular activity on shoulder abductor, elbow flexor, elbow extensor and wrist and finger flexor and wrist extensor while performing the three tasks. The RMS ratio was calculated as the ratio between the RMS values of firing muscular activities and of baseline activities.

Results
The AR was observed in 57% of subjects. The presence of AR was significantly different between tasks. The frequency was higher while performing finger opposition, compared to opening and clenching fist or to finger tapping. The AR was more frequently observed in low functioning group in manual ability (MACS III to V) than in high functioning group. The scores of MA-2, ULPRS and MHFCS were significantly higher in children without AR than children with AR ($p < 0.05$). The RMS ratio was significantly higher in children with AR than children without AR ($p < 0.05$). The total scores of AR were significantly related with RMS ratio (rho=0.476, $p < 0.05$).

Conclusion

Over half of the children with CP demonstrated the AR. The clinical AR scores were significantly related with RMS ratio of surface EMG. In addition, this study revealed the significant adverse effect of AR on upper limb function.

Table 1. Characteristics of participants

Characteristics		Participants (n=35)
Age (year)		9.6±3.7
Gender (M/F)		21 (60) / 14 (40)
CP type (unilateral/bilateral)		21 (60) / 14 (40)
GMFCS		
	I	8 (22.9)
	II	13 (37.1)
	III	8 (22.9)
	IV	5 (14.3)
	V	1 (2.9)
MACS		
	I	7 (20.0)
	II	15 (42.9)
	III	8 (22.9)
	IV	5 (14.3)
	V	0 (0.0)

Values are presented as number (%) or mean±standard deviation.
CP, Cerebral palsy; GMFCS, Gross Motor Function Classifi cation System; MACS, Manual Ability Classifi cation System.

Table 2. Comparison of associated reasction

| | AR total score | | p-value |
	AR(+)	AR(-)	
GMFCS			
I~II	11 (55.0)	10 (66.7)	0.728
III~V	9 (45.0)	5 (33.3)	
MACS			
I~II	8 (40.0)	14 (93.3)	0.002**
III~V	12 (60.0)	1 (6.7)	
MHFCS	5.55±1.54	6.80±1.47	0.013*
MA2			
ROM	65.19±28.23	88.65±14.22	0.007**
Fluency	80.60±24.36	98.13±3.66	0.018*
Accuracy	61.54±31.50	87.58±16.22	0.007**
Dexterity	54.05±28.24	79.68±21.41	0.008**
Average	65.34±27.01	88.51±13.36	0.005**
ULPRS	38.15±6.71	44.67±4.24	0.002**

Values are presented as number (%) or mean±standard deviation.
AR, Associated Reaction; GMFCS, Gross Motor Function Classifi
cation System; MACS, Manual Ability Classifi cation System; MA2,
Melbourne Assessment 2; ULPRS, Upper Limb Physician's Rating
Scale; MHFCS, Modified House functional classification scale.

Table 3. Comparison of RMS ratios by associated reaction

	AR(+) (n=15)	AR(-) (n=12)	p-value
hand grip	6.94±2.18	5.43±0.95	0.011*
thumb opposition	6.44±1.14	6.60±2.15	0.239
finger tapping	5.93±1.64	5.06±0.62	0.038*
Total tasks	6.44±1.11	5.70±0.77	0.030*

Values are presented as mean±standard deviation.
AR, Association Reaction; RMS, root mean square; CP, cerebral palsy