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Online Survey on Clinical Application of Constraint-Induced Movement Therapy in Children with Hemiplegic Cerebral Palsy in Korea

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Abstract

Objective : The aim of this study was to evaluate the current knowledge regarding constraint-induced movement therapy (CIMT) and its application in clinical practice by physiatrists and therapists in pediatric rehabilitation area in Korea.

Methods : Online survey via E-mails was sent to a total of 510 members (204 physiatrists and 306 therapists) of the Korean Society of Pediatric Rehabilitation and Developmental Medicine (KSPRDM).

Results : The response rate was 35.1% (179 of 510). A total of 179 questionnaires was completed by 39 physiatrists, 89 physiotherapists, 48 occupational therapists, and 3 speech therapists. 45.8% of responders had worked over 6 years in the pediatric rehabilitation setting and a total of 58.1% (n=104) of the sample had used CIMT. The main limitations of clinically applying CIMT included limited staff and inappropriate clinical setting (35.1%, n=61), lack of understanding (19.5%, n=34), and developmental issues of function on the unaffected side (13.8%, n=24). The cooperation of patients (77.6%, n=76), cognitive/behavioral factors (42.9%, n=42), and cooperation of caregivers (25.5%, n=25) were the 3 major concerns that could be limitations with CIMT.

Conclusions : Although considerable evidence supports the use of CIMT, many of physiatrist and therapists do not apply this method in practice. The improvement of limitations is necessary for wide use of CIMT in clinical practice in Korea.

Key words : Constraint-induced movement therapy, Cerebral palsy, Online survey

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Ⅰ. Introduction

One-third of children with cerebral palsy (CP) develop hemiplegia, wherein arm and hand use is usually more severely affected than walking (Sakzewsk et al., 2009). Constraint-induced movement therapy (CIMT) was first introduced in the 1980s for the treatment of adult stroke patients (Ostendorf et. al., 1981). CIMT involves the application of constraint to the unimpaired upper limb, along with intensive training of unimanual skills for the hemiplegic limb (Taub et al., 2004). This interventional approach is supported by theories of motor learning and neuroplasticity (Sakzewski et al., 2009; Gordon et al., 2011).

CIMT had been modified to enhance the compliance in adult and children with hemiplegia. The effect of modified CIMT in the children with hemiplegic cerebral palsy has been reported as high level of evidence as well as in the adult population following stroke or brain injury (Hoare et al., 2019; Novak et al.. 2013).

However, due to the variation in the content and intensity of CIMT intervention and the different study designs, it is not easy to conclude regarding the key aspects of CIMT and to compare the effects between different CIMT protocols. Importantly, this limits the confidence through which CIMT model can be chosen for implementation in clinical practice in children with hemiplegic cerebral palsy. Therefore it is necessary to assess what is the current issues of CIMT in children with hemiplegic CP and identify the gaps in the current knowledge and limitations in practice that need to be addressed to advance this area of pediatric rehabilitation. Several survey to demonstrate the current status of clinical application of CIMT in children with cerebral ppalsy in other countries (Eliasson et al., 2014; Levine at al., 2002) however, there is no previous study with survey in Korea.

In the present study, we aimed to assess the current knowledge regarding CIMT and its application in clinical practice by physiatrists and therapists in pediatric rehabilitation area in Korea via online survey.

Ⅱ. Methods

1. Study sample

This study was online survey to the members of academic association regardless their locations in Korea. E-mails were sent to a total of 510 members (204 physiatrists and 306 therapists) of the Korean Society of Pediatric Rehabilitation and Developmental Medicine (KSPRDM). The KSPRDM is an academic association of professionals who work with children with disabilities in South Korea. This organization includes well-known physiatrists and therapists who work with Korean patients with CP.

2. Design of Survey

1) Final questionnaire

The questionnare was based on a modification of previously published surveys (Eliasson et al., 2014; Page et al., 2002; Pedlow et al., 2014) and comprised 5 sections: background information (3 questions), CP care (3 questions), knowledge of CIMT (3 question), application of CIMT in practice (6 questions), and challenges for CIMT implementation (9 questions). Questions included a mixture of open, closed, and response choice questions, and the questionnaire was designed such that none of the questions could be missed.

In order to organize the survey items in a professional and objective way, two physiatrists and one occupational therapists, who have more than 10 years of experience in pediatric rehabilitation at training hospital, were reviewed the questionnaire. Appendix includes a copy of the questionnaire.

2) Online survey tool

Google survey, an online survey tool, was used to ensure easy distribution via e-mail. The questionnaire

was designed such that only those who read the participant information sheet and met the inclusion criteria could complete the questionnaire.

3) Process of survey

The KSPRDM members were provided a total of 4 weeks to complete the questionnaire; thereafter, a reminder e-mail was circulated to the entire database (to maintain anonymity of response), and the individuals were provided with an additional 4 weeks for survey completion. All responses were downloaded and stored on an encrypted computer. Figure 1 shows the flow of participants throughout the study stages.

3. Ethical approval

The study was approved by the institutional review board of Pusan National University Yangsan Hospital (IRB 05-2015-101).

4. Data analysis

All results were analyzed using SPSS version 22.0. The responses were calculated using frequency tables and percentages. Aggregated data were used for frequencies of physiatrist, physiotherapist and occupational therapist responses. Chi-square calculations were conducted to test for correlation.

Ⅲ. Results

1. Response rate

A total of 179 questionnaires were completed by 39 physiatrists, 89 physiotherapists, 48 occupational therapists, and 3 speech therapists. The response rate was 35.1% (179 of 510). A total of 171 of these responders (95.5%) were currently working with children with CP and other developmental delayed disorders. Seven answered questionnaire did not meet the selection criteria with missing data.

2. Background and knowledge of CIMT

Most responders (45.8%, *n*=82) had worked for over 6 years in the pediatric rehabilitation setting, and only 11.2% (*n*=20) worked for under 1 year with this population. Most responders (57.1%, *n*=96) reported that an average treatment session required 15 to 30 minutes, whereas 34.4% (*n*=56) conducted upper limb

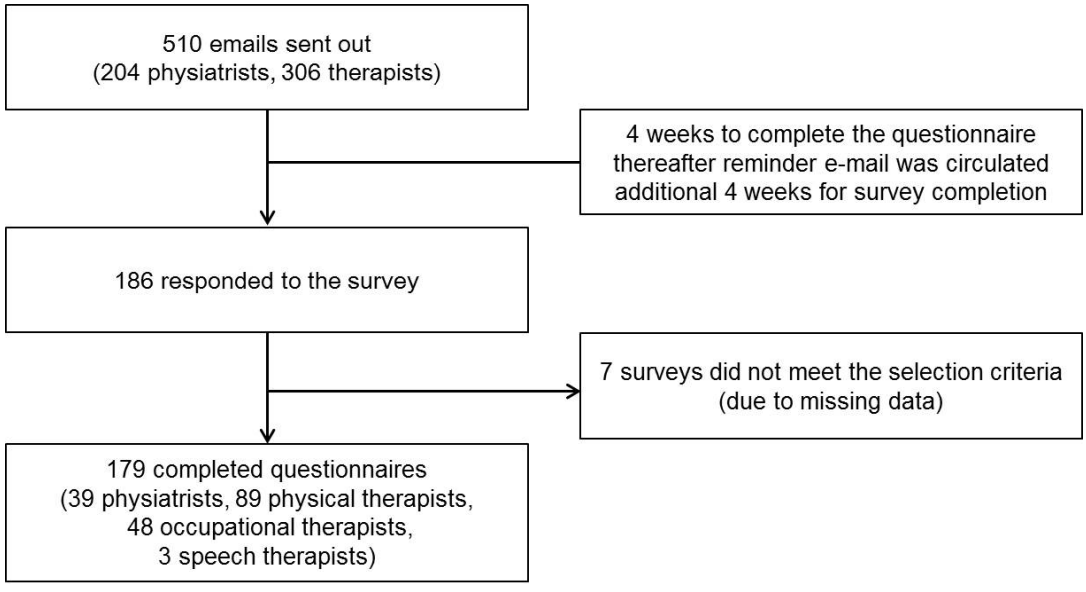

Figure 1. Flowchart of the survey participants

rehabilitation twice per week and 25.2% (*n*=41) conducted upper limb rehabilitation daily.

Knowledge regarding CIMT was most commonly obtained by reading a paper (77.0%, *n*=137); the other sources of knowledge included attending an congress or conference (42.7%, *n*=76) and peer discussion (14.6%, *n*=26). Only 16 (9%) responders had no background knowledge of CIMT.

A total of 59.6% responders (*n*=106) had safety concerns, irrespective of whether they had used CIMT; only 6.7% responders (*n*=12) believed that CIMT was not safe. Moreover, 59.6% responders (*n*=106) had concerns regarding the effectiveness of CIMT, whereas 7.3% responders (*n*=13) believed that CIMT was not effective.

3. Clinical applications of CIMT

A total of 58.1% (*n*=104) of the responders had used CIMT. Experienced responders who were asked about the common indications of CIMT in CP via a multiple choice question, answered that good patient compliance (73.1%, *n*=76), good caregiver compliance (48.1%, *n*=50), and limited effect with bimanual training (39.4%, *n*=41) were important.

The CIMT protocols used included modified CIMT (52.5%, *n*=53), forced use therapy (44.6%, *n*=45), and CIMT (28.7%, *n*=29), whereas the common components included task practice (86.4%, *n*=89), home skills assignment (58.3%, *n*=60), and constraint (39.8%, *n*=41). The training environments were the rehabilitation facility for 90.4% (*n*=94), home for 67.3% (*n*=70), and school for only 4.8% (*n*=5).

The responders reported that the cooperation of patients (77.6%, *n*=76), cognitive/behavioral factors (42.9%, *n*=42), and cooperation of caregivers (25.5%, *n*=25) were the 3 major concerns that could be limitations with CIMT (Table 1).

4. Optimal candidates and challenges for CIMT

In a total 179 responders, the optimal age of CIMT application was 3~5 years (22.8%, *n*=41), 2~3 years (19.8%, *n*=35), and 18~24 months (17.4%, *n*=31). About

Table 1. Clinical application of CIMT in children with hemiplegic cerebral palsy (*n*=104)

Preferred indications for CIMT in children with hemiplegic cerebral palsy

Items	Number of responders (percentage)
Indications	
Good patient compliance	76 (73.1%)
Good caregiver compliance	50 (48.1%)
Limited effect with bimanual training	41 (44.6%)
Adequate resources (staff and/or home setting)	25 (24%)
Others	6 (5.8%)
Limitations	
Cooperation of the patient	76 (77.6%)
Cognitive/behavioral factor	42 (42.9%)
Cooperation of the caregiver	25 (25.5%)
Non-effectiveness	11 (11.2%)
Tone abnormality	7 (7.1%)
Fatigue	7 (7.1%)
Pathologic movement	4 (4.1%)
Pain	3 (%)
Others	1 (5.8%)

More than 1 response was permitted.

the duration of CIMT application, 34.6% (*n*=62) of responders reported 3~6 hours as the maximal duration of constraint on the unaffected upper limb per day, whereas 31% (*n*=57) reported a duration of >6 hours. Half of the responders (61.8%, *n*=110) reported that 0.5~1.5 hours was the optimal time period for CIMT during one-to-one therapy. In addition, the optimal period for CIMT application was >4 weeks (45.68%, *n*=81) and 2~3 weeks (43.7%, *n*=78) (Table 2).

The major limitations of clinical application included limited staff in the rehabilitation facility and an inappropriate clinical setting (35.1%, *n*=61), lack of understanding by physiatrists and therapists (19.5%, *n*=34), and developmental issues of function on the unaffected side during constraint application (13.8%, *n*=24) (Fig. 2).

The tendency of patients to accept the recommendation of CIMT was positive but hesitant to apply in 50.3% (*n*=83) and positive but wanted to apply passively in 39.4% (*n*=65). Most responders (59%, *n*=98) reported that the splint was the preferred constraint method.

In the tools of assessment and measurement, the Quality of Upper Extremity Skills Test (QUEST, 19.4%, *n*=47), Jebsen-Taylor Test of Hand Function (15.2%, *n*=37), Manual Ability Classification System (MACS, 14.4%, *n*=35), Pediatric Motor Activity Log (PMAL, 12.4%, *n*=30) and Assessment of Motor and Process Skills (AMPS, 7.2%, *n*=18) were the common clinical outcome measures of CIMT (Fig. 3).

5. Difference of consensus between physiatrist, occupational and physical therapist

We performed data analysis of the responses between physiatrist, occupational and physical therapist. There was no significant differences of the responses about knowledge, clinical applications, optimal candidats and challenges of CIMT between three groups of occupation (p>0.05).

Table 2. Optimal candicates and challenges for CIMT in children with hemiplegic cerebral palsy (*n*=179)

Items	Number of responders (percentage)
Optimal age for application	
3~5 years old	41 (22.8%)
2~3 years old	35 (19.8%)
1.5~2 years old	31 (17.4%)
Proper time for application (per day)	
> 90% of the awakening time	19 (10.6%)
> 6 hours	57 (31.7%)
3~6 hours	62 (34.6%)
1~3 hours	32 (18.3%)
< 1 hours	3 (1.9%)
Proper time for man-to-man therapy (per day)	
> 6 hours	5 (2.9%)
3~6 hours	14 (7.8%)
1.5~3 hours	24 (13.7%)
0.5~1.5 hours	110 (61.8%)
< 0.5 hours	23 (12.7%)
Proper duration for application	
> 4 weeks	81 (45.6%)
2~3 weeks	78 (43.7%)
< 2 weeks	17 (9.7%)

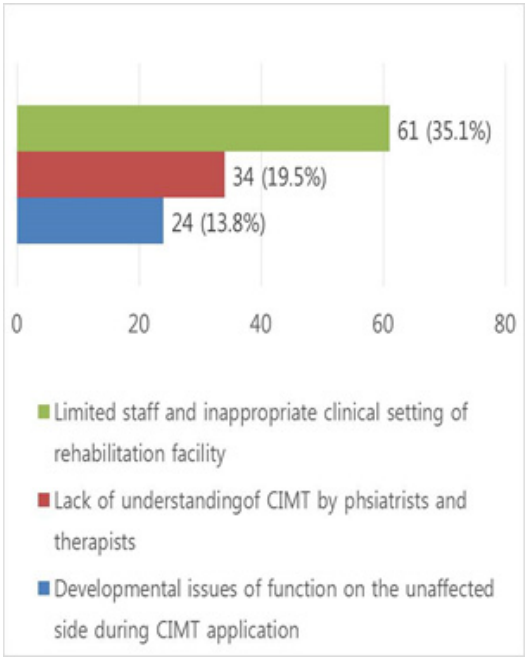

Figure 2. Major limitations of clinical application of contraint-induced movement therapy (number of respondents, %)

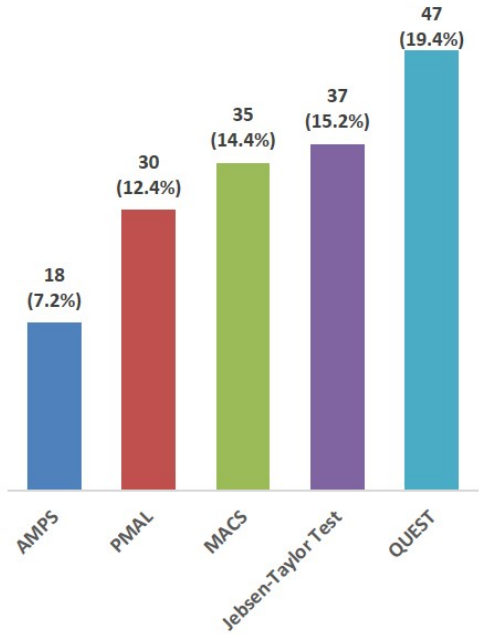

Figure 3. Major tools of assessment and measurement (number of respondents, %)

(AMPS: Assessment of Motor and Process Skills; PMAL: Pediatric Motor Activity Log; MACS: Manual Ability Classification System; Jebsen-Taylor Test: Jebsen-Taylor Test of Hand Function; QUEST: Quality of Upper Extremity Skills Test)

Ⅳ. Discussion

This study is online survey to professionals in the pediatric rehabilitation in Korea about clinical application of CIMT in children with hemiplegic cerebral palsy. Although CIMT has been recommended by many national clinical guidelines and has been advocated by the largest CIMT study performed to date, the findings of the present study suggest that many physiatrists and therapists (41.9%, *n*=75) who treat children with CP have not attempted using CIMT in Korea. More than 30% of the responders were not aware about the effectiveness and safety of CIMT. Hence, the lack of knowledge regarding this intervention and the available resources could affect its application in clinical practice. Concerns such as lack of training and lack of knowledge of CIMT protocol indicate the need for further introduction and training program on the application of CIMT.

In our results, one of the major limitations for CIMT application is limited staffs and environment in clinical practice. In occupational therapy, it is important for therapist and physiatrist to educate the caregiver including family to help apply CIMT for patient at home in real life.

And 35% of responders answered optimal time of CIMT application was 3~6 hours per day in the present study. In a randomized control trial (DeLuca et al., 2012) compared the effects of CIMT for 6 hours/day and 3 hours/day for 21 days in CP patients aged 3~6 years, but did not find any differences. They suggest that one of the reasons for this lack of difference may be because young children may have insufficient attention skills to benefit from CIMT duration of 6 hours/day, which would thus therapy with longer durations less effective. Moreover, many communities cannot commit to 6 hours/day for such therapy, which could lead to a heavy caregiver burden associated with scheduling and commuting. Therefore, interventions with modified schedules have been developed in various clinical settings. In a previous

study, a modified constraint time of 2 hours each day was adopted, and the parents and/or preschool teachers in the child's home or preschool setting assisted in performing the therapy (Eliasson et al., 2011). In the present study, 58.4% of responders reported that the maximal duration for which the constraint could be worn in the unaffected upper limb was <6 hours/day due to enhance the compliance. Ultimately, the way in which practice is achieved may be best chosen by a combination of the child and the parents, as well as the therapists according to compliance. The major limitation of CIMT on clinical application was incooperation of patient, same in the present study and the previous studies.

About the optimal age for application of CIMT in children were suggested over 3 years old (Sakzewski et al., 2009) however, 62.4% of responders reported that the optimal age for applying CIMT was <3 years in the present study. In the systematic review of CIMT in cerebral palsy reported by Chiu and Ada (2016), there was no significant relation between duration of CIMT and effect of CIMT. Neither was there a significant relation between age and affect of CIMT on activity or participation. In that systematic review, although CIMT was effective, it was no more effective than the same dose of upper limb therapy without restraint. This suggests that the mechanism of the effect is the dose of practice undertaken, rather than the type of practice. The methodology, participant and intervention characteristics of CIMT in children with hemiplegic CP are heterogenous in the previous studies, therefore it is difficult to confirm the optimal protocol to adapt CIMT in clinical practice.

However, in recently, CIMT for 31 children in 3-8 months of corrected age with asymmetric hand function had been tried. Baby-CIMT exhibited a better development in the affected hand than baby-massage (Eliasson et al., 2018). Further study is necessary to confirm safety and effectiveness of baby-CIMT including developmetal issues on unaffected side and investigate the optimal age of CIMT application.

Figure 4. Resting splint on unaffected side in contraint-induced movement therapy

In the type of constraint, unlike previous studies, splint (59%) was the most preferred tool in clinical practice in the present study (Fig. 4). The sling and mitt (glove) were reported as common type of constraint in the previous studies (Tervahauta et al., 2017).

In our results, major tools of assessment and measurement were Quality of Upper Extremity Test (QUEST), Jebsen-Taylor Test of Hand Function, Manual Ability Classification System (MACS), Pediatric Motor Activity Log (PMAL) and Assessment of Motor and Process Skills (AMPS). It revealed the similar tendency with tools used in the previous clinical studies (Chiu et al., 2016; Chen at al., 2014).

In the composition of CIMT protocol, core components of a constraint program include the use of a restraint, task grading, offering motivating tasks, and intensive and repetitive task practice (Hoare et al., 2007). In the present study, physiatrists and therapists mainly used 2 or 3 of the core components, and did not use the entire component set available. Development of clinical guideline of CIMT in children with hemiplegic CP is necessary for providing standardized therapy in further study.

Our study has several limitations. First, the low response rate and the relatively small sample size could limit the external validity of the results. Second, it could not demonstrate whether the opinions are represented with general consensus of Korean professionals in the pediatric rehabilitation area because the regional distribution of respondents was not identified. However, this study has academic value as the first online survey to investigate the current status of the recognition and clinical practice of CIMT in hemiplegic cerebral palsy in Korea.

Future studies with a larger sample size are needed to ascertain the optimal age for applying CIMT, appropriate type of constraint based on the functional status, and improvement of limitation in clinical practice.

V. Conclusion

Although considerable evidence supports the use of CIMT, many of physiatrist and therapists do not apply this method in practice. The improvement of limitations is necessory for wide use of CIMT in hemiplegic cerebral palsy children in clinical practice in Korea.

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— 국문초록 —

편마비 뇌성마비 환아에서 강제유도운동치료의 국내 임상적용에 대한 설문조사

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목적 : 이 연구는 국내 소아재활 분야에 종사하는 재활의학과의사 및 치료사를 대상으로 강제유도운동치료(constraint-induced movement therapy, CIMT)에 대한 지식과 임상적용 현황에 대해 조사하고자 하였다.

연구방법 : 대한소아재활발달의학회에 등록된 510명 (재활의학과의사 204명, 치료사 306명)을 대상으로 전자우편을 이용한 설문조사를 시행하였다.

결과 : 총 510명 중 179명이 설문에 응답하여 응답률은 35.1%였다. 응답한 179명 중 재활의학과 의사 39명, 물리치료사 89명, 작업치료사 48명, 언어치료사 3명이었다. 응답자 중 45.9%(82명)는 소아재활분야의 경험이 6년 이상인 전문가로 구성되어 있었고, 58.1%(104명)가 강제유도운동치료에 대한 경험이 있었다. 임상 진료에서 강제유도운동치료를 적용하는 경우는 환자의 순응도가 좋을 때 73.1%(76명), 보호자의 순응도가 좋을 때 48.1%(50명), 양손훈련(bimanual training)의 효과가 제한적이라고 판단될 때 39.4%(41명) 순으로 조사되었다. 임상적용에서 제한점으로 작용하는 요인은 치료인력 부족이나 가정내 환경 부적합 등과 같은 환경제한 35.1%(61명), 인식부족 19.5%(34명), 건측 제한으로 인한 건측 기능발달 저해에 대한 우려 13.8%(24명)으로 조사되었다. 강제유도운동치료를 중단한 이유로는 환자의 비협조 77.6%(76명), 인지/행동요인 42.9%(42명), 보호자의 비협조 25.5%(25명), 효과가 없다고 판단될 때(non-effectiveness) 11.2%(11명) 순으로 조사되었다.

결론 : 강제유도운동치료의 의학적 근거가 높게 보고되고 있지만 이 연구에서는 많은 수의 재활의학과 의사와 치료가사 실제 임상치료에서 적용하지 못하고 있음을 확인하였다. 국내 현황에서 제한점을 개선하여 향후 임상적용 확대를 위한 노력이 필요하겠다.

주제어 : 강제유도운동치료, 뇌성마비, 설문조사