# Use of Robotics in a Pediatric Constraint-Induced Movement Therapy Program

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## Background:
Pediatric Constraint-Induced Movement Therapy (CIMT) is an effective intervention for children with both congenital and acquired hemiparesis (Brady & Garcia, 2009; Reidy et al., 2012). Virtual reality (VR) and robotic therapies (RT) are emerging modalities in occupational and physical therapy that provide means for repetitive practice of target movements, such as reaching in space (Fasoli et al., 2008) or grasp and release (Carmeli et al., 2010). These modalities typically employ robotic arms, joysticks, or other controllers to measure the patient's performance of the targeted movement. Early studies demonstrate that patients using robotic devices in therapy sessions are motivated and make positive gains after intervention with both stationary (Fasoli et al., 2008; Frascarelli, 2009) and glove-based devices (Carmeli et al., 2010). To date, only one study (F. Leet et al., 2010) reported use of VR combined with a robotic device in a pediatric CIMT setting.

## Purpose:
Clinicians in an established, intensive CIMT program found robotic therapies to be a natural complementary modality to incorporate during a group-based CIMT program. This poster reports on the use of a swing style device, a wireless motion feedback device, and a glove-based robotic device in this program.

## Objectives:
Participants who view this poster will be able to identify ways to increase patient motivation with effective and engaging clinic-based robotic activities, and identify the potential risks and benefits of using complementary robotic modalities during CIMT.

## Robotics Intervention Description:
Patients enrolled in the program received intensive PT and OT services six hours a day, five days a week, for 21 days. Participants wore casts on the stronger upper extremity for 24 hours a day for the first 16 days of the program, and received bimanual treatment the last five days. Immediately prior to and after intervention, children were assessed using standardized measures. During those six hours, the patients used a UE glove (HandTutor™ by MediTouch), a wireless motion feedback device on a Velcro strap (3D Tutor™), or a sling-based robotic device (Armeo® Boom by Hocoma) for at least one hour a day, three days a week.

## Positives
| **Promotes repetitive task practice** | **Age and cognitive ability of the child will determine their capacity to follow directions and play the games associated with the device** |
| **Could be used to target specific motor movements (e.g., shoulder flexion, supination, wrist extension)** | **The use of the child’s arm and hand may prohibit his or her use of a robotic device that was created for adult use** |
| **Many devices have a high level of sensitivity, so even children with limited AROM can activate them, leading to increased self-efficacy** | **Baseline level of motor function will determine the level of additional support or adaptations a device may require for the participant to hold the device** |
| **Age-appropriate activity that can be done with peers or as a home exercise program** | **Visual perceptual deficits may pose a challenge or add additional frustration to game play** |
| **Can simulate real world activities** | **During intervention, therapists should monitor for compensatory movements that could cause repetitive use injuries, and breaks should be provided at intervals** |
| **Possible secondary benefits for visual perceptual and visual motor skills** | **Monitoring muscle fatigue and providing the appropriate challenge based on the child’s occupational performance is the job of the therapist** |
| **In-device assessment tools monitor and provide feedback on progress, provide data for documentation, and aid in increasing motivation of the patient** | **Assessment tools on devices are not well studied, and therefore, may not be very reliable as the only measurement of changes** |

## Conclusions:
When implementing pediatric CIMT programs, therapists should consider complementary therapies such as virtual reality and robotic therapy to potentially augment the gains associated with this approach. This poster provides a framework for incorporating robotics into a group-based, camp-like program that can be replicated in clinics. Further research should analyze the effects of treatment using pre/post and follow-up outcome measures. Comparisons of various robotic devices and the most effective dosage in collaboration with CIMT should be explored.

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**Figures 1 and 2:** Patient using HandTutor™ with use of strap to focus practice on wrist extension.

**Figures 3 and 4:** Armeo® Boom® targeting shoulder horizontal abduction and adduction, with therapist assisting with blocking compensatory shoulder elevation.