Journal of Hand Therapy 27 (2014) 201–208

Contents lists available at ScienceDirect

Journal of Hand Therapy

journal homepage: www.jhandtherapy.org

JHT Read for Credit Article #317.
Scientific/Clinical Article

Stronger relation between impairment and manual capacity in the non-dominant hand than the dominant hand in congenital hand differences; implications for surgical and therapeutic interventions

Monique S. Ardon MSc, PT[a,b,*], Ruud W. Selles PhD[a,b], Steven E.R. Hovius MD, PhD[b], Henk J. Stam MD, PhD[a], Magdalena Murawska MSc[c], Marij E. Roebroeck PhD[a], Wim G.M. Janssen MD, PhD[a]

[a] Department of Rehabilitation Medicine and Physical Therapy, Erasmus MC – University Medical Center Rotterdam, P.O. Box 2040, 3000 CA, Rotterdam, The Netherlands
[b] Department of Plastic and Reconstructive Surgery and Hand Surgery, Erasmus MC – University Medical Center Rotterdam, P.O. Box 2040, 3000 CA Rotterdam, The Netherlands
[c] Department of Biostatistics, Erasmus MC – University Medical Center Rotterdam, P.O. Box 2040, 3000 CA Rotterdam, The Netherlands

ARTICLE INFO

Article history:
Received 14 March 2013
Received in revised form
12 November 2013
Accepted 20 November 2013
Available online 4 December 2013

Keywords:
Adolescent
Child
Female
Hand deformity
Congenital
Body functions of the hand and forearm
Male
Manual activity capacity

ABSTRACT

Objectives: To evaluate manual activity capacity (i.e. activity capacity to perform hand activities) and its relation with body functions of the hand and forearm in children with congenital hand differences (CHD)
Methods: We assessed 10–14 year-old children with CHD ($N = 106$) using a functional handgrips test. Measurements of body functions included joint mobility and muscle strength. Patient characteristics were hand dominance and severity.
Results: We found a stronger relation between body functions and manual activity capacity in non-dominant hands than dominant hands. Dominant hands scored significantly higher on manual activity capacity than nondominant hands that were similarly impaired at body functions level. Severity of the CHD and body functions had only small effects on manual activity capacity.
Conclusion: The relation between body functions and manual activity capacity is stronger in non-dominant hands than dominant hands, indicating that improvement in body functions lead to larger changes in manual activity capacity in the non-dominant hand. This may suggest that in bilaterally-affected children surgery should be done at the non-dominant hand first since this hand would benefit most from surgery-induced body functions improvement.

Introduction

The impact of a congenital hand difference (CHD) on a child's functioning can be described at different levels of functioning.[1] The World Health Organization's International Classification of Functioning, Disability, and Health for Children and Youth (ICF-CY) distinguishes three domains: body functions, activity and participation.[2] Children with a CHD can experience impairments in body functions of the hand and forearm, further referred to as body functions, such as restricted joint mobility, sensation and grip strength, and may be restricted in activities.

A child's activity, which the ICF-CY defines as the execution of a task or action by an individual, can be described by the two qualifiers of capacity and performance.[2] 'Capacity' is defined as what a child can do in a standardized environment, and 'performance' is

Abbreviation: CHD, congenital hand difference.

This study was supported by Johanna Children's Fund (Arnhem, The Netherlands) and Kinderfonds Adriaanstichting (Rotterdam, The Netherlands) grant number 2006/0062-063. Their role was purely to give financial support for the study. The authors declare they have no competing financial interests.

We certify that no party having a direct interest in the results of the research supporting this article has or will confer a benefit on us or on any organization with which we are associated and, if applicable, we certify that all financial and material support for this research (e.g., NIH or NHS grants) and work are clearly identified in the title page of the manuscript.

* Corresponding author. Department of Rehabilitation Medicine, Erasmus MC – University Medical Center Rotterdam, P.O. Box 2040, 3000 CA Rotterdam, The Netherlands. Tel.: +31 10 7044600; fax: +31 10 7033843.
E-mail address: m.ardon@erasmusmc.nl (M.S. Ardon).

0894-1130/$ – see front matter © 2014 Hanley & Belfus, an imprint of Elsevier Inc. All rights reserved.
http://dx.doi.org/10.1016/j.jht.2013.11.002

what a child actually does do in daily life. Impairments in body functions can lead to restrictions in capacity to perform daily activities that require the use of the upper limbs.[3] While capacity reflects the child's ability to execute a task, performance is additionally influenced by the child's environment, which can facilitate or hamper performance.[2]

In general, rehabilitation interventions as well as surgical interventions in children with CHD aim to improve body functions with the ultimate goal to improve manual activity capacity, also referred to as dexterity or manual ability. For example, hand surgeons perform muscle tendon transfers to enhance strength for specific movements or perform osteotomies to improve alignment of bones and joint movements. Even so, strength training and splinting therapy aim to improve muscle strength and joint mobility. However, the relationship between body functions and manual activity capacity to perform tasks is not straightforward and therefore it is difficult to state whether these interventions lead to the intended improvement of manual activity capacity.[4,5]

Although body functions in children with CHD are well studied, the key components of the domain of body functions determining manual activity capacity of these children are largely unknown.[6–8] For example, many surgical interventions aim at strengthening the thumb, since it is assumed that the presence of a thumb accounts for at least 40% of the usefulness of the total hand.[9] However, objective data are lacking to support which muscle functions are most important for manual activity capacity and which levels of joint mobility and muscle strength are needed for manual activity capacity.

Understanding the relation between body functions and manual activity capacity is essential for developing and selecting appropriate intervention strategies in children with CHD. Therefore, the aim of the present study was to disentangle the relationship between body functions and manual activity capacity in children with CHD.

Materials and methods

This study used data from a cross-sectional study on functioning and health-related quality-of-life of children with a CHD. The Medical Ethical Committee of our hospital approved the study and parents gave their informed consent to participate, as did all children above 12 years of age.

Participants

Participants in this study sample were recruited from a database of children with a CHD treated at our hospital. Inclusion criteria were: age 10–14 years, no cognitive or developmental delay, and sufficient knowledge of the Dutch language. We selected a heterogenous group of CHD patients to ensure that we had a relatively large variation in both body functions and manual activity capacity that would allow for investigating their interrelations. Three hundred participants were randomly selected using a computer generated random sequence. We evaluated 120 participants and we found no differences between participants and non-participants regarding gender, diagnosis, and severity of the CHD. Children and their parents received a letter concerning the purpose and procedure of the study. When they agreed to participate, a measurement session was planned and inform consent forms were signed. Due to time burden, some children did not participate in all measurements and we had missing values on some outcome measures (in 5 children we missed measurements on manual activity capacity, in 4 children on strength, in 1 child both on manual activity capacity and strength, in 2 on Kapandji and in 2 on palmar abduction) Therefore, we were able to evaluate 106 of the children for the mentioned research purpose. Characteristics of the participating children are presented in Table 1.

Table 1
Characteristics of participating children

Age (mean ± SD, range)	11.8 ± 1.6 (10–14) years
Gender	
Boys	55%
Girls	45%
Affected side	
Unilateral	69%
Nondominant affected	62%
Dominant affected	7%
Bilateral (Nondominant and dominant affected)	31%
Extent of the CHD (affected digits per hand)	
1	29%
2	11%
3	12%
4	10%
5	37%
Surgical treatment	
None	36%
1 or more	64%
Diagnosis according to IFSSH classification	
Failure of formation	25%
Failure of differentiation or separation of parts	21%
Duplication	21%
Overgrowth	1%
Undergrowth	29%
Congenital constriction ring syndrome	3%
Generalized skeletal abnormalities	0%

Manual activity capacity

Since there is currently no available standardized assessment of manual activity capacity in children with CHD, we tested manual activity capacity using the Eliasson test. Eliasson et al developed this test for children based on the Sollerman test, evaluating 6 types of grip in 9 tasks (Table 2).[10] This test, which is less extensive than the Sollerman test and more suitable for children of our age group, consists of tasks that require grasping objects either transverse grasping or diagonal grasping and tasks that require pinch grip. All tasks are scored on a 5-level ordinal scale. The scores range from 0 if the child cannot grip the object to 4 if the child can grip the object

Table 2
Eliasson test for manual activity capacity; tasks and scoring system

Type of grasp	
Transverse grasp	Grasp a 2.5 cm horizontal bar in mid-air and place it on the table
Transverse grasp	Move a 2.5 cm Ø vertical bar from one pegboard position to another
Transverse grasp	Lift a glass and pretend to drink
Diagonal grasp	Hold a knife and cut paste into pieces
Five-finger pinch	Pull a sleeve on and off the unaffected arm
Tripod pinch	Unscrew a 2 cm Ø cap from a toothpaste tube
Tripod pinch	Unscrew a 7 cm Ø lid from a jar
Lateral pinch	Grasp a vertically oriented plate (5 × 5 × 1 cm) in mid-air and place it on a table; requiring supination of the forearm
Pinch	Pick up a small cube and touch the chin with it
Score	**Judgment of grips**
0	Cannot grip the object
1	Grips object but cannot complete task
2	Grips object using an awkward grip and motion but completes task
3	Grips object using a slightly deviant grip and motion but completes task
4	Grips object using normal grip and motion and completes task