Evidence-Based Management of Postural Control in a Child with Cerebral Palsy

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ABSTRACT

The authors review and discuss the evidence exploring the use of dynamic compression garments with children with cerebral palsy. The evidence is presented in case-study format with a focus on postural control and impact on involuntary movements.

Key Words: cerebral palsy; child; orthotic device.

RÉSUMÉ

Un examen et une discussion sur l'information disponible à propos de l'utilisation de vêtements de compression dynamiques chez les enfants qui sont atteints de paralysie cérébrale. Le tout est présenté sous le format d'une étude de cas se concentrant sur le contrôle postural et les répercussions sur les mouvements involontaires.

Simon is a 5-year-old boy diagnosed with cerebral palsy, Gross Motor Function Classification System (GMFCS) level 2, presenting with decreased postural control and involuntary movements affecting independent mobility and balance. His past medical history includes prematurity (born at 32 weeks gestation) and a moderate hearing impairment. Simon and his parents have identified therapy goals to improve dynamic balance and decrease involuntary movements during quiet stance and sitting. Simon currently attends a full-day kindergarten program and receives consultative occupational therapy, physiotherapy, and speech-language pathology services in the classroom. His teacher has identified concerns with standing balance and the need for trunk support during fine motor activities.

CLINICAL QUESTION

Is there evidence to support the use of dynamic compression garments for children with cerebral palsy? The rationale for considering this clinical question is the current availability of many different garments purporting to improve postural control and decrease involuntary movements (e.g., SPIO,¹ UPsuit²). The relationship among postural control, proximal stability, and readiness for movement has been recognized for many years.³ Answering this clinical question will help us to determine whether garment use is appropriate for our client.

LITERATURE SEARCH

Through a search of the CINAHL and MEDLINE databases, we identified and reviewed 10 studies published between 1997 and 2011 that examined the use of dynamic compression garments for children with cerebral palsy. Participants varied in presentation and GMFCS level; various studies included participants with spasticity, athetosis, dystonia, and ataxia, as well as participants with hemiplegia, diplegia, and quadriplegia. One study was a small randomized controlled trial (evidence level 2); another was a combined descriptive, cross-over, and recipient control study (evidence level 3); and 8 were case series (evidence level 4). Secondary review of reference lists from these studies revealed no further studies relevant to our clinical question.

EVIDENCE

Cerebral palsy is a permanent disorder of the development of movement and posture, resulting in activity limitations due to non-progressive pre- or perinatal changes in the brain. Disturbances of sensation, perception, cognition, and communication may also be present, as well as epilepsy and secondary musculoskeletal problems.⁴

The GMFCS⁵ allows the classification of children with cerebral palsy, typically a heterogeneous group, into five levels on the basis of gross motor function. Children

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classified at GMFCS level 2 are expected to be able to ambulate independently without assistive devices but may have limitations in distance and walking outdoors or in the community.⁵ This classification system does not limit the potential for improvements in movement quality with intervention or orthoses.⁶

Children with cerebral palsy often show involuntary movements and decreased postural control, which affect balance and performance of activities of daily living.⁷ Researchers have suggested that dynamic compression garments can reduce muscle tone in spastic and dystonic muscles, reduce involuntary movements, and improve trunk stability.

In general, dynamic compression garments are made of spandex or neoprene and are designed specifically for an individual client to apply pressure to the trunk, limbs, or both using zippers or hook-and-loop or other fasteners to ensure a close fit. Additional layers of spandex reinforce the garment and apply more pressure to specific muscles or muscle groups.^{8,9} Researchers have hypothesized that these garments work by providing somatic inputs, specifically proprioceptive and deep pressure, improving body awareness and muscle activation and thus enhancing postural control.^{1,9} Contraindications for wear include compromised lung function, peripheral cyanosis,^{2,10} hypoactivity,² and decreased voluntary movement.²

Several studies have noted the effect of dynamic compression garments on postural control and proximal stability. The majority reported that garment use provided the immediate benefit of increased postural stability, documented through observer report of movement^{1,2} and non-standard assessment of balance.⁹ Improved upper limb and fine motor function have also been observed and related to improved proximal stability.^{2,9-11} One study demonstrated improved sitting balance using the Gross Motor Function Measure, a standardized assessment measure.¹¹ Another study found positive effects on postural control using a 3D motion analysis system.¹² Few studies have commented on lasting effects after removal of the garment, although one did report carryover effects on postural control for as long as 36 hours.²

These studies also supported the use of dynamic compression garments to reduce involuntary movements and to improve movement quality, noting that the garments provided the immediate benefit of decreased involuntary movements, documented through observational analysis of movement^{2,9} and parent reports of visible reduction of involuntary movements.⁹ One study reported improved grading of movement, based on clinical observation,¹ and another reported smoother movements, based on analysis using a six-camera motion analysis system.¹⁰ Another study observed a carryover effect of decreased involuntary movements for as long as 36 hours after the garments were removed.¹²

Another positive outcome of the use of the dynamic compression garments, according to the studies we reviewed, was that clients reported increased confidence

in their physical abilities^{2,9} and increased participation in physically challenging activities.¹³

All studies reported compliance issues during study trial periods, and gradual progression of wear time was required. Researchers documented parents' and children's preferences and consistently identified several primary challenges, including difficulty in putting on and taking off the garment, which affected children's independence in dressing; increased difficulty with toileting; and skin issues.^{9,10} Other main complaints were related to general discomfort, especially in hot weather or uncontrolled environments,^{9,10} and some limitation of voluntary movement.² In fact, many study participants reported that they did not enjoy wearing the garments,^{12,14} and few said they would consider using them beyond the study period.^{10,12}

LIMITATIONS OF THE EVIDENCE AND FUTURE RESEARCH

Most of the studies we found had small sample sizes,^{1-7,9-14} which limited the authors' ability to perform statistical analyses.¹⁰⁻¹² Within these small studies, heterogeneity of participants may also have affected researchers' ability to generalize their results.^{2,9-12,14} The studies we identified included only one randomized controlled trial that compared two different compression garments during intensive therapy;¹⁴ the other studies used neither randomization nor blinding. Few studies used standardized assessment tools for physical function,^{11,13,14} and all relied on caregiver questionnaires or observational analysis.

Future research should examine the use of dynamic compression garments in specific sub-populations of people with cerebral palsy, using standardized outcome measures and larger sample sizes. Because children with cerebral palsy are a relatively small and heterogeneous group, randomized controlled trials may not be feasible. Future studies should consider optimum wear time and carryover effects after removal of garments and should take into account qualitative reports from both clients and families, which can provide insight into compliance and comfort issues.

CONCLUSIONS

Simon's symptoms are typical of those of many children with cerebral palsy and highlight the need for interventions that have the potential to decrease involuntary movements and improve dynamic balance by improving postural control. Dynamic compression garments are one possible strategy, but the evidence to support their use is limited, and the topic does not currently appear to be attracting new research. Nevertheless, information on compression garments is widely available to families, and clinicians are often approached for advice on the use of these garments. If Simon and his family expressed interest in using a garment, we would suggest, based on the evidence, that they first consider a trial to determine whether the garment has the desired effect of improving

postural control; during the trial, standardized objective measures would be used to assess the effects of the garment, along with observation and parent feedback. This approach would help Simon and his family to make an informed decision, carefully weighing the potential benefits of the garment with the known discomforts.

REFERENCES

1. Hylton N, Allen C. The development and use of SPIO Lycra compression bracing in children with neuromotor deficits. *Pediatr Rehabil.* 1997;1(2):109–16. Medline:9689245
2. Blair E, Ballantyne J, Horsman S, et al. A study of a dynamic proximal stability splint in the management of children with cerebral palsy. *Dev Med Child Neurol.* 1995;37(6):544–54. <http://dx.doi.org/10.1111/j.1469-8749.1995.tb12041.x>. Medline:7789663
3. Seeger BR, Caudrey DJ, O'Mara NA. Hand function in cerebral palsy: the effect of hip-flexion angle. *Dev Med Child Neurol.* 1984;26(5):601–6. <http://dx.doi.org/10.1111/j.1469-8749.1984.tb04498.x>. Medline:6510561
4. Rosenbaum P, Paneth N, Leviton A, et al. A report: the definition and classification of cerebral palsy April 2006. *Dev Med Child Neurol Suppl.* 2007;109(Suppl 109):8–14. Medline:17370477
5. Palisano R, Rosenbaum P, Walter S, et al. Development and reliability of a system to classify gross motor function in children with cerebral palsy. *Dev Med Child Neurol.* 1997;39(4):214–23. <http://dx.doi.org/10.1111/j.1469-8749.1997.tb07414.x>. Medline:9183258
6. Rosenbaum PL, Walter SD, Hanna SE, et al. Prognosis for gross motor function in cerebral palsy: creation of motor development curves. *JAMA.* 2002;288(11):1357–63. <http://dx.doi.org/10.1001/jama.288.11.1357>. Medline:12234229
7. van der Heide JC, Begeer C, Fock JM, et al. Postural control during reaching in preterm children with cerebral palsy. *Dev Med Child Neurol.* 2004;46(4):253–66. <http://dx.doi.org/10.1111/j.1469-8749.2004.tb00480.x>. Medline:15077703
8. Attard J, Rithalia S. A review of the use of Lycra pressure orthoses for children with cerebral palsy. *Int J Ther Rehabil.* 2004;11(3):120–6. <http://dx.doi.org/10.12968/ijtr.2004.11.3.13384>.
9. Edmondson J, Fisher K, Hanson C. How effective are Lycra suits in the management of children with cerebral palsy? *J Assoc Paediatr Chart Physiotherapists.* 1999;90:49–57.
10. Nicholson JH, Morton RE, Attfield S, et al. Assessment of upper-limb function and movement in children with cerebral palsy wearing Lycra garments. *Dev Med Child Neurol.* 2001;43(6):384–91. <http://dx.doi.org/10.1017/S001216220100072X>. Medline:11409827
11. Knox V. The use of Lycra garments in children with cerebral palsy: a report of a descriptive clinical trial. *Br J Occup Ther.* 2003;66(2):71–7.
12. Rennie DJ, Attfield SF, Morton RE, et al. An evaluation of Lycra garments in the lower limb using 3-D gait analysis and functional assessment (PEDI). *Gait Posture.* 2000;12(1):1–6. [http://dx.doi.org/10.1016/S0966-6362\(00\)00066-7](http://dx.doi.org/10.1016/S0966-6362(00)00066-7). Medline:10996291
13. Flanagan A, Krzak J, Peer M, et al. Evaluation of short-term intensive orthotic garment use in children who have cerebral palsy. *Pediatr Phys Ther.* 2009;21(2):201–4. <http://dx.doi.org/10.1097/PEP.0b013e3181a347ab>. Medline:19440130
14. Bailes AF, Greve K, Burch CK, et al. The effect of suit wear during an intensive therapy program in children with cerebral palsy. *Pediatr Phys Ther.* 2011;23(2):136–42. <http://dx.doi.org/10.1097/PEP.0b013e318218ef58>. Medline:21552073