S3 E6\_ Research Roundup on Technology

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**SPEAKERS**

Jocelyn Cohen, Dr. Marie McNeely

**Dr. Marie McNeely** 00:01

Hello and welcome to Changing What's Possible: The Disability Innovation podcast brought to you by Cerebral Palsy Alliance Research Foundation or CPARF. I'm your host, Dr Marie McNeely, and this season, we are excited to bring you cutting-edge stories and insights on research, technology, and innovation for people with CP and other disabilities. All of the studies featured in today's Research Roundup represent interesting, innovative work happening in the CP research space, outside of the projects that CPARF has funded.

**Dr. Marie McNeely** 00:34

Today, I'm going to talk about three recent research studies that highlight the development and evaluation of new technology based interventions for people with CP and other disabilities. In one study, a team of researchers led by Dr. Bahman Azarhoushang from Furtwangen University in Germany, described the process of designing and fabricating a new customized hand orthosis for people with CP using a process called 4d printing. A hand orthosis or splint can be a useful tool to treat muscle tightness or stiffness, also known as spasticity, in people with CP. But these orthoses can be heavy and difficult and potentially expensive to customize and adjust to an individual's needs, particularly over time, and you might be familiar with the process of 3d printing, listeners, which can be used to make three-dimensional objects using a digital model.

**Dr. Marie McNeely** 01:28

A variety of different materials can be used, and the object is created by depositing the material layer by layer. Now, 4d printing uses the same principles, but the 3d object that's created is designed so that it can also change shape after it's printed based on inputs from its environment, things like temperature, humidity, or electrical current. The researchers used a highly precise scanning device to create a model of an individual's hand, and used software to design the customized orthosis. They used a specialized polymer resin material that allowed the orthosis to have shape memory effects. This means that it can be stretched into a new shape and then returned to its original shape when heated to a high temperature. Being able to modify the orthosis using these shape memory effects allows for gradual stretching of the spastic hand within an individual's pain-free range.

**Dr. Marie McNeely** 02:23

In their study, the researchers were able to successfully print the orthosis and investigate its shape memory properties and the repeatability of the shape memory effects, so how many times it can change shape and then return to its original shape. They also confirmed that the material did not have any toxic effects, which is important because it could be resting against the skin. This 4d printing process, using the specialized resin, allows for a fast, low-cost creation of comfortable, lightweight orthoses that can be really customized to each person with CP. So we're excited to see where this technology goes.

**Dr. Marie McNeely** 03:00

 Now in a different study, Ian Bales and Dr. Haohan Zhang from the University of Utah developed a cable-driven robotic platform that can facilitate or train natural head and neck movements for people with CP and amyotrophic lateral sclerosis, which is ALS or Lou Gehrig's disease. So we know that limited postural control of the head and neck can cause pain and it can impact a person's ability to interact and engage with others and with their environment. Current treatments that use static neck collars, and even some of the more cutting-edge new exoskeletons constrain movement, and they don't allow a person to move their head and neck completely naturally. When talking about positions and orientations that an object or a robot or part of your body can reach, scientists and engineers use the term degrees of freedom, and a physical object can have up to six degrees of freedom — so they can move forward and backward, side to side, up and down. And objects can also rotate around those three axes. Now the robotic platform in this particular study is unique in that it does allow for unconstrained, wide-ranging movements with all six of these possible degrees of freedom of the head and neck.

**Dr. Marie McNeely** 04:12

In the current study, the researchers discussed the design, the validation, and controls of this robotic platform, and they also did a small test with healthy young adults and demonstrated that applying robotic resistance during head and neck movements increased muscle activation in the neck, and applying robotic assistance to help during these movements reduced muscle activation in the neck. This really showed the potential value of this kind of robot for rehabilitation applications, and this device is still in its very early stages, but a robotic system that can apply controlled forces to the head with these six degrees of freedom could potentially have a variety of applications, both in future scientific research and in rehabilitation. So a lot of different promising applications for this device.

**Dr. Marie McNeely** 05:01

Now, a third study that we are going to talk about today was led by researchers at Medical University Vienna and Ottobock HealthCare. They examined how a wearable full-body electrostimulation garment affected mobility and pain in small groups of people with CP, multiple sclerosis or MS, and stroke, all of whom had upper motor neuron symptoms, which include things like muscle weakness and spasticity, this tightness or stiffness. The garment is called the Exopulse Mollii Suit. It covers the arms, legs and trunk, and it looks kind of like a form-fitting tracksuit. It contains 58 electrodes that can send electrical stimulation noninvasively through the skin to spastic muscle groups to help reduce spasticity and stimulate weak muscles. After an hour of use, so just one session, all three groups, so people with CP, MS and stroke showed significant functional improvement, lower fall risk and a reduction in spasticity related pain. Now to extend these results even further, participants in all three groups also showed sustained improvements in mobility, decreased fall risk and reductions in spasticity related pain after four weeks of using the stimulation garment for an hour a day every other day for four weeks. In addition, participants with CP showed significant improvement in balance and characteristics of their walking after using the stimulation garment. Now, the data on the use of the garment for four weeks, I think is particularly interesting because it represents a key step in translation, where people with disabilities were able to successfully use this product themselves in their own homes. And I think it's important to note that this was an early, relatively small study. However, the promising results will inform future, larger, and more rigorously controlled trials. So these advances in customized hand orthotics, robotic platforms for head and neck movement, and electrical stimulation, are really exciting, and I'm thrilled to welcome Jocelyn, Cohen, CPARF's Vice President of Education, back to the show to talk about these findings and what they could mean for people with CP and other disabilities.

**Jocelyn Cohen** 07:13

Thanks for having me back, Marie. I'm always excited to join you on the podcast. So these studies all illustrate how innovative technology plays a role in managing life with a disability, and it can do so in unexpected ways. People tend to think that massive solutions make the biggest difference, but it's often assistance for the small, everyday movements and tasks that makes a lasting impact on quality of life. And research that results in low cost, easily accessible, comfortable technology that can potentially help disabled people strengthen the muscles they want to strengthen, preserve or expand the range of motion that they have, or lessen their pain, will have a positive verbal effect. And if people with disabilities can use this technology in their own homes on their own time, it could be transformative.

**Dr. Marie McNeely** 07:58

Well, Jocelyn, I certainly agree with you, and we appreciate you joining us and sharing your perspectives today.

**Jocelyn Cohen** 08:04

Thanks so much for having me.

**Dr. Marie McNeely** 08:05

And listeners. Thank you for joining us as well. You can find links to the abstracts for the papers we talked about today with the notes for this episode on cparfs website. And now I'd like to take a moment to tell you about 3forCP, CPARF's grassroots fundraising initiative for cerebral palsy research and disability innovation. Whether you level up a read-a-thon, a sip-and paint event, a comedy show, or something else that you love, 3forCP gives you the chance to make a difference in your own signature way. Head to 3forCP.org, to get started, that's the number 3, F, O, R, C, P, dot, O, R, G, and we look forward to connecting with you again in our next episode of Changing What's Possible.