what in the "HEEL" do they feel?

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Why do we do the things we do?

I am very fortunate to be in a position to ask this question a lot. I ask it to myself, to my colleagues and to providers across the country. As members of a care team, what is the most dangerous answer to that question?

"Because we've always done it that way."

This answer puts us in a place of complacency, which is not fair to our patients. They deserve for us to push ourselves, our professions and to continue to strive for better results. This study was an opportunity to challenge the way we've always done things. Things were really great and we were consistently seeing good results – but could we do better? That was the question we sought to answer.

Over the past few years, we have walked hundreds of children on a gait mat (Zeno Walkway / Protokinetics Software[1]) in various SMOs and AFOs. As we compared data from Barefoot to Shoes Only to Shoes plus orthoses, we noticed trends. We saw increased step length, decreased base of support, improved center of pressure and improved gross motor skills. But we also noticed that in orthoses, kids tended to be more anterior and have a faster transition from initial contact to foot-flat. These characteristics affect the achievement and quality of both gait and functional skills.

We wondered if we could do better.

Our team discussed these observations and asked further questions. If kids are getting too far anterior too fast, are they strengthening their trunk extensors? If they don't get good eccentric contractions of their dorsiflexors in loading response and have too much knee and hip flexion, can they gain strength? What are the effects of anterior weight lines on posture, gait and function? Do we need to promote posterior weight shifts?

What do kids truly feel in their orthoses?

There are 104 mechanoreceptors on the plantar surface of the foot (Figure 1)[2]. We see concentrations on the forefoot, lateral midfoot and heel. The ability to feel changes in terrain and adjust posture to build a repertoire of motor and postural strategies is a vital part of typical development[3,4]. With shorter footplates on many of our SMOs and AFOs, we are allowing the forefoot to feel the floor. Could we allow the heel to feel the floor? What are the effects of a heel post?

Figure 1. Location of plantar surface mechanoreceptors.

What can we do to make a difference?

These questions and conversations led to the development of the Open Heel Modification (Figure 2). This modification adds a very thin inner boot to the orthosis and removes

the heel post. The inner boot not only reduces irritation from the edges of the opening but more importantly, helps ensure we have total contact and maintain circumferential compression.

In this study, we had 11 participants with an average age of 4.5 years old. Patients were included in this study if they were receiving a new pair of orthoses (SMOs, Toe Walking SMOs or AFOs) from their Certified Orthotist and presented with anterior weight lines and/or foot slap. Diagnoses of the participants included Down Syndrome, Autism, Toe Walking, Hypotonia and Pronation. Our goals were to promote more posterior weight lines, slow loading response and improve proprioception while still controlling pronation.

Figure 2. Open Heel Modification on Surestep SMO and Toe Walking SMO.

Figure 3. Standard Surestep SMO with Heel Post and Surestep SMO with Open Heel Modification.

What did we change?

Before analyzing the effects of the new modification on gait and function, we first had to evaluate foot position to ensure we were still controlling pronation. Patients stood in their standard Surestep SMOs with a heel post and in their Surestep SMOs with the open heel modification. There was no significant change in calcaneal position between devices (Figure 3). The combination of the properties of the plastic, trim lines and circumferential compression improved alignment and provided the dynamic stability necessary to control excessive pronation.

Patients also walked on the gait mat Barefoot, Shoes Only (when applicable), Heel Post Orthoses and Open Heel Orthoses. The gait results included decreased velocity and increased time from initial contact to foot-flat with the Open Heel Modification. Anterior weight lines tend to lead to increased velocity. Many of our participants struggled slowing down and walking with control. They were essentially falling with every step as their trunk led their feet. By slowing down, they could work through eccentric contractions, gain strength and work on posterior and lateral weight shifts. By increasing time from initial contact to foot-flat, we slowed down loading response and allowed the natural anatomy of the heel to work and control the mechanics, rather than the plastic heel post. This led to increased extension through the lower extremities and trunk as well as better mechanics when doing functional skills such as squatting.

"I can feel my feet!"

Comments like this from our patients along with feedback from therapists and parents about how they felt proprioception improved, led us to believe that, along with the compression of the orthoses, the dynamic tactile input through the forefoot and heel helped improve stability and sensory input. These types of comments are what it is all about. This is the reason we strive to never answer the question "Why do we do it this way?" with "Because it's the way we've always done it."

For questions, or more information, please email **megans@surestep.net** or visit **www.surestep.net/clinicians**, where you can find our Open Heel Modification FAQ sheet.

Resources

1. Kennedy PM, Inglis JT. Distribution and behavior of glabrous cutaneous receptors in the human foot sole. J Physiol. 2002 Feb 1; 538(Pt. 3):995-1002.
2. Protokinetics Software and Zeno Walkway. www.protokinetics.com
3. Dusing SC, Harbourne RT. Variability in Postural Control During Infancy: Implications for Development, Assessment, and Intervention. Phys Ther. 2010; 90:1838-1849.
4. Fetters L. Perspective on Variability in the Development of Human Action. Phys Ther. 2010; 90:1860-1867.