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# Pediatric Hypotonia

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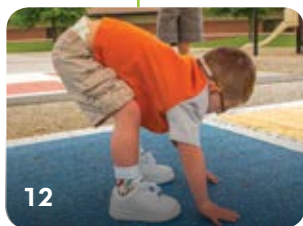
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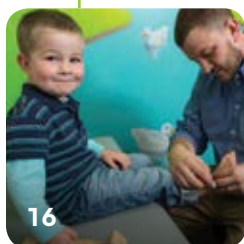
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## FROM THE EDITOR:

### *Mobility and More*

At the most basic level, mobility is about getting from point A to point B. But, for many children with hypotonia, it's about so much more.

It's about independence. It's about confidence. It's about maintaining strength, fitness, and healthy bones. It's about not being excluded from activities enjoyed by their typically developing peers.

And improved mobility may have even more benefits in those children whose hypotonia is associated with social and behavioral developmental delays. New research has identified an association between motor skills and sociobehavioral milestones in children with autism spectrum disorder, who often present with hypotonia (see "The Importance of Gross Motor Skills," page 12).

This suggests that early intervention to improve gross motor skills—including orthotic devices and physical therapy—may also help certain children interact more comfortably with others. That won't come as a surprise to the clinicians and parents who have personally seen it happen.

This special issue is filled with evidence-based information and personal success stories illustrating how effective interventions can enhance mobility in children with hypotonia. That could literally be the first step toward drastically improving a child's quality of life. Not to mention their ability to get from point A to point B.

BY JORDANA BIEZE FOSTER,  
EDITOR



Now 10 years old,  
loves to play soccer,  
ride her bike

Her name is Julia.

She is a  
celebrity  
of sorts.



## An Unexpected Path, an Invaluable Perspective

**FOR THIS FAMILY, ONE TINY EXTRA CHROMOSOME  
LED TO A JOURNEY OF SELF DISCOVERY**

When our son was born, we prayed for a healthy baby with 10 fingers and 10 toes. Our prayers were answered. Three years later, those same prayers were said for baby number two. And, once again, our prayers were answered. Baby number two was also born with 10 fingers and 10 toes. But there was one microscopic addition: an extra copy of chromosome 21. Otherwise known as: Down syndrome.

Being told that your child was born this way—it was a shock. It's just not something you think will happen to you.

I remember when the doctor came into my room. He sat down next to me and explained that our daughter likely had trisomy 21. I asked, "What is trisomy 21?"

At the time, my husband was at home with our 3-year-old son. I called him crying and confused. When he arrived at the hospital, he reassured me that everything was going to be OK.

"Julia is our daughter, and we love her unconditionally, so let's just move forward and figure it out as we go," he said.

I can't say that I rolled with it quite the same way. I cried—a lot. I kept asking, "Why us?" People kept telling me, "God doesn't give you more than you can handle." And I would reply, "Well...I think God confused me with someone else!"

It wasn't until I received the first sympathy card that it all made sense to me. I tried not to be offended as I knew the intention was good. It was then that I realized I didn't have any reason to be sad. I was, and still am, blessed to have this child. She is our winning lottery ticket. But that didn't mean it would be easy.

Within days of Julia's birth, we were connected with the Indiana First Steps Early Intervention Program. Julia started physical therapy at four weeks old. Developmental, occupational, and speech therapies soon followed. Julia was not born with any additional medical needs.

However, because most children with Down syndrome have hypotonia, or low muscle tone, we knew that needed to be addressed. Because of the hypotonia, our physical therapist said that Julia would benefit from supramalleolar orthoses (SMOs) to help her walk. She specifically recommended SureStep.

We are lucky to live near the SureStep corporate headquarters. Julia was 18 months old when she first started wearing SureStep SMOs, and she was walking shortly after that. Since then, she hasn't stopped. Now 10 years old, she loves to play soccer, ride her bike, and climb on the playground jungle gym.

It's funny how things happen for a reason. If it weren't for Julia, my path would have never crossed with Bernie Veldman, owner and developer of SureStep, and I wouldn't be the company's executive director of marketing. I'm thankful that I can work for a company that is so passionate about helping children with special needs.

As people in our community meet Julia, they are drawn to her charming personality. She is a celebrity of sorts. At a local clothing store that we frequent on mommy-daughter days, one of the employees adores Julia and always asks her to model her clothes when she tries them on. Our son's baseball team has adopted her as a member of their team.

It's no different at school. Her classmates high-five her in the hallway, help her with her backpack, and open the door if she needs assistance. They even write her letters to tell her that she is their best friend.

Julia is too young to understand her celebrity status, but I know that all the love and attention she receives gives her the confidence she needs to develop into an even more amazing young lady.

As I look back on these 10 years, I wonder why I ever shed a tear about having a child with Down syndrome. It was the path our family was chosen to take, and I know we're up for it. I could not imagine life any other way. Without a doubt, our family and friends have been profoundly affected by this gift. The people we've met, the challenges we've faced, and even my career choice have all been influenced by one little girl.

Her name is Julia.

Suzi Klimek lives with her husband and two children in Granger, IN. Originally from Wayzata, MN, she relocated to Granger after graduation from Saint Mary's College in Notre Dame, IN. Klimek is the executive director of marketing for SureStep.

A version of this article was previously published in the June 2011 issue of *Family* magazine.



# Understanding Hypotonia

Diagnostic challenges should not delay clinical intervention

Hypotonia, or abnormally low muscle tone, is by itself not a disorder but a symptom of an enormous array of issues—many of which can be difficult to diagnose accurately. Even in the absence of a specific underlying diagnosis, however, children with hypotonia can benefit from clinical intervention.

Hypotonia can result from damage to the brain, spinal cord, nerves, or muscles, or may be a result of genetic, muscular, or central nervous system (CNS) disorders. The condition appears

independently from muscle weakness, although the two may coexist in some disorders, such as motor neuron disease or multiple sclerosis. Young children with hypotonia appear “floppy” and may present with inappropriate head lag, astasia, hypermobility, decreased deep tendon reflexes, and problems sucking or swallowing. Older children with hypotonia may exhibit delays in gross motor skills or coordination or problems with ligament and joint laxity, respiratory control, posture, or speech.<sup>1,2</sup>

Demographically, hypotonia affects both genders equally and is no more likely to occur in one particular ethnic or racial group than another. It is one of the most common muscular abnormalities diagnosed in newborns with disorders such as Down syndrome, cerebral palsy, Prader-Willi syndrome, and Tay-Sachs disease yet, in some connective tissue disorders or certain muscular dystrophies, low muscle tone may not be revealed until later in life. Hypotonia is an associated symptom among many



*“Expertise matters in both performing diagnostic studies and assessing a child’s individual abilities.”*

children with autism spectrum disorders,<sup>3,4</sup> but typically improves over time and responds to clinical intervention.

Neuromuscular specialist for children Thomas O. Crawford, MD, who treats patients at Johns Hopkins Children’s Center in Baltimore, MD, estimates more than 95% of patients he sees for hypotonia can be evaluated with a comprehensive history and physical examination.

“In central issues, muscle tone may be diminished, but there is a discrepancy between tone during power of motion and the resting tone. That’s an important distinction. If I find a child has more vigorous muscle power than tone, that leads me to concentrate on CNS issues,” Crawford explained.

Expertise matters in both performing diagnostic studies on children, such as EMG, and assessing individual abilities, he said.

“If a child is weak as well as hypotonic from a central cause, his face is less animated than, for example, a child with spinal muscular atrophy, but in children with congenital myopathies, their faces may look unresponsive but the children are not,” Crawford said.

In the 1970s, neurologists began classifying types of hypotonia, but “benign congenital hypotonia” remained a diagnosis when no cause could be found. Improvements in identifying genetic, neuromuscular, and connective tissue disorders now provide more detailed answers, opening the door to appropriate treatment responses. Still, some families live with the frustration of knowing hypotonia exists without discovering its underlying cause.

In some cases, idiopathic hypotonia resolves within the first few years of childhood, though minor cognitive impairments or developmental delays may persist.<sup>5</sup> Hypotonia caused by hormonal or metabolic disorders, such as rickets or congenital hypothyroidism, must be specifically screened for but can be easily treated.

Ronald D. Cohn, MD, chief of the Division of Clinical and Metabolic Genetics at The Hospital for Sick Children in Toronto, Canada, and an internationally recognized specialist in the genetics and clinical care of children with hypotonia, helped design a diagnostic algorithm to streamline hypotonia assessment for clinicians, distinguishing primary involvement of the upper motoneuron (central hypotonia) versus the lower motoneuron and motor unit (peripheral hypotonia) to indicate, for example, the need for magnetic resonance imaging.

Cohn and genetic counselor Emily C. Lisi, MS, have concluded that hypotonia can be a symptom of more than 600 genetic disorders, with still more waiting to be identified.

“A staged diagnostic approach categorizing patients as having peripheral,

central, or combined hypotonia is the most efficient to providing a rational work-up. Establishing a diagnosis is crucial for prognosis, management, and treatment strategies and for ascertaining an accurate recurrence risk for future offspring,” they wrote in a 2011 study.<sup>6</sup>

## *Hypotonia in chromosomal abnormalities*

“Individuals with Down syndrome are at risk for foot alignment problems due to hypotonia and ligamentous laxity. Both characteristics contribute to joint hypermobility,” said senior physical therapist Patricia C. Winders, PT, director of therapies at the Anna and John J. Sie Center for Down Syndrome at Children’s Hospital Colorado in Aurora.

“The ligaments do not hold the bones together tightly for optimal alignment and function. The joints of the foot have excessive flexibility, which causes instability and inefficient mechanics when standing, walking, running, and jumping,” she said. “The child cannot use his strength effectively because the muscles are not aligned for efficient activation. Since his strength does not generate efficient power, he uses more energy during each skill and fatigues more quickly. The consequences of faulty alignment and mechanics range from impaired performance to pain, which can result in limitations in walking. Since walking will be vital for his entire lifetime, it is very important to be proactive in promoting optimal alignment and function, beginning when he learns to walk.”

The goal of physical therapy for an individual with Down syndrome is to achieve maximal physical potential and to build a body that is fit and functional throughout his or her life, Winders said.

“Because of physical problems [hypotonia, ligamentous laxity, and decreased strength], he is prone to develop compensations, which are ways he adapts to make up for the physical problems. Some compensations, if allowed to persist, will eventually result in inefficient and painful





movement patterns that will compromise his function as an adult,” she said. “Physical therapy needs to focus on minimizing the compensations that will lead to impairment of motor functioning and on building the posture, strength, and movement patterns that he will need as an adolescent and adult.”

Hypotonia is a common feature of genetic disorders associated with developmental delay. Children with Angelman syndrome have gait ataxia with tremulous limbs, but may not always have hypotonia.<sup>9</sup> Neonates with Prader-Willi syndrome (PWS), however, have severe hypotonia, evidenced by lethargy and weak or no sucking. As children grow, their gross motor skills are typically delayed; they may sit at 12 months and walk at 24 months, though in some cases walking may be de-

layed until they are aged 4 or 5 years.

The insatiable appetite that is the hallmark of PWS does not typically present before preschool age, but obesity rates begin to soar during preschool years. Scoliosis; hip dysplasia; respiratory control issues; early risks of osteoporosis; short stature; short, wide feet that require extra care to fit shoes properly; and the stress of a restricted dietary and home environment pose challenges for the families of children with PWS and their healthcare providers.<sup>10</sup>

In 2010, Korean researchers found a high prevalence of spinal deformity, limb malalignment, and foot abnormality in PWS, regardless of age or obesity.<sup>11</sup> They urged pediatric orthopedic surgeons to evaluate PWS patients annually for these conditions because of their possible concealment by obesity.

Early intervention with occupational and physical therapy and lifelong strength training and aerobic conditioning are critical to addressing overall health status, yet therapists must be aware that many patients with PWS have decreased sensitivity to pain. Any evidence of pain should be promptly addressed, as it may suggest a serious but masked underlying problem, such as a fracture or abnormality.

## Missed diagnoses

Cohn suggests children with mild hypotonia and features such as joint hypermobility, pectus excavatum, pes planus, or cardiac abnormalities be carefully evaluated, as he believes patients with connective tissue disorders who have less severe forms of hypotonia remain dramatically underdiagnosed.

Crawford, too, cautions that beyond the parameters of classic presentations of obvious congenital disorders of infancy, hypotonia may be missed.

“Children with classic Duchenne muscular dystrophy are not hypotonic as infants and, as a consequence, that diagnosis may not be considered until later. Some pediatricians might not think of Duchenne dystrophy for a boy who at 15 months of age manifests motor and cognitive delay. But weakness doesn’t show up until later. In many of those cases, we are missing diagnoses,” Crawford said. “Any

boy not walking by 16 months should have a CK [creatine kinase] screening. In the case of Duchenne, the result will be five digits even though the child may show no signs of weakness.”

Congenital hypotonia may be seen in tandem with joint hypermobility or ligamentous laxity, but, excluding obvious dysmorphic presentations, hypermobility may not be diagnosed until children are school-aged and present with arthralgia, back pain, abnormal gait, or joint deformity. Knees, elbows, wrists, metacarpophalangeal joints, and ankles are most commonly involved, according to British arthritis researchers, who collected data during a three-year period from pediatric rheumatology and hypermobility clinics.<sup>12</sup> Nearly half of the study participants were described in their clinical history as “clumsy,” and more than a third showed signs of poor coordination in early childhood.

Dutch pediatric physical therapists performing a retrospective study concluded that one-third of children with generalized joint hypermobility presented with severe delays in motor development, though there was no significant association between the number of hypermobile joints and the age of independent walking.<sup>13</sup>

Joint hypermobility, if associated with hypotonia, may be indicative of Marfan syndrome, Ehlers-Danlos syndrome, osteogenesis imperfecta, or other mild variants of these and other musculoskeletal or connective tissue disorders.

## Objective assessments

In a 2005 study, physical therapists and occupational therapists found that the specific characteristics of hypotonia included increased flexion, hypermobile joints, round shoulder posture, decreased strength, low activity tolerance, delays in motor development, and poor attention and motivation.<sup>14</sup>

Some studies acknowledge that objective measurement of the degree of hypotonia in an individual poses a challenge because, historically, therapists have defined resistance subjectively based on their methods and areas of expertise. Reliable tools, such as the 2011 Segmental Assessment of Trunk Control (SATCo),<sup>15</sup> which measures discrete

## *“Intervention with physical therapy and orthoses in childhood is key to preventing or managing pain in adolescence and adulthood.”*

levels of trunk control in children with motor disabilities, are being developed.

Billi Cusick, PT, MS, C/NDT, COF, of Telluride, CO, uses SATCo in her practice.

“In my experience managing the alignment and movement disorders that are common in children with hypotonia, the functioning alignment of the joints and the somatosensory system are critical areas of concern,” Cusick told *LER*.

She pointed to a recent systematic review that determined children with benign joint hypermobility syndrome demonstrated significantly poorer proprioception compared to children without the disorder.<sup>16</sup>

“Mechanoreceptors in load-bearing joints and the skin on the plantar foot deliver sensory information about limb position and weight bearing when they are stimulated,” Cusick explained. “When joint surfaces are malaligned due to laxity in supporting ligaments, those receptors lose appropriate contact, and, presumably, their messages to the central nervous system are compromised. Lax joints fall to end range when loaded, where it appears that the sensory receptors finally detect the functioning positions. This lack of adequate and timely sensory information is evident in postural deviations, such as a wide-based stance and gait, excessive spinal lordosis, anterior pelvic tilt, knee hyperextension, and foot pronation seen commonly in children with hypotonia. For these children, such postural deviations are normal, and they persist without intervention.”

Intervention with physical therapy and orthoses in childhood is key to preventing or managing pain in adolescence and adulthood commonly associated with joint hypermobility and hypotonia, even if an underlying diagnosis is not determined. Persistent postural deviations and foot joint laxity typically deform the feet and interfere with independent mobility and endurance as body size and weight

increase, Cusick said, citing a 2011 study by Wolf et al that recommended managing the pain with prolonged therapy and general conditioning, with special emphasis on improving strength and proprioception.<sup>17</sup>

Cusick not only has decades of experience treating children clinically, she has used her expertise with her own daughter, Ting, who arrived from China aged 12 months and unable to assume an all-fours position, crawl, get into and out of a sitting position, or pull to kneeling or standing.

“Her hips were very weak,” Cusick said. “She had never taken weight on her knees or feet before, so I began to help her put weight through them in small increments and in a variety of postures. I used a jumper seat suspended on a spring and later fitted her in a pair of support shorts to keep her hips from sliding into full abduction when she attempted to assume all fours.”

Ting was soon crawling and pulling to stand, but her feet were profoundly pronated, her foot ligaments were lax, and her wide stance imposed further pronatory forces on her forefeet. Cusick fitted her with heel cups and sturdy flat-soled sneakers, and Ting was soon cruising. At age 5 years, she began gymnastics; at 6, she started soccer; and at 15, Ting became a competitive cheerleader.

“Although Ting’s feet are aligned and competent, because she has a tendency toward joint laxity that is typical of the Chinese population, she continues to wear plantar orthotic inserts that protect her feet and knees from the wear that commonly occurs with excessive pronatory strain,” Cusick said.

In caring for patients with low muscle tone or ligament laxity, Cusick relies on management strategies that improve functioning joint alignment and raise the level of—and improve the quality of—sensory input in daily life. To support

these goals, she developed TheraTogs, a live-in orthotic undergarment and strapping system for children with hypotonia and other issues that is designed to deliver enhanced sensory input and improve postural alignment, and can be used in conjunction with orthotic devices that specifically target the foot and ankle. She also selects play activities that build balancing skills, muscle strength, and muscle tone, while maintaining the feet, trunk, and hips in optimum alignment.

As Cohn and Lisi underscored, an inability to define an underlying diagnosis for low muscle tone should not interfere with the ability to manage hypotonia in patients of any age. Symptomatic treatment can and needs to be tailored, they wrote, to create lifelong strategies vital to maintaining strength, reducing pain, and fostering independence.

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References are available at [lowerextremityreview.com](http://lowerextremityreview.com), or by scanning the QR or tag codes above.





# Gait: The Cornerstone of Intervention

*Quantifying the effects of hypotonia starts in the clinic*

Effective management of children with hypotonia requires an understanding of how the condition affects gait. Clinicians typically rely on their professional experience when discussing the effects of hypotonia on gait in pediatric patients, partly because they trust that experience, but also because so little research has actually elucidated these effects.

"This needs to be explored from a research standpoint, because we really don't know," said Mark Holowka, CPO, who practices at Children's Healthcare of Atlanta. "It's difficult to quantify hypotonia because muscle testing isn't reliable in such young patients. As a result, we tend to rely on what we can observe and what we hear from the parents and the physical therapists on the team."

Pending better funding for formal studies into hypotonia and associated hypermobility, many clinicians feel they should conduct informal research as best they can.

"I think there has to be a real emphasis placed on gait analysis within clinical practice," said Jason Henry, MSPT, LO, the practice manager at Hope Orthotics in Spring, TX. "We have to take the mindset that clinical practice is research. Many different aspects of gait can be analyzed even if you don't have a gait lab, and that data has to be collected on a broader scale. We need more information about outcomes."

According to Holowka, a grasp of the distinctions between pathologies associated with hypotonia is critical to clinical intervention, regardless of similarities in symptoms.

"For example, autism is more of a sensory issue, whereas in a Down syndrome patient, it's important to focus on their joints and joint laxity," he said. "You have to understand what is associated with each pathology, because these kids will have different developmental and physiologic concerns."

Holowka added that performance inside the lab can differ significantly from that outside—a phenomenon he's found more prevalent with autism patients than others. Parents are often the best source of insight about such disparities.

"The patient will walk perfectly in the lab, but then the parents say, 'Oh no, they don't walk like this at home,'" he said. "It's ironic, because ideally what we want is for them to walk imperfectly in the lab so we can help them walk perfectly outside of the lab."

Kathy Martin, PT, DHS, a professor and director of the Doctor of Physical Therapy program at the University of Indianapolis, agreed that clinicians must rely on their own observations and measurements to characterize gait in children with hypotonia. And, despite the paucity of formal studies, most clinicians seem to agree about the outlines of those characteristics.

"My opinion is that hypotonia affects gait, in that I see kids with a wider base of support and more cocontractions, who are trying to artificially create stability," she said. "These kids are using everything but the kitchen sink to keep themselves upright because they have to work so hard to control their body against gravity."

Such patients may be less able to adapt to environmental obstacles than typically developing children, Martin explained, and have to change their ambulatory strategies when confronted with such obstacles.

"Children with Down syndrome may drop to their knees and crawl over an obstacle rather than stepping over it," she said. "Down syndrome also includes issues related to balance and postural control, of course; it's not just hypotonia. That raises the issue of what is the limiting factor, why they feel they can't step over the object—but hypotonia contributes to that."



➔ “Children with hypotonia may be less able to adapt to environmental obstacles than typically developing children.”

## The reading

In the scant literature that does address hypotonia in pediatric patients, a few key points are worth noting. First, though hypotonia is often thought of as muscle weakness, researchers point out that it is more accurately described as reduced resistance to passive range of motion in joints. Weakness, by contrast, is defined as a reduction in the maximum muscle power that can be generated.<sup>1</sup>

Many neurological conditions have been associated with hypotonia; the most commonly studied connection is with Down syndrome (DS), but others include Prader-Willi syndrome (PWS) and Ehlers-Danlos syndrome (EDS). Although hypotonia does occur in children who do not have a specific neurological diagnosis, the difficulty of categorizing such children means they are less likely to be included in scientific studies.

According to Faye McNerney, PT, DPT, a pediatric physical therapist in Troy, OH, DS has become the research standard because hypotonia is more consistent in that patient group.

“There is no gold standard for describing hypotonia, and because everyone with Down syndrome has some degree of hypotonicity, they are chosen as research subjects,” she said. “Children with low muscle tone typically have joint hypermobility, which results in various biomechanical effects. Hypermobility of the foot-ankle joint allows the feet to pronate, and with time you’ll see shortening of the peroneal muscle, lengthening of the posterior tibialis, medial rotation of the tibia, genu valgum, and hip internal rotation. As a result of these issues and poor balance, patients typically use a wide base of support during stance and ambulation.”

Curt Bertram, CO, National Orthotic Specialist for Hanger Orthopedic Group who works at Children’s Hospital of Wisconsin, in Milwaukee, agreed.

“When I talk about hypotonia, I think about Down syndrome patients, because those are the quintessential hypotonic patients,” he said. “They have a hard time with advanced ambulation skills—climbing stairs, negotiating ramps, and running.”

Indeed, because DS has been studied more than other syndromes, a review of the literature can shed at least some light on hypotonia and gait. For example, early research in DS patients reported that characteristic gait deviations included increased variability, out-toeing, flat foot at initial contact, a wider base of support, and poor foot control.<sup>2</sup>

A more recent paper by Italian researchers, published in *Gait & Posture* in 2008, further clarified aspects of gait associated with DS. Compared with controls, 98 children with DS (mean age 11.7 years) walking at a self-selected speed had more hip

flexion during the whole gait cycle, more knee flexion in stance phase, less knee range of motion (ROM), and more ankle plantar flexion at initial contact. Moreover, ankle power was limited in terminal stance and preswing, as indicated by low propulsive capacity at push-off. Children with DS also had stiffer hip joints but more lax ankle joints.<sup>3</sup>

In a 2012 study of foot-ground interaction during upright standing, some of the same researchers found that 99 children with DS (mean age 9.7 years) exhibited larger midfoot and reduced forefoot contact areas, increased arch index values, and increased average contact pressures in the midfoot and forefoot than controls.<sup>4</sup> Of course, standing measures don’t necessarily predict gait mechanics, but the authors noted that the prevalence of flatfoot in DS patients, associated with higher contact pressures, suggested the importance of clinical observation and intervention to reduce balance and gait impairment. Some gait impairments, however, would appear to be less affected by foot posture. For example, Brazilian researchers compared gait in toddlers with DS with controls and reported no differences in stiffness or lower



limb cocontraction indices (CCIs) during stance; however, DS patients showed greater CCIs during swing phase.<sup>5</sup>

In 2011, Italian researchers also evaluated gait patterns in Ehlers-Danlos and Prader-Willi syndromes. Although this



research was conducted in adults, the rare conditions have been so infrequently studied that results are worth noting here.

The two conditions were associated with different gait strategies. Patients with PWS showed some functional limitations at every level of the lower limb joints, whereas those with EDS had greater limitations that were nevertheless found mainly at the distal joints.

The authors recommended that PWS patients be encouraged to walk to improve muscle mass, strength, and energy balance, while rehabilitation for EDS patients should focus on improvement of ankle strategy.<sup>6</sup> Another Italian study comparing gait patterns in adult PWS and DS patients reported a cautious abnormal gait in both groups that was even less stable in DS patients. Those with DS also demonstrated significantly less hip flexion, knee flexion, and ROM in all joints compared to PWS patients. Both groups had significantly weaker push-off than controls.<sup>7</sup>

Finally, Canadian researchers reported in 2011 that children with autism had significant differences in cadence and peak hip and ankle kinematics and kinetics compared with controls. The children with autism also had reduced plantar flexor moments

and increased dorsiflexion angles, which may have been associated with hypotonia.<sup>8</sup>

As noted, clinicians have long observed similar patterns in their patients with hypotonia.

“The disruption in neurology between the feet and the brain leads to an inefficient, dysfunctional gait,” said Jim Bauman, CO, who is in private practice at Edge Homecare Prosthetics and Orthotics in Edison, NJ. “For children with low tone, gait is more staggering and appears clumsy because of what they need to do to get their bodies to move through space.”

## The role of hypermobility

As noted, hypotonia is often associated with joint hypermobility, which presents its own challenges.

“Hypotonic patients end up with hypermobility, first and foremost in the foot-ankle complex,” said Curt Bertram. “These children overpronate right at initial contact, then once they get to midstance, the foot-ankle complex can’t stabilize, so their toe lever is shortened and they lose propulsion. With time and repetition in that position, they develop bony modeling that enhances the pronatory deformity.”

According to Jason Henry, ligamentous laxity and the associated lack of coordination lead to the kind of balance deficits for which DS patients try to compensate during gait with strategies such as wider stance.

“You see delays in milestones such as cruising,” Henry said. (Cruising in this case doesn’t refer to muscle cars or girls, but rather the strategy of holding onto furniture or other stabilizing objects while learning to walk.) “You’re going to see high guard, a lot of pronation, recurvatum, genu valgum, things like that. It goes all the way up, because hypotonia is global, so you see hyperlordosis, an anterior center of mass, and so forth.”

Researchers and clinicians acknowledge that they are somewhat baffled by the connection between hypotonia and hypermobility. Muscles contain motor neurons but ligaments don’t—they provide primarily proprioceptive feedback—so the physiological correlation between the conditions isn’t clear. Nevertheless, the connection is obvious in the clinic.

*“Hypotonia is often associated with joint hypermobility, which presents its own challenges.”*





*“Down syndrome patients compensate for balance deficits with gait strategies such as wider stance.”*

“Either problem can affect the development of motor skills, but it’s even worse if you put them together,” said Kathy Martin. “The ligaments are the primary stabilizers of your joints, and if they aren’t working well, your muscles are the second line of defense. Kids with low tone don’t have either, and I think that’s what leads to the delay in the acquisition of motor skills and the gait deviations we see.”

A few researchers have investigated hypermobility and gait. In a 2011 study, 29 pediatric patients with hypermobility syndrome had greater passive knee ROM but less peak knee flexion during walking than 37 healthy controls (mean age of participants was 11.5 years). Midstance knee extension during walking was increased in the hypermobile children, but gait speed was



not significantly different between groups.<sup>9</sup> Another study found decreased lateral trunk stability during walking in hypermobile children and adults.<sup>10</sup> Research into the hypermobile type of EDS (in this case, in adults), moreover, reported significantly impaired balance and gait; 95% of them fell during the course of a year.<sup>11</sup> And British researchers have reported that, when joint hypermobility syndrome overlaps with genetic disorders such as EDS and Marfan syndrome, children report relatively high levels of neuromuscular and motor development problems.<sup>12</sup>



Further complicating the picture, however, is that hypermobility can exist by itself, absent the neurological conditions associated with hypotonia. In a study of 8-year-old schoolchildren with generalized joint hypermobility or benign joint hypermobility syndrome, but without other problems, Danish researchers reported that neither condition reduced motor competence or physical activity.<sup>13</sup> A study from the Netherlands reached a similar conclusion.<sup>14</sup>

Even though research into pediatric flexible flatfoot (PFF) is sometimes used as a proxy given the scarcity of data about hypotonia and hypermobility, the clinicians *LER* spoke with for this article generally downplayed the idea of a correlation. Depending on severity and factors such as patient and clinician preferences, most cases of PFF are treated with watchful waiting or simple orthotic strategies. And PFF is not, in any case, a neurological condition.

“The problem with Down syndrome children is that they have hypermobility associated with hypotonia, and they end up in a severely overpronated position,” explained Curt Bertram. “It’s a rotary deformity and very difficult to correct with mild treatment like a foot orthosis. Neither hypotonia nor the associated hypermobility is going to go away in kids with Down syndrome or Prader-Willi syndrome, whereas flexible flatfoot will typically resolve as the child develops and matures.”

Clinicians will continue to recognize and treat the manifestations of hypotonia and hypermobility regardless of etiology. That’s good news for patients and their parents.

CARY GRONER IS A FREELANCE WRITER IN THE SAN FRANCISCO BAY AREA.



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# The Importance of Gross Motor Skills

*Early intervention can help provide a solid foundation*

Many kids with Down syndrome, autism, and other neurological conditions may experience biomechanical limitations in the form of delayed development of gross motor skills. One of the drivers of that delay can be hypotonia.

LER spoke with a group of experts on the link between hypotonia and the development of gross motor skills. They explained why early intervention for hypotonia is worthwhile, eventually putting the child in a better position all around.

"I like to think of the body as a building and the feet as the foundation; if your foundation is stable, it is easier to build levels on your building and keep it stable," explained Clare MacFarlane, PhD, a physiotherapist at Therapies for Kids in Sydney, Australia. "If your foundation is a bit wonky or unstable, building levels, or gross motor skills, can be harder to achieve."

## Finding their stride

For a healthy child, the acquisition of gross motor skills starts at one month, and includes capabilities such as lifting the head for a few seconds while lying on the stomach and bringing a hand to the mouth while in a supine position.

Pinpointing hypotonia by assessing gross motor skills in infants can be difficult as they progress at their own rates, and some may gain the skills faster than others. In addition, the degree of hypotonia can influence when symptoms appear. In the case of mild hypotonia, the lack of gross motor skills may not be evident until the child is considerably older.

However, in an infant with more severe hypotonia, the child



*“Problems with gross motor skills can often be summed up in one word—stuck.”*

may simply struggle to gain control over the head, said MacFarlane, who, along with David Wong, DPM, runs a podiatry clinic at Therapies for Kids.

“So, depending on the child, the severity, and the age, there could be a range of gross motor skills affected,” she added.

As a general rule, a 1-year-old child should pull himself to standing while holding on to support and take a few steps, an action known as cruising. Again, while gross motor skill development will vary by individual, the ability to stand unaided and walk independently usually comes at 15 months.

It’s at the cruising stage that a child with hypotonia may start to experience problems with gross motor skills, which can often be summed up in one word—stuck, said Megan Smith, CO, director of clinical research at SureStep in South Bend, IN.

“They pull to stand on time, but then they don’t start cruising within or close to a couple of months of that,” she explained. “Eventually, they may start cruising, but then they get stuck on that; they don’t really let go [of the support]. Parents will often say, ‘They don’t seem to be getting anywhere.’ Then it becomes a bit of a waiting game to see if they progress.”

The cause of this slow progression from assisted standing to independent walking is most likely an unstable pronated base at the foot and ankle, explained Jason Henry, MSPT, LO, practice manager at Hope Orthotics in Spring, TX. A child with hypotonia will lack the ability to support themselves on one leg for that brief moment before taking a step.

Of course, many people pronate to some degree, and toddlers will pronate quite a bit given that they have a fat pad on the inner border of the foot that “hides” the arch. As a result, they tend to look a bit flat-footed until the arches develop, usually by age 6 years. But children with hypotonic muscles demonstrate excessive pronation and ligamentous laxity, Smith said.

“We have to make that distinction between normal pronation and what is excessive,” she said.

Physiological signs of excessive pronation may include the heel tilting into valgus and a medial weight shift that will cause the midfoot to collapse. The knees and hips will become misaligned because of the pronation in the feet.

Subsequently, a child with hypotonic muscles who attempts to stand or cruise is likely to present with lower limb alignment issues, poor balance, and an inability to advance to jumping, going up or down stairs, running, or kicking a ball, MacFarlane said.

Older kids may show a lack of motivation to be active or suffer from excessive fatigue after short bouts of activity. Other signs that hypotonic muscles are impacting gross motor skills include poor posture, poor lower limb biomechanics and alignment, decreased coordination, motor dyspraxia, and decreased proprioception and body awareness, MacFarlane added.

## *Treating hypotonia: The sooner the better?*

If hypotonia is making it difficult for the child to reach milestones in gross motor skills, MacFarlane said, then orthoses are in order, and are prescribed based on the child’s specific presentation.

For instance, a rigid orthotic device may reduce excessive pronation and stabilize the foot and ankle. A gait plate may be an option to reduce in-toeing or out-toeing, she said.

Specialized sensomotoric orthoses with protrusions under certain musculotendinous junctions in the foot create a push or pull effect, thus either relaxing or activating the muscle. These dynamic orthoses are prescribed for many conditions, such as cerebral palsy and toe walkers, MacFarlane explained.

“We have found a combined approach of pediatric physiotherapy and podiatry to be a hugely successful intervention collaboration for the children we treat, especially those with low tone or combined needs,” she said.

For Smith, the goal with orthotic treatment of hypotonia is to improve tone, and by extension, improve the child’s chances of gaining appropriate gross motor skills.

“[Supramalleolar orthoses] allow some normal supination and pronation, but we can put the child in a much better biomechanical position, and let the muscles be recruited properly to help with those gross motor skills,” she said.

The experts agreed that earlier is better when it comes to treating hypotonic muscles. The idea that the child may “out-grow” the excessive pronation and develop muscle tone over time isn’t a viable one, MacFarlane emphasized.

“Unfortunately there are a lot of professionals with advice to wait until seven years of age before intervention, but this simply cannot be applied to all children,” she said. “In some cases, there will be correction with time. But if I have a child coming to me at the age of five presenting with sore knees, poor coordination, delayed skills...I will definitely prescribe orthoses [along with standard physiotherapy intervention for the presenting problems].”

Henry said he also prefers early intervention for hypotonia, although usually not earlier than age 10 months to 1 year.

“It depends on the situation and presentation of the child, but we are rarely providing functional lower extremity bracing prior to early standing activity,” he said.

However, he added that they often don’t see the child at his practice until after he or she has already struggled with standing for some time, which isn’t ideal.

“Early intervention for true hypotonia can optimize a child’s ability to function with quality gait, running, and activity in general,” he said.

The point of the orthoses in this patient population is to pro-



vide dynamic stability and optimize dynamic alignment throughout activity for efficient function.

“This is much different than traditional orthotic thinking, which involves the use of rigid orthoses locked in subtalar neutral,” Henry explained. “That school of thought places alignment as the sole goal and function is left out of the picture. We do not function in constant subtalar neutral, so to ask a hypotonic child to do so doesn’t make sense.”

What does make sense? An orthotic device that gives the child with hypotonia proprioceptive feedback, working for—and

not against—they to control excessive malalignment issues dynamically, Henry said.

“A child with hypotonia should be able to pronate and supinate within reason so that appropriate motor learning can take place,” he added.

MacFarlane said that, at her clinic, there is not necessarily a “correct age,” to address low muscle tone.

“We have been known to treat on a case-by-case basis, which allows some degree of freedom with ‘minimum age,’” she said. “I have referred a twenty-two-month-old for orthotics, as he had incredibly poor foot biomechanics and foot posture due to low tone and hypermobility, which was impeding his walking skill, stability, and confidence. He was just starting to walk at this age, which is defined as delayed.”

## *Hypotonia: A piece of the puzzle*

The term “benign congenital hypotonia” applies to children with low muscle tone who have no other underlying conditions. In these cases, the hypotonia is considered mild and outcomes are generally favorable with appropriate treatment.

But in many cases, the hypotonia is linked to an overall neurologic condition, such as autism and autism spectrum disorder (ASD), Down syndrome, cerebral palsy, muscular dystrophy, and Tay-Sachs disease.

Other symptoms that can be associated with any of these disorders—sensitivity to touch, anxiety, attention-deficit/hyperactivity disorder, behavioral problems—may, in addition to low muscle tone, play a role in the delayed development of gross motor skills.

In fact, a theory gaining ground in the medical community is that helping children with hypotonia reach gross motor skills milestones can ultimately drive improvements in other areas, such as communication skills.

Megan MacDonald, PhD, an assistant professor of Movement Studies in Disability at Oregon State University in Corvallis, recently authored a study that found a link between motor skills and disease severity scores in children with autism and ASD. That study was published in the April issue of *Adapted Physical Activity Quarterly*.

For lower extremity professionals, working with these children and their hypotonia may mean having to indirectly manage their nonbiomechanical symptomology to get them to cooperate during their treatment course.

“Behavioral issues seen in clients with any symptomology is hard,” MacFarlane agreed. “Appointments can be successful or a disaster, a lot of which is dependent on not only the client-practitioner interaction, but the input of the parent as well.”

The experts agreed that engaging the parents of these kids prior to the first appointment can make a world of difference. MacDonald called parents “an amazing resource.”

“Many times, the parents have strategies in place for manag-



ing their children, such as a reward system or some other way to keep them engaged and compliant. So check in with [parents] beforehand and learn what that system is, because it's good to maintain that consistency across the care spectrum. Sometimes kids are more receptive to that," she recommended.

Building trust is particularly important for working with these patients. While healthcare professionals are no doubt pressed for time, MacFarlane and Smith suggested starting slowly.

"The child with autism may need some familiarization to the surroundings or the practitioner before they may be comfortable to be examined," MacFarlane said. "There may need to be a desensitization routine established allowing the child to become used to touch or having orthoses in their shoes."

Smith's two-appointment protocol offers the child an opportunity to get used to her and the treatment process. Another advantage is that the orthotic devices she prescribes do not require casting, only measurement.

"It cuts down on the evaluation time and the amount we have to interact with the patient in a way that's unfamiliar to them," she said. "So, if we have a child with behavioral or sensory issues, we'll go slow and just talk. I work with the parents while the child sits with a parent or in a lap so they start to see that it's a safe place to be. At that first visit, we do the evaluation and mea-

surement. They come back in for a second time for the delivery, and I've never had a child react in a negative way."

Henry suggested that biomechanical experts look to what drew them to the profession in the first place—the desire to work with, and help, people.

"I don't know that interacting with these kids is something that can be taught; rather something that probably comes naturally for someone drawn to doing this for a living," he said. "I think the short answer lies in having patience, bringing a positive approach, and being a friend to that child and his or her family."

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*"Helping children with hypotonia reach gross motor skills milestones may ultimately drive improvements in other areas, such as communication skills."*





# Orthotic Solutions for Children with Hypotonia

*New research underscores years of positive clinical results*

When it comes to orthotic management of pediatric patients with hypotonia, the medical literature is only beginning to document the effectiveness that clinicians have been reporting anecdotally for years.

“The efficacy of treating low tone with orthoses is very poorly studied, but it is the standard of care because I feel intuitively that we can help these kids, and because we’ve seen good clinical results,”

said Kathy Martin, PT, DHS, a professor and director of the Doctor of Physical Therapy program at the University of Indianapolis.

Important considerations related to orthotic management of children with hypotonia include which children need what type of device (whether an ankle-foot orthosis, a supramalleolar orthosis, or an in-shoe foot orthosis) and how early to intervene.

## *The evidence*

There is, at least, some research that examines the case for bracing. Lisa Selby-Silverstein, PT, PhD, coauthored a 2001 paper reporting that foot orthoses affected the gait of children with Down syndrome; effects included reduced heel eversion and transverse plane foot angle during gait, but also a decrease in walking speed.<sup>1</sup> And, in a small (two-subject) 2012 study, researchers found that a flexible SMO improved functional motor performance, whereas a less flexible one impeded it.<sup>2</sup>

Martin published the results of a more robust and compelling study in 2004. Seventeen children with Down syndrome (mean age 5 years, 10 months) were given flexible SMOs and tested three times over 10 weeks on a number of measures that included standing, walking, and running. She found that the devices were associated with significant improve-



ments in postural stability both at the time of fitting (week 3) and after seven weeks of wear (week 10). Martin noted that, the more challenging the task, the more time was needed to see significant improvement, but also that degree of joint laxity did not affect results.<sup>3</sup>

Martin and a couple of colleagues—Julia Looper, PT, PhD, assistant professor of physical therapy at the University of Puget Sound, in Tacoma, WA; and Shelby-Silverstein, who is associate professor of physical therapy at Neumann University in Aston, PA—have put together a proposal for a multisite clinical trial to assess treatment variables, but, even if funding becomes available, results are likely years away.

*“A flexible orthosis will allow a child to explore his or her movement range but still improve biomechanical alignment.”*

### Individual practice

As noted, clinicians have seen results in their own practices.

“When a normal child is learning to walk, their arms come out, their knees are straight, they’re moving from side to side, trying to balance,” said Curt Bertram, CO, National Orthotic Specialist for Hanger Orthopedic Group who works at Children’s Hospital of Wisconsin, in Milwaukee. “That’s normal in the prewalking child; but a child with Down syndrome may be in that phase at twenty-eight months, and the condition of their foot isn’t going to improve. So in those cases I think it’s important to

realign the foot in an SMO, to provide a more stable base of support so they can get the proprioceptive feedback they need for balance.”

Bertram said if the orthosis is flexible enough, it will allow the child to explore movement range but still return them to a more normal biomechanical alignment in the gait cycle.

“I’m in favor of treating as soon as possible because they’re already delayed,” he continued. “These kids don’t have normal biomechanics or muscle tone. We sometimes see older children with Down syndrome who haven’t been treated with orthotics, and they typically end up with very deformed, rigid, stiff foot deformities.”

The needs of individual patients with hypotonia can be complex and challenging, however.

“We work very closely with the physical therapist in making these decisions,” said Jason Henry, MSPT, LO, the practice manager at Hope Orthotics in Spring, TX. “You’re looking at age, anatomy, range of motion, strength, coordination, and functional status. I start with an SMO, then work my way up the chain. Are they able to stand independently? If not, they may need a little more support than you get with an SMO. Do they go into a great deal of recurvatum? If so, how are we going to address that?”

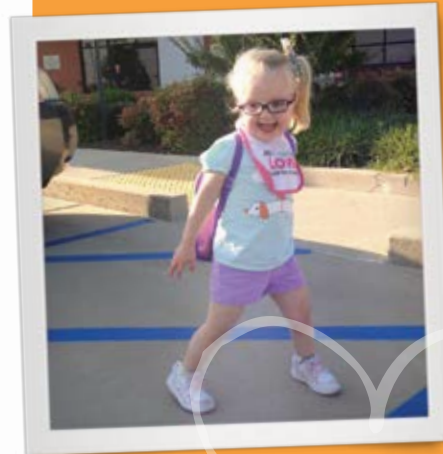
Henry prefers flexible SMOs because they allow all the important motions in the sagittal plane—plantar flexion and dorsiflexion at the ankle, forefoot extension, and the like.

“The child can pronate and supinate out of subtalar neutral, which is what you want,” he said.

He too believes in bracing earlier rather than later.

“Some people say you shouldn’t put braces on kids until they’re twenty-four to thirty months old, and I don’t agree with that,” he said. “They’re getting further behind on developmental milestones, and the body is maturing. The limbs are elongating and they’re motor learning things in improper alignment, so they’ll walk, but what’s the quality of the gait?”

## PHOTO CONTEST WINNERS



### Hannah

Hannah’s spunky personality shines through now that she is able to walk with confidence. Hannah was born with a chromosome abnormality that is associated with hypotonia. She started her journey by wearing the SureStep Indy 2 Stage AFOs when she was 14 months old. Now, at 3 years old, she is excited to walk into her classroom on her own in her SMOs!



### Tyler

Tyler certainly scores a slam dunk for creativity with this great photo. Tyler, who is almost 9 years old and has cerebral palsy, has sported eight pairs of SureStep orthotic devices since he was an infant. Each set has played a special role in helping him to improve his gait. His mother says, “I am not sure where he would be without SureStep orthotics.”

## PHOTO CONTEST WINNERS



### Rebekah

Daddy's little girl—nothing is more precious. Little Rebekah, who is almost 3 years old and has Down syndrome, took her first steps in her SureStep SMOs with daddy at her side. Rebekah's mom, a physical therapist assistant, says her SMOs have truly given her a "step up." Daddy just may have to chase after his sweet daughter as she continues to make great strides.



### Urijah

Urijah is 3 years old and loves wearing his Farm Friends SMOs with green straps! Now that he has his SMOs, his Charcot-Marie-Tooth disease doesn't seem to slow him down. He has learned to come up on his tip toes and to run, and should soon be jumping up a storm! Urijah's parents have high hopes for him and can't wait to see him jumping "high in the sky!"

## Changes

Faye McNerney, PT, DPT, a pediatric physical therapist in Troy, OH, has seen the field evolve over the course of her 36 years of practice.

"I used to lock up the foot using a rigid SMO or AFO, because I was afraid of what would happen to their foot if they kept rolling inward," she said.

A 2008 study helped quantify the deleterious effects of such approaches, she noted, though it didn't include children with hypotonia. In a British case study of a woman who had her lower leg immobilized following a foot fracture, researchers measured substantial and rapid loss in leg muscle volumes both proximal and distal to the immobilization site. Recovery remained incomplete up to two months after the cast was removed.<sup>4</sup> And, in another study by the same lead author, children immobilized due to hip osteochondritis showed increased ankle stiffness throughout the immobilization period.<sup>5</sup>

McNerney has seen the positive effects of SMOs as her own practice patterns have changed over the years.

"With the flexible braces we immediately see their feet come closer together," she said. "Over time, we don't see the flat-footed gait pattern; a heel-toe pattern develops. In my adult patients with Down syndrome who don't have these flexible SMOs available, I see a much more flat-footed gait pattern."

*"Orthotic interventions have to be carefully selected and matched to the child. Too little is a problem, but so is too much."*

## When to start

One controversy that has arisen in recent years has to do with the point in the child's development when orthotic intervention is most appropriate. In her studies of Down syndrome patients, for example, Julia Looper has argued that intervening prior to the acquisition of independent walking may interfere with the child's motor-learning skills.<sup>6-8</sup> Kathy Martin acknowledges that this may be the case but points out that it is also important to consider the larger context of cognitive and emotional development.

"We agree that once these kids have learned to walk, orthoses help them," Martin said. "Where we disagree is that Julia's research suggests we should not intervene prior to the acquisition of independent walking. My clinical experience has shown that if you put kids in an orthosis when they are interested in pulling to stand, they start walking sooner. And once they gain independent mobility, their cognitive and social-emotional development explodes. So when I look at a child with Down syndrome who already has cognitive delay, I think the earlier we get them exploring their environment independently, the better their ultimate cognitive function will be."

In her conversation with *LER*, Looper addressed this collegial disagreement by conceding the point.

"She's right," she said of Martin. "My take is that, in kids who are going to be wearing orthoses forever, it doesn't matter that much if they develop control of their ankle. They will be in the orthoses anyway, so exploring their environment and getting the cognitive development is more important."

Looper's position now is that children with milder conditions, who may need to wear orthoses for a shorter period of time, might benefit from watchful waiting.

"I think there is a gradation, and it depends on how much calcaneal eversion we're seeing, and what's going on generally with the child," she said.

Martin emphasized, however, that orthotic interventions have to be carefully selected and matched to the child. Too little is a problem, but so is too much.





"When you and I walk, we pronate and supinate around midline; that's what normal gait is," she said. "Being stuck in pronation throughout the gait cycle isn't normal, but putting a child in a rigid orthosis that holds them in midline constantly isn't normal either. That's where some of the newer SMOs come in; they are more lightweight plastic, thin and flexible and dynamic, so they can bring a child back to midline but not rigidly hold them there. They can pronate and supinate around midline as they walk, and that should be the goal."

## Early intervention

If there's a practitioner who has redefined the meaning of early intervention, it's Debbie Strobach, MA, PT, a pediatric physical therapist and splinting specialist at Mercy Children's Hospital in St. Louis, MO.

"We splint children with AFOs before they leave our neonatal intensive care unit," Strobach said.

According to Strobach, preemies born earlier than 30 weeks have a higher risk of hypotonia and muscle imbalance, and may present with significant ankle and hindfoot eversion. This, in turn, causes problems with adjoining muscles.

"We see the fibularis become more powerful than the anterior and posterior tibialis, stretching the medial structures of the foot and putting children at risk for pronation when they're getting ready to stand," she said. "I want them in good alignment so that, as they grow, their tendons and ligaments can support the ankle and foot correctly. That helps the adjoining muscles contract and work as they should, as well."

Strobach and her colleagues use customized solid ankle-foot splints similar to AFOs to counteract such forces. She has

been able to assess the effects of her interventions simply by comparing them to children who didn't receive them.

"Kids from other hospitals who weren't splinted in the NICU come to us at nine, twelve, eighteen months of age, and they may even have contractures in the fibularis muscles. We find that the babies can wear splints for maybe a month in the NICU, and then we'll follow them up as outpatients for another month or two. In the NICU, they wear the splints three hours on and three hours off, coordinated with their feeding and handling times. We find that if we splint them early, very few need splints later when they start to stand and walk independently."

Strobach and her colleagues also deal with older children with benign hypotonia, who typically get SMOs or UCBL (University of California Biomechanics Laboratory)-style splints.

"Some of those kids are still not walking by sixteen or eighteen months, so we start them as soon as we get a referral," she said. "Most of them graduate into a plantar orthosis by the time they are four to six years old, and then they're done. The key is having splints that don't inhibit the muscles so you can strengthen them and align the foot correctly throughout the day, for good muscle balance."

## Bringing research home

Such approaches, however convincing, remain more a matter of personal clinical experience than evidence-based medicine. Given the paucity of controlled trials, then, clinicians are increasingly documenting their results.

Megan Smith, CO, director of clinical research for SureStep, a maker of flexible SMOs, presented the findings of four recent case studies at the O&P World Congress in Orlando in September 2013.

"The four kids were fifteen or sixteen months old, and presented with diagnoses of developmental delay, benign hypotonia, and significant pronation," she said. "We put them in flexible SMOs and followed them for sixteen weeks, with film every other week."

When the children had mastered a skill on the Peabody developmental motor skills scale (eg, pulling to stand, cruising, taking steps, walking fast), Smith noted the child's age and compared those num-

bers with the Peabody norms.<sup>9</sup> Although the participants began their evaluations at a baseline of about five months' developmental delay, by the end of the sixteen weeks of study, that disparity had been cut to only a month (for more recent case studies, see "Orthotic success stories: Four cases in a series," pages 20-27.)

"We found that the kids who wore the SMOs had a rate of change 1.8 times greater than normal," she said. "In other words, they were acquiring gross motor skills nearly twice as fast as normal kids and catching up to their peers."

*"Given the paucity of controlled trials, clinicians are increasingly documenting their results."*

## The future

As clinicians continue to define and refine the effectiveness of their interventions, and if better funding becomes available to conduct randomized trials, ideally the kind of protocols described here will become better documented, adjusted, and, where appropriate, standardized. It will make life easier for practitioners, of course, but the ultimate beneficiaries will be children whose development has been hindered by hypotonia.

CARY GRONER IS A FREELANCE WRITER IN THE SAN FRANCISCO BAY AREA.



References are available at [lowerextremityreview.com](http://lowerextremityreview.com), or by scanning the QR or tag codes at left.

## ORTHOTIC SUCCESS STORIES: FOUR CASES IN A SERIES

# Addison

### *Case Study One*

Addie was prescribed SMOs (supramalleolar orthoses) when she was aged 18 months and presented with developmental delay, hypotonia, and pronation. Prior to receiving her SMOs, she had been pulling to stand for four months and cruising for three months. She had just begun to take some independent steps, but was still very unstable.

Addie started pulling to stand around age 14 months (five months delayed) and had mastered walking with one hand held at age 18 months (six months delayed). Prior

to receiving her SMOs, her gross motor skills rate of change (months/skills) was .61, compared to .43 for a typical child of the same age.

After receiving her SMOs, Addie gained gross motor skills much faster, at a rate of .52, compared to 1.03 for a typical child of the same age. By the end of the study, Addie was walking backward and running, and had closed the gap to be only two to three months behind her peers. She gained three months of skills in four months.

BY MEGAN SMITH, CO

**BACKGROUND:** Each child in this case series was assessed every other week for 16 weeks (12 weeks for one patient who moved out of state) to determine mastery of items 23, 26-28, 30-39, 41, 42, and 45 (ranging from “pull to stand” to “run”) on the Peabody Developmental Motor Scale. Test instructions were modified as needed for children to understand them. Parents were included in each session and encouraged to play with the child in order to demonstrate the targeted skills. Graphs illustrate age of mastery for each item number for the hypotonic child compared to a “typical” child, with linear trend lines illustrating rate of change, and demonstrate the improved mastery of skills after prescription of SMOs.



Day One - Barefoot

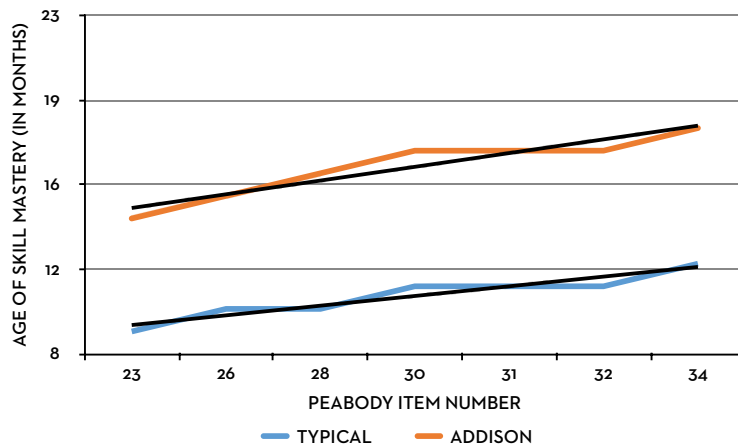


Day One - SMOs

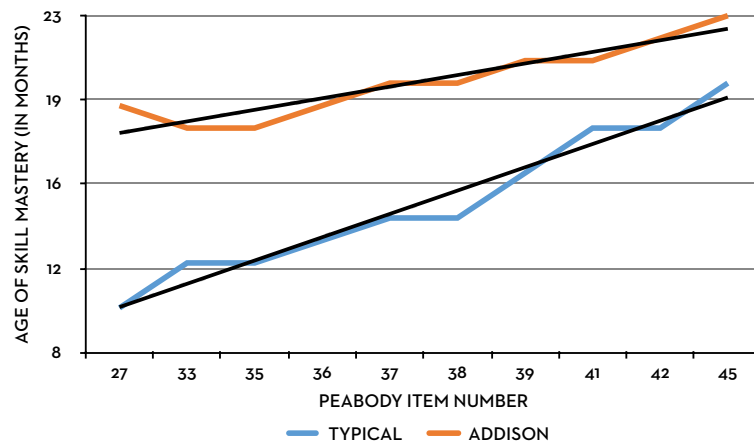


## Gross Motor Skill Mastery Over Time

Gross Motor Skill Prior to SMOs



Gross Motor Skill With SMOs



### PEABODY ITEM DEFINITIONS

- |   |   |
|---|---|
| 23 Pull to stand with support                                   | 35 Walking 5 steps with no hands held (independent)                                   |
| 26 Cruising: 4 steps  | 36 Standing, picks up toy from ground, stands up and takes 3 steps                    |
| 27 Lowering to sitting without falling                          | 37 Creeps up 2 steps  |
| 28 Takes 4 steps with trunk held                                | 38 Walks 10 feet with narrow base of support, has heel-toe gait for half the distance |
| 30 Standing: Child will let go of table and stand for 5 seconds | 39 Creeps down 3 steps backward, without support                                      |
| 31 Standing: Away from table, child will stand for 3 seconds    | 41 Walking fast   |
| 32 Stepping: 4 steps with one hand held                         | 42 Walking backward   |
| 33 Standing up from ground without turning more than 20°        | 45 Running  |
| 34 Walking 8 feet with one hand held                            |   |

Source: Folio MK, Fewell R. Peabody developmental motor scales and activity cards. Chicago: Riverside Publishing; 1983.

## ORTHOTIC SUCCESS STORIES: FOUR CASES IN A SERIES

# Sawyer

### *Case Study Two*

Sawyer was prescribed SMOs (supramalleolar orthoses) at age 18 months, when he was demonstrating pronation, hypotonia, and ligamentous laxity. He was pulling to stand and cruising but not yet standing independently. In addition to the SMOs, he received physical therapy once a week for the duration of the study.

On the day he received his SMOs, Sawyer was cruising and taking some steps with both hands held for assistance. Relative to a typical child, his developmental delay was eight months. Four months later, he was walking with a medium guard and narrow base of support. He had mastered eight to nine months of gross motor skills in four months, putting him about three to four months behind his peers. His gross motor skills rate of change (months/skills) after receiving his SMOs was .28 compared to .51 for a typical child of the same age.

BY MEGAN SMITH, CO

**BACKGROUND:** Each child in this case series was assessed every other week for 16 weeks (12 weeks for one patient who moved out of state) to determine mastery of items 23, 26-28, 30-39, 41, 42, and 45 (ranging from “pull to stand” to “run”) on the Peabody Developmental Motor Scale. Test instructions were modified as needed for children to understand them. Parents were included in each session and encouraged to play with the child in order to demonstrate the targeted skills. Graphs illustrate age of mastery for each item number for the hypotonic child compared to a “typical” child, with linear trend lines illustrating rate of change, and demonstrate the improved mastery of skills after prescription of SMOs.



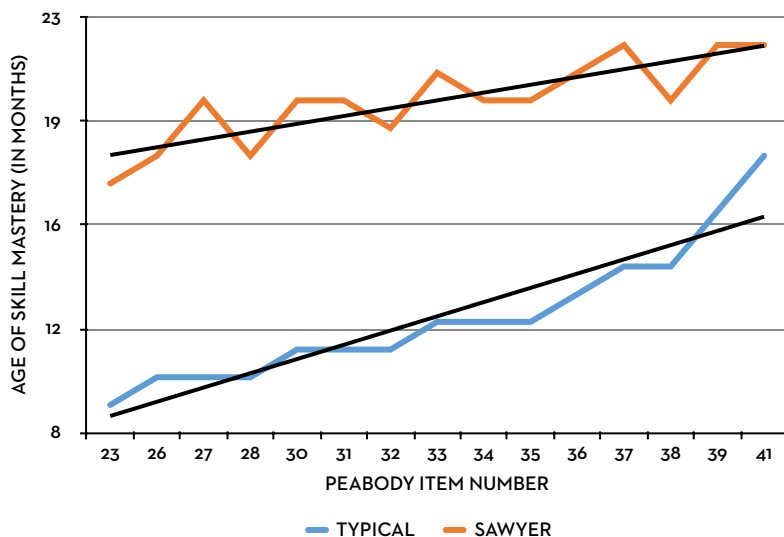
## Day One - Barefoot



## Day One - SMOs



## Gross Motor Skill Mastery Over Time



### PEABODY ITEM DEFINITIONS

- |   |   |
|---|---|
| 23 Pull to stand with support                                   | 35 Walking 5 steps with no hands held (independent)                                   |
| 26 Cruising: 4 steps  | 36 Standing, picks up toy from ground, stands up and takes 3 steps                    |
| 27 Lowering to sitting without falling                          | 37 Creeps up 2 steps  |
| 28 Takes 4 steps with trunk held                                | 38 Walks 10 feet with narrow base of support, has heel-toe gait for half the distance |
| 30 Standing: Child will let go of table and stand for 5 seconds | 39 Creeps down 3 steps backward, without support                                      |
| 31 Standing: Away from table, child will stand for 3 seconds    | 41 Walking fast   |
| 32 Stepping: 4 steps with one hand held                         | 42 Walking backward   |
| 33 Standing up from ground without turning more than 20°        | 45 Running  |
| 34 Walking 8 feet with one hand held                            |   |

Source: Folio MK, Fewell R. Peabody developmental motor scales and activity cards. Chicago: Riverside Publishing; 1983.

## ORTHOTIC SUCCESS STORIES: FOUR CASES IN A SERIES

# Jeremiah

### *Case Study Three*

Jeremiah was prescribed SMOs (supramalleolar orthoses) at age 15 months, when he was demonstrating pronation, hypotonia, and ligamentous laxity. He was pulling to stand and cruising but not yet standing independently. In addition to the SMOs, he received physical therapy once a week for the duration of the study.

On the day he received his SMOs, Jeremiah was cruising and taking some steps with both hands held for assistance. Relative to a typical child, his developmental delay was six months. Four months later, he was walking with a low guard and narrow base of support. He had mastered eight to nine months of gross motor skills in four months, putting him about one to two months behind his peers. His gross motor skills rate of change (months/skills) was .34 compared to .51 for a typical child.

BY MEGAN SMITH, CO

**BACKGROUND:** Each child in this case series was assessed every other week for 16 weeks (12 weeks for one patient who moved out of state) to determine mastery of items 23, 26-28, 30-39, 41, 42, and 45 (ranging from “pull to stand” to “run”) on the Peabody Developmental Motor Scale. Test instructions were modified as needed for children to understand them. Parents were included in each session and encouraged to play with the child in order to demonstrate the targeted skills. Graphs illustrate age of mastery for each item number for the hypotonic child compared to a “typical” child, with linear trend lines illustrating rate of change, and demonstrate the improved mastery of skills after prescription of SMOs.



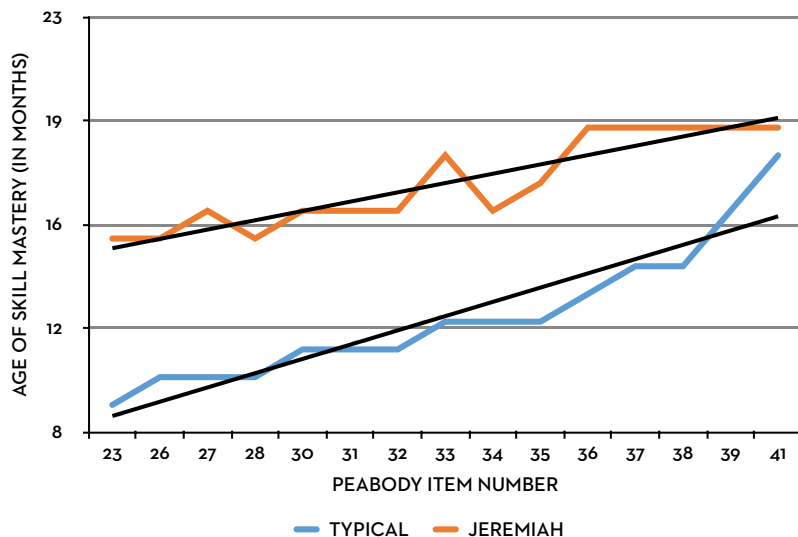
## Day One - Barefoot



## Day One - SMOs



## Gross Motor Skill Mastery Over Time



### PEABODY ITEM DEFINITIONS

- |   |   |
|---|---|
| 23 Pull to stand with support                                   | 35 Walking 5 steps with no hands held (independent)                                   |
| 26 Cruising: 4 steps  | 36 Standing, picks up toy from ground, stands up and takes 3 steps                    |
| 27 Lowering to sitting without falling                          | 37 Creeps up 2 steps  |
| 28 Takes 4 steps with trunk held                                | 38 Walks 10 feet with narrow base of support, has heel-toe gait for half the distance |
| 30 Standing: Child will let go of table and stand for 5 seconds | 39 Creeps down 3 steps backward, without support                                      |
| 31 Standing: Away from table, child will stand for 3 seconds    | 41 Walking fast   |
| 32 Stepping: 4 steps with one hand held                         | 42 Walking backward   |
| 33 Standing up from ground without turning more than 20°        | 45 Running  |
| 34 Walking 8 feet with one hand held                            |   |

Source: Folio MK, Fewell R. Peabody developmental motor scales and activity cards. Chicago: Riverside Publishing; 1983.

## ORTHOTIC SUCCESS STORIES: FOUR CASES IN A SERIES



# Kate

### *Case Study Four*

Kate was prescribed SMOs (supramalleolar orthoses) at age 18 months, when she was demonstrating pronation and hypotonia. She was pulling to stand, cruising, and taking some steps with trunk support, but not yet standing independently.

On the day she received her SMOs, her developmental delay was eight months compared to a typical child. Immediately after receiving

her SMOs, she started to stand independently and take steps with just one hand held. Three months later, she was walking with a low guard and narrow base of support. She had mastered eight months of gross motor skills in three months, ultimately putting her three months behind her peers. Her gross motor skills rate of change (months/skills) was .25 compared to .51 for a typical child of the same age.

BY MEGAN SMITH, CO

**BACKGROUND:** Each child in this case series was assessed every other week for 16 weeks (12 weeks for one patient who moved out of state) to determine mastery of items 23, 26-28, 30-39, 41, 42, and 45 (ranging from “pull to stand” to “run”) on the Peabody Developmental Motor Scale. Test instructions were modified as needed for children to understand them. Parents were included in each session and encouraged to play with the child in order to demonstrate the targeted skills. Graphs illustrate age of mastery for each item number for the hypotonic child compared to a “typical” child, with linear trend lines illustrating rate of change, and demonstrate the improved mastery of skills after prescription of SMOs.



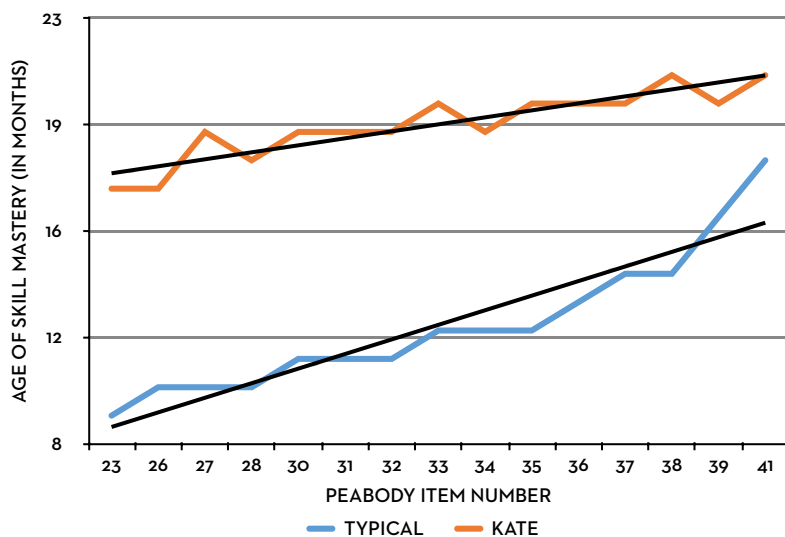
## Day One - Barefoot



## Day One - SMOs



## Gross Motor Skill Mastery Over Time



### PEABODY ITEM DEFINITIONS

- |   |   |
|---|---|
| 23 Pull to stand with support                                   | 35 Walking 5 steps with no hands held (independent)                                   |
| 26 Cruising: 4 steps  | 36 Standing, picks up toy from ground, stands up and takes 3 steps                    |
| 27 Lowering to sitting without falling                          | 37 Creeps up 2 steps  |
| 28 Takes 4 steps with trunk held                                | 38 Walks 10 feet with narrow base of support, has heel-toe gait for half the distance |
| 30 Standing: Child will let go of table and stand for 5 seconds | 39 Creeps down 3 steps backward, without support                                      |
| 31 Standing: Away from table, child will stand for 3 seconds    | 41 Walking fast   |
| 32 Stepping: 4 steps with one hand held                         | 42 Walking backward   |
| 33 Standing up from ground without turning more than 20°        | 45 Running  |
| 34 Walking 8 feet with one hand held                            |   |

Source: Folio MK, Fewell R. Peabody developmental motor scales and activity cards. Chicago: Riverside Publishing; 1983.

# SureStep<sup>SM</sup> CFab

**QUALITY FABRICATION**  
**PERSONALIZED SERVICE**  
**QUICK TURN-AROUND TIME**  
**COMPETITIVE PRICING**  
**CUSTOM TO MEASUREMENTS**

"After using SureStep for many years on my pediatric patients, it only made sense to utilize their CFab on all lower extremity orthoses. Superior quality, communication and a fast turn-around has created a positive outcome for my adult patient population."

"Simply put, SureStep has nailed it with their CFab program. My adult population has benefited greatly from the quality and craftsmanship that has always been a part of the SureStep program."

**John Brestovansky, CO, LO, LP**  
Total Care O&P

## INCREASE PROFITS WITH SURESTEP CFAB

Utilizing SureStep CFab will allow O&P professionals to manage profitability, time and costs easily and effectively. SureStep CFab can give you the edge that your practice needs to stay ahead of the competition. By using our services, not only will practitioners have access to years of knowledge and expertise, but also experience the same quick turn-around times SureStep customers are accustomed to. Ask about our prep option for even greater savings!



1

### ONLINE

This course covers the same educational content as the live InServices, but in a webinar format. Designed to last about 3 hours, this course will offer Continuing Education Units (CEUs) for both certified practitioners and physical therapists. CEUs may vary by state.

2

### ON DEMAND

Created with convenience in mind, clinicians can take this one-hour course, anytime, anyplace. Specifically-designed for O&P professionals who work with SureStep, this course includes a self-guided presentation including 25 questions that will test users on basic SureStep concepts. Course is approved for 1 CEU.

3

### IN PERSON

Certified SureStep presenters travel nationwide teaching about Hypotonia and its effects on gait to physical therapists and O&P professionals. This course is 4.5 hours long, includes dinner and has been approved for 4 CEUs.

*SureStep courses are available at no charge.*

Check out our website at [www.surestepacademy.net](http://www.surestepacademy.net) for the schedule of courses approved in your state.

## Defining Culture



“Enriching and transforming lives through compassionate care and innovation” is our company mission statement. As our focus is on the pediatric special needs population, it’s pretty easy to stay attentive to that mission. Still, we know we can only make a difference in the lives of our patients with the dedication of our employees to our mission and the culture we strive to achieve. Our culture is the “compass” that guides us.

While every organization has its own way of sharing its philosophy, we at SureStep define ourselves—our culture—in the following ways:

**Compassionate care**  
**Unparalleled service**  
**Life changing outcomes**  
**Tremendous team spirit**  
**Unrelenting drive**  
**Remarkable quality**  
**Extreme innovation**

Even though a company’s culture can be difficult to capture or define, we believe it can elicit a powerful energy in any organization. At the National Down Syndrome Congress Annual Convention in Indianapolis where I, as the founder of SureStep, was presented with the “Exceptional Meritorious Service Award,” that energy enveloped me. Since 1978, this award has honored and recognized individuals whose service and significant contributions to persons with Down syndrome and their families have had national or international significance.

The experience was humbling to say the least. It caused me to reflect on how what started as a simple idea has grown into a company filled with amazing people who have joined together to change the lives of children worldwide. It comes back to culture. Our team is made up of people with shared values, beliefs, and behaviors. This culture guides individual decisions and actions at the unconscious level. As a result, it has had a profound effect on SureStep’s well-being and success—a success that has allowed us to enrich and transform lives.

I hope that as parents and practitioners, you will join our extended family and experience the culture we have worked so hard to create.

SINCERELY,  
BERNIE VELDMAN, CO  
CEO, SURESTEP



## SureStep Products

- 30 SureStep SMO
- 32 BigShot/BigShot Lite
- 33 Indy 2 Stage
- 34 Pullover & Advanced
- 35 HEKO & HEKO PreFab
- 36 Criss Crossers & De-Rotation Straps
- 37 TLSO
- 38 Shoes/Sandals
- 39 Components



# SureStep SMO



## INDICATIONS

- Pronation
- Low muscle tone (Hypotonia)
- Developmental delay
- Delay in acquiring gross motor skills
- Poor coordination or balance

## CONTRAINDICATIONS

- High muscle tone
- Spasticity
- Tight heel cords
- Tight peroneals

## SUGGESTED CODES

- L1907x1
- L2275x2

## CUSTOM FABRICATED TO MEASUREMENTS

Casts and measurements required when #5 measurement exceeds 2 3/4"

## SureStep SMO

The SureStep SMO remains the most advanced method of controlling excessive pronation and providing stability to the hypotonic population.

Through the use of extremely thin, flexible thermoplastic, the SureStep SMO compresses the soft tissue of the foot. This compressive force stabilizes the foot and ankle complex while still allowing for the development of the intrinsic muscles, muscle strategies and movement patterns necessary to develop a normal, natural gait pattern.

The SureStep SMO has revolutionized orthotic management for children with hypotonia and has become the mandated method of treating this population in many areas of the world.

## No Casting Required

Many custom orthoses require casting which is a time-consuming, messy and often a traumatic process for smaller children. SureStep SMOs require only nine easy measurements. It's simple, it's quick, and it's effective.

## No Adjustments, No Waiting

SureStep products are available to orthotic and prosthetic facilities nationwide and in 30 countries around the world. Once we receive an SMO order from a certified O&P clinician, the product will be fabricated and shipped within 2 business days. No returning for adjustments, no more waiting for long fabrication times. That means a child can be wearing their SureStep SMOs within a week.

## Benefits of SureStep SMOs

- Improved efficiency
- Increased stability
- Enhanced alignment

### Need a clinician in your area?

Email or call us with your zip code and we'll give you a list of facilities nearest you. You can reach us at: [info@surestep.net](mailto:info@surestep.net) or 877.462.0711

Visit our site for more information  
and videos | [SureStep.net](http://SureStep.net)



## About Our Trimlines

The SureStep SMOs are carefully marked for “right” and “left” and although they may look different than other orthoses, our unique patented trimlines are an integral part of the system that enhances a child's ability to run, jump and play naturally.

The “lateral”, or outside trimline of the SureStep SMO extends further than the “medial”, or inside trimline. This is in sharp contrast to most traditional orthoses.

## Enhanced Alignment

Excessive pronation puts undue stress on the knees and hips by changing the alignment of the lower extremities, taxing the muscles of the legs greatly.

This often results in complaints of fatigue or “tired legs”. SureStep helps to stabilize the foot and ankle relieving stress and allowing the muscles to work more efficiently.

## SURESTEP PATTERNS

You know you are getting SureStep brand and quality when you see our exclusive patterns. Visit our website to choose your favorite!



## LIVE OUTSIDE THE U.S.?

SureStep products are available in many areas of the world. Our list is growing daily. To learn more about how you can obtain our products internationally, please email us your request at [info@surestep.net](mailto:info@surestep.net).

FOLLOW US





# BigShot/BigShot Lite



## INDICATIONS

- Pronation
- Hypotonia
- Triplanar instability in weight bearing
- Inability to stand independently
- Mild toe-walking

## CONTRAINDICATIONS

- High muscle tone
- Spasticity
- Severe toe-walking

## SUGGESTED CODING

- L1907
- L2280
- L2275x2

## CUSTOM FABRICATED TO MEASUREMENTS

Casts and measurements required when #5 measurement exceeds 2 3/4"



## SureStep BigShot

A growing child means eventually outgrowing the original SureStep SMO. The BigShot and BigShot Lite are the perfect solutions for older children who still need the stability of SureStep.

The SureStep BigShot incorporates all of the same features of the SureStep SMO with the addition of a soft silicone-like inner boot to ensure comfort. The flexible, plastic outer frame serves to provide the compression and stability that children exceeding 80 lbs. need, but allow all of the normal, necessary flexibility for a smooth, natural gait pattern.



## SureStep BigShot Lite

The BigShot also comes in a "lite" version for children between 50 lbs. and 90 lbs. The BigShot Lite offers a thinner inner boot, as well as a thinner, more flexible plastic than its stronger counterpart, the BigShot.

### Need a clinician in your area?

Email or call us with your zip code and we'll give you a list of facilities nearest you. You can reach us at: [info@surestep.net](mailto:info@surestep.net) or 877.462.0711



# Indy 2 Stage



## SureStep Indy 2 Stage

A uniquely designed orthosis developed to help children reach their potential. This exceptional “orthosis within an orthosis” allows for the SureStep SMO to be utilized independent of the AFO. Children can work through a variety of transitional skills without impeding normal muscle function. When used together, the SureStep SMO locks securely into the AFO transforming this truly dynamic SMO into an AFO that provides triplanar stability without restricting normal usage of intrinsic musculature of the foot. By doing this, children can continue to develop those intrinsic muscles, muscle strategies and movement patterns necessary for an improved gait pattern.

## Product Benefits

Therapists can use the SureStep Indy 2 Stage as a tool for children as they transition through their upright gross motor skill development. The Indy 2 Stage is ideal for children who require the proximal support of an AFO to achieve



independent stance, but still benefit from an SMO for proper crawling, pull-to-stand and cruising activities. It is also a great solution for children as they progress to taking independent steps with the AFO. It allows for them to continue to work on improving motor plans with the internal SureStep SMO, thus providing a smooth transition to less bracing.

## Battling Fatigue

Children with disorders that cause increased fatigue throughout the day can begin their day in only the SureStep SMO. This will serve to facilitate increased effort to maintain their functional muscle groups. As they fatigue throughout the day, the external AFO can be added to maintain a stable and functional gait pattern.

Visit our site for more information and videos | [SureStep.net](http://SureStep.net)



## INDICATIONS

- Low muscle tone (Hypotonia)
- High muscle tone (Hypertonia)
- Flexible pronation or supination
- Poor proprioceptive awareness
- Difficulty with transitional skills
- Sagittal and/or frontal plane weakness or instability

## CONTRAINDICATIONS

- Significant ankle contractures
- Severe spastic involvement

## SUGGESTED CODING

- Solid: L1960, L2280, L2275
- Hinged: L1970, L2280, L2820, L2220x2, L2250\*, L2275

\*DA Hinge only

## VARIATIONS

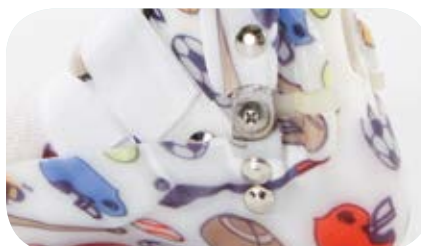
- Articulated (Standard with DA or Free Motion Hinge based on height)
- Solid ankle
- Posterior leaf spring

## CUSTOM FABRICATED TO MEASUREMENTS

Casts and measurements required when #5 measurement exceeds 2 1/2"



Dual Adjustable Hinge



Free Motion Hinge

# PullOver & Advanced



## PULLOVER

### INDICATIONS

- Pronation
- Low muscle tone (Hypotonia)
- Mild-hemiplegia
- Drop foot
- Weakened dorsiflexors
- Sagittal plane instability

### CONTRAINDICATIONS

- Significant spasticity
- Tight heel cords
- Fixed deformities of the foot
- Tight peroneals

### SUGGESTED CODING

- L1970
- L2275
- L2280
- L2210x2

### CUSTOM FABRICATED TO MEASUREMENTS

Casts and measurements required when #5 measurement exceeds 2 1/2"

## ADVANCED

### INDICATIONS

- Pronation
- Low muscle tone (Hypotonia)
- Joint hypermobility
- Delayed standing
- Inability to stand for prolonged times

### CONTRAINDICATIONS

- Strong spasticity
- Significant contractures
- Significant foot deformities

### SUGGESTED CODING

- L1960
- L2275x2

### VARIATIONS

- Full foot plate
- SureStep trimlines

### CUSTOM FABRICATED TO MEASUREMENTS

Casts and measurements required when #5 measurement exceeds 2 1/2"

## SureStep PullOver

The SureStep PullOver is an amazing tool that not only facilitates improved stability of the foot and ankle complex using a SureStep SMO, but it is also the only SMO that incorporates a true dorsiflexion assist through the use of a removable proximal strut. This allows for the use of the device as a SureStep SMO, whenever proximal support or dorsiflexion assist is not necessary.

When appropriate, the proximal strut can be attached easily and the PullOver becomes a free-motion, dorsiflexion assist AFO. The PullOver is a perfect solution for many children with mild hemiplegia, or for children with hypotonia that need just a little bit of additional help into dorsiflexion.

## SureStep Advanced

The SureStep Advanced AFO is the ideal device for pre-walkers. The SureStep Advanced incorporates the same concept of circumferential compression as the SureStep SMO. Plus, it extends to full AFO height, integrating increased sagittal plane stability to help children find their ideal standing position.

While the SureStep Advanced AFO prevents plantarflexion, simple changes to the proximal strapping configuration allows for varying degrees of dorsiflexion. The SureStep Advanced AFO is very adaptive. When children are ready for ambulation, it can be converted easily to a SureStep SMO. This unique device can be fit with either a full footplate or a modified SureStep footplate.

# HEKO & HEKO PreFab

Visit our site for more information  
and videos | [SureStep.net](http://SureStep.net)



## SureStep HEKO Custom

SureStep HEKO is the first and only pediatric hyper extension knee orthosis to incorporate a 4-axis knee hinge, for smooth, anatomically correct flexion and extension. This exceptional device provides localized control of the knee, preventing hyperextension, valgus and varus, while allowing full flexion and extension. With adjustable extension stops, the HEKO offers up to 30 degrees of adjustability. Each SureStep HEKO is custom fabricated to measurements using SureStep's CAD/CAM system, but can be fabricated from a cast impression or scan. The HEKO comes complete with 2 anti-migration/suspension sleeves.

With two hinge sizes, the SureStep HEKO is ideal for patients up to 100 lbs.

## SureStep HEKO PreFab

The HEKO PreFab incorporates all of the features of the original HEKO into a prefabricated version.

Integrating the same unique 4-axis knee hinge, this more flexible HEKO PreFab allows even more adjustability.

HEKO PreFab provides the physical therapist or O&P professional a prefabricated option that can create much greater knee stability and improve function dramatically.

Available in 4 prefabricated sizes, in either soft purple or black, HEKO PreFab is ideal for patients up to 50 lbs.

### INDICATIONS

- Knee instability
- Genu-recurvatum
- Flexible Genu-valgum or Genu-varum

### CONTRAINDICATIONS

- Fluctuating edema

### SUGGESTED CODING

- L1846 (Custom)
- L1845 (PreFab)
- L2820
- L2830
- L2750x2
- L2397 (Suspension Sleeve)

### CUSTOM HEKO FROM MEASUREMENTS

**PREFAB SIZES:**  
S, M, L, XL

**HINGES CAN BE SOLD  
SEPARATELY**



# Criss Crossers & De-Rotation Straps



## SureStep Criss Crossers

The first and only device developed to discourage w-sitting, Criss Crossers use a unique audio cue to remind children to change their position.

Available in 4 standard sizes, this innovative design can be worn under most regular clothing and will fit most infants, and small children. The small sealed battery (similar to a watch battery) and tone generator easily unplug to allow normal cleaning and care.

Criss Crossers are a simple and effective method of discouraging w-sitting without putting any other positional limitations on children.

### INDICATIONS

- Flexible internal or external femoral or tibial rotation

### CONTRAINDICATIONS

- Fixed rotational deformities

### SUGGESTED CODING

- L2999

### PEDIATRIC & ADULT SIZES AVAILABLE

### FOLLOW US



**Need a clinician in your area?**  
Email or call us with your zip code and we'll give you a list of facilities nearest you. You can reach us at: [info@surestep.net](mailto:info@surestep.net) or 877.462.0711

## SureStep De-Rotation Straps

The SureStep De-Rotation Straps offer dynamic control for mild femoral or tibial rotation. The latex-free elastic hook-and-loop strap system easily attaches to shoelaces or to lower extremity orthoses. And its low-profile design easily hides under clothing.

Available in both beige and white, the universal "pediatric" size will fit patients up to 5 ft. tall. Also available in a universal "adult" size, these devices can be custom-fitted to the patient simply and quickly.

This product gives O&P professionals and physical therapists an easy-to-use solution for flexible internal or external femoral or tibial rotation.



Visit our site for more information  
and videos | [SureStep.net](http://SureStep.net)



## SureStep TLSO

The SureStep TLSO has redefined spinal management. The soft, flexible plastic serves well to create improved upright positioning, while still allowing for slight movement in all planes.

By more evenly distributing pressure circumferentially, this unique device creates stability without rigidity, permitting the core to continue to strengthen. Custom fabricated from measurements, cast impressions or scans, the SureStep TLSO comes complete with a soft interface which is available in multiple thicknesses for improved comfort and compliance.

The SureStep TLSO is available with either an anterior or posterior opening and can be modified to accommodate G-tubes, baclophen pumps, etc. The SureStep TLSO is the ideal solution for many wheelchair bound children who have difficulty in maintaining an upright sitting position.

## Breathing Modifications

**Anterior Window:** This simple, yet effective modification facilitates anterior expansion of the ribs and abdominal areas. The anterior window requires a posterior opening and is a perfect solution for children who tend to breathe lower.

**Gill Modification:** While this modification may look small, its impact will be great. The gill modification simply allows the chest to expand laterally and enables improved breathing within the TLSO. This modification can be added to either an anterior or posterior opening TLSO, and can be added at the time of fabrication, or anytime thereafter.



Anterior Window



Gill Modification

### INDICATIONS

- Inability to control position in wheelchair
- Postural instabilities of the trunk
- Flexible kyphosis or lordosis

### CONTRAINDICATIONS

- Fixed scoliotic curvatures
- Adolescent idiopathic scoliosis
- Severe respiratory limitations

### SUGGESTED CODING

- L0482x1

### VARIATIONS

- Anterior opening
- Posterior opening
- Early Intervention (0.75mm)
- Standard (1.25mm)
- Adult (2mm)

### CUSTOM FABRICATED TO MEASUREMENTS, CASTS OR SCANS

### SURESTEP PATTERNS

You know you are getting SureStep brand and quality when you see our exclusive patterns. Visit our website to choose your favorite!

[www.surestep.net](http://www.surestep.net)



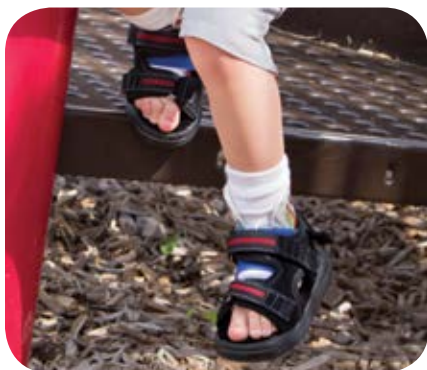


# Shoes/Sandals



## SureStep Children's Footwear

SureStep shoes have been custom designed specifically for children who wear orthoses. Their wider, deeper heel, toe box and instep allow for adequate room and a comfortable fit. The unique tread promotes intrinsic movement and flexibility while a special “cut-line” allows for easy shoe modifications.



Shoes and socks are available for purchase directly through your orthotist or online at [www.surestepshop.com](http://www.surestepshop.com)



### SHOES

- Decreased number of eyelets for easier donning and doffing
- High quality upper and solid sole with pink or blue trims
- Sole designed for custom modification
- Two removable insoles for perfect fit
- Low profile and highly functional
- **Sizes: Toddler 3 to Youth 12**



### SANDALS

- Sandals are designed with more height and longer straps to accommodate various types of orthoses
- Same flexible sole to allow intrinsic movement
- Highly functional, durable material in pink or black
- Sole designed for custom modification
- **Sizes: Toddler 3 to Youth 12**

### SURESTEP SANDAL SOCKS NOW AVAILABLE!

Show off those little toes in your SMOs! Seamless, Cool, Toeless socks; the perfect option when pairing orthotic devices with sandals!



# Components

Visit our site for more information  
and videos | [SureStep.net](http://SureStep.net)



## *SureStep HEKO Hinge*

Originally designed and developed for use in the SureStep HEKO, this unique hinge is the only 4-axis pediatric hinge available. Perfect for use in KAFOs, knee orthoses and elbow orthoses; it is lightweight and low profile. The hinge has adjustable extension stops that allow specific range of motion limitations and adjustability. Available in two sizes, the HEKO hinge will work well for patients up to 100 lbs.



## *SureStep DA Hinge*

Available in both toddler and youth sizes, the SureStep DA Hinge does what other hinges cannot. The tall proximal upright extends well into the AFO strut, facilitating corrugation of the plastic and strengthening the strut. This allows AFOs to be fabricated with much thinner, lighter weight plastics. The inverted “Y” distal stirrup connection allows for a solid, stable attachment to a molded footplate, further strengthening the AFO. Adjustments for both dorsiflexion and plantarflexion stops allow the O&P clinician to adjust for as much, or as little ROM as necessary. Dorsiflexion assist bands can be easily added at the time of fabrication or anytime thereafter. At less than  $\frac{3}{8}$ " thick, the DA Hinge is lower profile than most poly hinges.



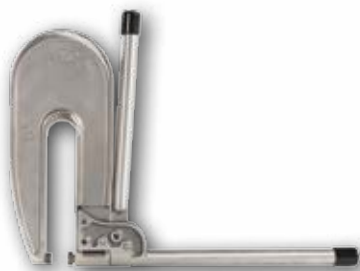
## *SureStep Free Motion Hinge*

The SureStep Free Motion Hinge is a simple yet elegant hinge that is quickly becoming the first choice by O&P clinicians across the country. Boasting the lowest profile of any hinge in its class, the SureStep Free Motion Hinge is quick and easy to use in fabrication. With no alignment rods or jigs necessary, these hinges can be visually aligned, formed and pulled within a few short minutes, saving valuable fabrication time. Fabrication technicians love this hinge for its ease of use. Practitioners love it for its low profile and cost savings. Available in 4 sizes; infant, pediatric, adult and tall.



## *SureStep Dorsiflexion Assist Band*

Simplicity strikes again. This small band can be added to most new or existing AFOs to add dorsiflexion or plantarflexion assist. The smooth even pull that it generates is perfect for both small and large AFOs. Tension can be adjusted by simply changing the attachment point, and at less than  $\frac{1}{8}$ " thick, bulk will never be an issue.



## *SureStep Rivet Press*

Say goodbye to the days of pounding rivets and replacing poorly installed speedy rivets! With the SureStep Rivet Press, you will be able to streamline the fabrication process, saving time and eliminating the need for reinstallation of rivets. There are only so many hours in a day. Why not spend less time on fabrication, and increase your productivity?



#### **KiddieGAIT™**

Sizes available to fit infants to approximately 10 years

**SureStep<sup>SM</sup>**

**Official Distributor of  
KiddieGAIT™ & KiddieROCKER™**



#### **KiddieROCKER™**

Sizes available to fit approximately 5 to 10 years

SureStep is a proud distributor of the Allard KiddieGAIT™ and KiddieRocker™. The SureStep SMO and Allard Kiddie product line have always made a great orthotic combination, so it only makes sense to offer them together. Because of our partnership, SureStep customers can easily order both product lines at one convenient time. Give us a call to discuss our competitive pricing.

Whether you order one or a dozen, we know you'll be happy with the results.