

Lower Extremity Review

# ler:PEDIATRICS

February 2016



**Mobility-enhancing care in CP helps strengthen bones**

**Keeping kids in braces can prevent clubfoot relapse**

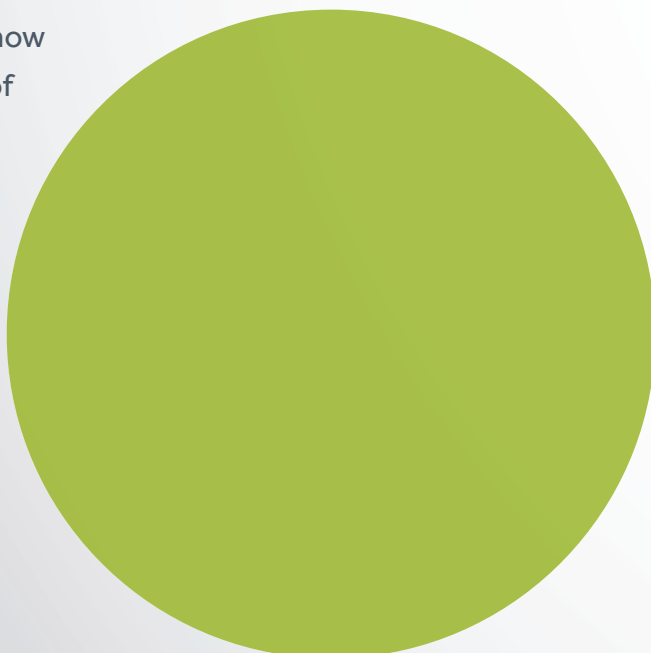
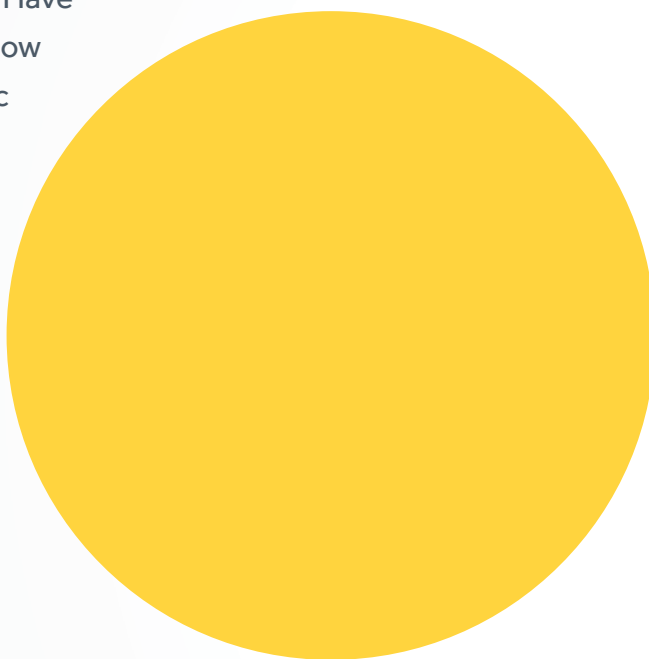
## **PLUS:**

- Trampolining and fracture risk
- Ankle instability issues in CMT
- ACL injury-prevention warm up



# Introducing a new look for the brand!

We have freshened up our look to better represent our company mission and visually communicate what our brand is all about; mobility, innovation and fun. Have no worries, we are the same company you know and trust, striving to provide effective orthotic solutions for the children we serve. Our website has been redesigned to improve user experience, acting as a resource for orthotists, physical therapists, and parents alike. The new interface is easy to navigate and allows users to quickly find the information they are seeking. For the full explanation of our new identity, check out the blog on our website and let us know what you think of the new look.





# growing with us





# allard|USA

Can you play with me?



Support for better life



kiddieGAIT™

Functional Heel-to-Toe Gait  
with stability and spring assist



kiddieROCKER®



S.W.A.S.H.®

Increased levels of function  
with sitting, standing and walking

allard|USA

[www.allardusa.com](http://www.allardusa.com)

ALLARD USA, INC.  
300 Forge Way, Suite 3  
Rockaway, NJ 07866-2056

[info@allardusa.com](mailto:info@allardusa.com)  
Toll Free 888-678-6548  
Fax 800-289-0809



Shutterstock.com #143398453

## news

### 7 Multiple jumpers increase risk for 'trampoline ankle'

*Large forces can cause severe fractures*

By P.K. Daniel

### 8 Improving foot posture, balance in CMT may aid ankle stability

*Early care advised for FAI prevention*

By Katie Bell

### 9 Dynamic warm up with balance, plyo work leads to safer landings

*Helps protect ACL in both genders*

By Chris Klingenberg

## features

### 11 Mobility-enhancing care in CP helps strengthen bones

Cerebral palsy (CP) can decrease mobility, which is key to quality living. Children with CP with compromised mobility are at risk for low bone mineral density and fragility fractures, but physical therapy programs and orthoses can help kids be more active to build stronger bones.

By Hank Black

### 15 Keeping kids in braces can prevent clubfoot relapse

More than a third of Ponseti-corrected clubfoot relapse and require additional treatment. Making a complete initial correction, ensuring optimal brace comfort, and encouraging parental buy-in to bracing over the long term reduces brace nonadherence, a major cause of recurrence.

By Barbara Boughton

## From the editor: So much depends on the ankles



Several stories in this issue of *LER: Pediatrics* emphasize the long-term consequences of ankle instability and other problems at this important joint. Compromised ankle function can cause declines in physical activity and put children at risk for obesity, weak bones, and other problems that threaten quality of life.

More than half of all ankle sprains occur in kids and young adults aged between 10 and 24 years (see "Treating and preventing ankle sprains in children," *LER: Pediatrics*, February 2015, page 9).

Lingering instability is common, as well. An Australian study, for example, found that 71% of children with a history of ankle sprain had perceived instability and as many as 47% had mechanical instability (see "Rates of chronic ankle instability in children are surprisingly high," *LER: Pediatrics*, November 2014, page 5). Appropriately treating initial ankle sprains can give typically developing children and those with neuromuscular conditions better odds of living an active lifestyle.

In pediatrics, early care for ankle injuries isn't happening enough, according to orthotist David Misener, CPO, MBA, who discusses sprain prevention in "Improving foot posture, balance in CMT may aid ankle stability," page 8.

Too often, he said, parents wait to seek care until ankle injuries become chronic. Parents need to get more timely care for their children's ankle injuries, and practitioners and coaches need to up their awareness and actively encourage intervention.

Balance exercise and bracing have been shown to help prevent sprains in adolescents. Once a sprain occurs, initial immobilization, followed by restoring range of motion and strength and addressing issues with neuromuscular control and balance, can help protect children from a lifetime of weak ankles.

Emily Delzell, *Senior Editor*



# **MAXIMIZE RESULTS** with **MINIMAL RESTRICTION**

for Treatment of all Lower Limb  
**Bowing Deformities.**

*Outstanding  
Patient  
Compliance*

Independent or Dependent  
Tibio-Femoral  
Adjustment Capabilities



Auto Aligning

**VVAS™**

Polycentric Joints



**800.837.3888**

**AnatomicalConceptsInc.com**

# Multiple jumpers increase risk for 'trampoline ankle'

## Large forces can cause severe fractures

By P.K. Daniel

Multiple trampoline jumpers are a primary cause of "trampoline ankle," according to a recent Canadian study, which also noted that, when two individuals are bouncing out of sync, they generate kinetic energy forces that produce a high-impact effect that can cause serious growth-plate injuries in children.

Researchers at the University of Ottawa retrospectively reviewed case files of skeletally immature patients who sought medical care at a tertiary hospital between 2001 and 2011 and who had a trampoline-related injury and a physeal fracture of the medial malleolus. They evaluated circumstances leading to the injury, as well as treatment outcomes and complications.

They identified 11 patients (mean age 11.8 years, seven girls) with medial malleolus Salter-Harris types III and IV fractures (MacFarland fractures) and collected information on how the injury occurred for 10. Nine of these children were bouncing on the trampoline at the same time as someone else when the injury occurred. The one jumper known to be a single user had been participating in competitive trampolining, which the authors noted likely would result in higher impact than regular recreational trampoline use.

Seven children had Salter-Harris type III fractures through the growth plate and epiphysis. Four had Salter-Harris type IV fractures through the growth plate, epiphysis, and metaphysis. Six required surgery.

"In the 'trampoline ankle,' the injury actually involves the growth plate near the ankle and that is why this is a unique type of injury in kids and not adults," said Paul Moroz, MD, a pediatric orthopedic and spine surgeon at Shriners Hospitals for Children in Honolulu, HI, who was senior author for the study while a member of the University of Ottawa faculty.

"Kids can and do break other bones in trampoline injuries, not just ankles," he said. "But, it is the pattern of ankle fractures associated with increased trampoline popularity that we started to see in Ottawa that

made us think that there was something about tramps leading to more severe ankle fractures. The multioccupant factor became obvious soon after that."

*The Journal of Pediatric Orthopaedics* published the study in November 2015.

Multiple jumping can occur on any type of trampoline—round backyard tramps with safety netting and protective padding, competition-grade rectangular equipment, and the wall-to-wall kind found at trampoline parks.

This means all types can cause injuries due to the double-bounce effect, Moroz said. "I don't think it is the type of tramp that is the issue, it is the number of people on the tramp at one time that is important," he said.

Multioccupant jumping generates kinetic energy forces, producing a high-impact effect that can cause serious growth-plate injuries.

The Ottawa researchers pointed to a 2011 study in the *Emergency Medical Journal* that addressed the force and energy transfers that occur when two individuals of different sizes use a trampoline together. Those researchers concluded that a 176-pound adult bouncing out-of-sync with a 55-pound child will dramatically increase the load absorbed by the child's lower limbs, resulting in forces equivalent to a fall onto a solid surface from a height of almost 9.25 feet.


A national database study by Indiana University (IU) researchers published last fall revealed that about 1 million people suffered trampoline injuries resulting in emergency department visits between 2002 and 2011. More than a quarter (288,876) suffered broken bones, and more than one-third (35.7%) occurred in the lower extremity.



The average age for those with fractures was 9.5 years, with nearly 93% of patients 16 years or younger.

The Iowa study did not delineate multiple jumpers, but coauthor Randall T. Loder, MD, chair of IU's Department of Orthopaedic Surgery in Indianapolis told *LER: Pediatrics*: "[In] my own anecdotal experience taking care of many of these children there is often more than one person on the trampoline, and there is the double-hit phenomenon—the child hits the trampoline when the other child is landing, doubling the force."

The Ottawa study authors said their results raise concerns about potential high-energy impacts generated by trampoline misuse.

"The kid who gets this kind of fracture is on the descent when the trampoline [bed] is ascending, so the forces on the ankle are more than anticipated [by the child], and it is this excessive force that excessively traumatizes the ankle," said Moroz. "Multiple occupants also mean any kid is more prone to being off-balance and having more force against their ankle and ankle growth plate, and that combination is what makes a more severe ankle fracture." 

#### Sources:

Blumetti F, Gauthier L, Moroz P. The 'trampoline ankle': severe medial malleolar physeal injuries in children and adolescents secondary to multioccupant use of trampolines. *J Pediatr Orthop B* 2015 Nov 19. [Epub ahead of print].

Loder R, Schultz W, Sabatino M. Fractures from trampolines: results from a national database, 2002 to 2011. *J Pediatr Orthop* 2014;34(7):683-690.

Menelaws S, Bogacz A, Drew T, Paterson B. Trampoline-related injuries in children: a preliminary biomechanical model of multiple users. *Emerg Med J* 2011;28(7):594-598.



# Improving foot posture, balance in CMT may aid ankle stability

## Early care advised for FAI prevention

By Katie Bell

Functional ankle instability (FAI) is a common problem in children and adolescents with Charcot-Marie-Tooth disease (CMT), according to Australian research that advises further study of interventions that target balance and normalize foot structure to evaluate whether they can help improve ankle stability in this population.

Lead author Kristy Rose, PhD, a lecturer in pediatrics at the University of Sydney, said, "One of the reasons we decided to do this study was because our pediatric patients with CMT report a high incidence of ankle instability that includes ankle sprain during their daily activities. We know that FAI has the potential to cause significant pain and disability, which could be a big problem for these children who already have underlying pathology resulting from their peripheral neuropathy."

The study's aim was to investigate the relationship between FAI and other functional, structural, anthropometric, and demographic characteristics in children and adolescents with CMT.

Investigators from the Institute for Neuroscience and Muscle Research at The Children's Hospital at Westmead in Sydney recruited 30 children (16 girls) with CMT aged 7 to 18 years. An assessor trained to administer the Cumberland Ankle Instability Tool asked children and their parents questions about their perceptions of ankle instability in both the left and right ankle.

Investigators collected data on foot structure using the Foot Posture Index; ankle range of motion, which they measured during a weightbearing lunge; and functional parameters, including balance, timed motor function, and falls that occurred the week before the study visit.

Of the participants, all but one (29) reported moderate to severe bilateral FAI. Girls reported greater ankle instability than boys. FAI was associated with cavus foot structure, which was evident in 13 participants, with a more severe cavus foot posture associated with greater ankle instability.

The researchers noted the majority of studies on CMT that have identified pes cavus as a common feature have been in adults and that foot structure may progress to a more cavus posture later in life, especially during musculoskeletal growth. FAI was also associated with female gender and impaired toe-to-heel balance.

The findings were published in the *Journal of Foot and Ankle Research* in November 2015.

Commenting on the link between FAI and female gender, Rose noted, "One of the reasons was perhaps girls were better reporters of FAI, were more mature than males of the same age, and had a better understanding of their bodies. The other thing could be flexibility and hypermobility. We didn't assess hypermobility, one of our

"Kids with CMT report a high incidence of ankle instability that includes ankle sprain during daily activities."

— Kristy Rose, PhD

regrets, but hypermobility is more commonly seen in females than males. Perhaps our female participants had greater joint laxity that made them more susceptible to FAI."

Discussing the treatment of FAI, Rose noted, "For our pediatric patients with CMT we work on proprioception, dynamic balance, and try to address the strength imbalance issue around the foot and ankle; people with CMT have much stronger ankle invertors and plantar flexors than they do evertors and dorsiflexors. For patients who have anatomical causes for their FAI, such as lateral ligamentous laxity, there are surgical procedures that may assist, but these are usually not done until more conservative treatments are attempted."


David Misener, CPO, MBA, who prac-



Photo courtesy of Surestep.

tices at Clinical Prosthetics and Orthotics in Albany, NY, said ankle sprains in children with CMT are not prevented adequately as the neurological condition is not often diagnosed in childhood, unless present in another family member. He noted that the child may be seen as clumsy until CMT is diagnosed in adulthood.

"I want to endorse earlier treatment," said Misener, who noted that patients usually wait until an ankle sprain becomes a chronic problem to seek medical treatment.

Misener suggested wearing functional foot orthoses and custom ankle foot orthoses daily to prevent sprains, adding that prefabricated devices can also help. He said the cavus foot type should be treated with functional foot orthoses with a lateral post to prevent recurring sprains. Rather than total contact orthoses that are often prescribed, Misener suggested placing the pes cavus foot in a pronated position by building up the lateral longitudinal arch of the orthosis. 

Katie Bell is a freelance writer based in New York City.

Source:

Rose KJ, Hiller CE, Mandarakas M, et al. Correlates of functional ankle instability in children and adolescents with Charcot-Marie-Tooth disease. *J Foot Ankle Res* 2015;5:8:61. eCollection 2015.



# Dynamic warm up with balance, plyo work leads to safer landings

## Helps protect ACL in both genders

By Chris Klingenberg

A one-time neuromuscular training intervention designed to prevent anterior cruciate ligament (ACL) injury is more effective than a traditional warm-up for improving landing technique in youth athletes, according to a study that could help convince coaches and athletes to embrace such training programs.

"While there is existing evidence in studies that have followed athletes across a whole season and seen improvements, we feel that the strength of our findings is that they can be used as support for initial buy-in from coaches and athletes," said Hayley Root, MS, ATC, a doctoral student in the Human Performance Lab at the University of Connecticut in Storrs and first author of the study. "It would be difficult to extrapolate our specific findings, as there is such a strong link between program compliance, exercise fidelity, and dosage with end-of-season results."

In the study, 89 active children (29 girls; age =  $13 \pm 2$  years, height =  $161.57 \pm 12.57$  cm, mass =  $56.14 \pm 13.46$  kg) were randomized into one of three warm-up groups. The participants were in grades five through nine and were members of a fall or winter school sports team that trained at least three days per week.

Each participant performed a vertical jump, long jump, shuttle run, and jump-landing task in a randomized order before and within 10 minutes after completing a standardized warm-up protocol. The groups were matched for participant grade, sex, and sport. All three warm-up programs were limited to 10 to 12 minutes to mimic the time allotted to a normal warm up.

The static warm-up (SWU) protocol focused on muscle lengthening for the hamstrings, quadriceps, gastrocnemius and soleus complex, hip flexors, and hip adductors. Participants jogged at a comfortable pace for five minutes and then performed five static bilateral stretches. Each stretch was maintained for approximately 30 seconds at a point of mild discomfort.

The dynamic warm-up (DWU) protocol focused on a gradual increase in warm-up intensity, as well as dynamic movements

that mimicked actual game play. It was divided into three phases along a 20-m course: dynamic stretching and agility exercises for 10 m, an acceleration run for 10 m, and a recovery jog back to the starting line.

The injury prevention program (IPP) also focused on a gradual increase in warm-up intensity with the same three-phase setup as the DWU. The DWU and IPP included similar exercises, but the IPP also incorporated balance and plyometric exercises.

The groups differed significantly in terms of their improvement from baseline on the jump-landing task; that task was as-

Research has shown that neuromuscular training reduces injury incidence in children at both the high school and middle school levels.

sessed using the Landing Error Scoring System (LESS), which is scored based on errors in landing technique associated with ACL injury risk. The IPP was associated with a greater improvement in LESS scores than the SWU or the DWU. No between-group differences in change scores were observed for the vertical jump, long jump, or shuttle run.

The findings were published in November 2015 by the *Journal of Athletic Training*.


Although female athletes in general have a higher risk of ACL injury than their male counterparts, the UConn researchers made a point of including youth athletes of both genders.

"We did run pretesting analyses between sexes and did not find any statistical differences, so we opted to combine males and females to evaluate overall warm-up group difference," Root said. "Also, due to the acute nature of this study, no differences between the two sexes were noted during



implementation. While we do agree that girls have an increased risk of ACL injury, males make up a larger overall number of ACL injuries, and we believe that these findings are important for both sexes, particularly at the youth level."

Although most research on training for ACL injury prevention thus far has involved postpubertal athletes, investigators from Cincinnati Children's Hospital Medical Center—like their UConn counterparts—have found that neuromuscular training can be effective in youth athletes as well as high schoolers. In a study presented at the 2015 meeting of the National Athletic Trainers Association, researchers randomized 474 female volleyball, basketball, and soccer players to warm-up based neuromuscular training or a sham intervention and found the experimental group had a significantly lower rate of injury over the course of a season.

"Participation in trunk- and hip-focused neuromuscular control exercises reduced injury incidence compared to a sham intervention. This positive protective effect was highly significant at both the high school and middle school level," said Kim Barber Foss, MS, ATC, an athletic trainer and research biomechanist at the center and lead investigator of the study. 

Chris Klingenberg is a freelance writer based in Massachusetts.

#### Sources:

Root H, Trojan T, Martinez J, et al. Landing technique and performance and youth athletes after a single injury-prevention program session. *J Athl Train* 2015; 50(11):1149-1157.

Barber Foss KD, Thomas SM, Khoury J, et al. Comparison of injury rates between trunk and hip focused neuromuscular training intervention group and speed training controls: a double blind randomized controlled trial. Presented at annual meeting of the National Athletic Trainers Association, St. Louis, June 2015.



# THE **SOLUTION** TO PATIENT COMFORT & COMPLIANCE, ALONG WITH **SUPERIOR REIMBURSEMENT**



Tarso Clubfoot AFO  
Mounted on the  
Dobbs Dynamic  
Quick Release Bar

**Tarso Clubfoot AFO Model # 1646** is  
available in number sizes from 0000 up to 9  
**SUGGESTED L CODE: L1930\* x 2**

**The Dobbs Dynamic Quick Release Bar with  
Dorsi-Spring Assist** is available in 2 lengths  
small 7-9" & regular 9-14".

**SUGGESTED L CODES L2300X1,  
AND L2768X2, OR L2210X2**



\*The final and sole responsibility for the correct coding, within established laws, rules, and standards of products, rests upon the party submitting the claim.

## MARKELL SHOE CO., INCORPORATED

504 Saw Mill River Road, P.O. Box 246, Main Station, Yonkers, NY 10702  
Tel: 914-963-2258 • Fax: 914-953-9293 • [markellshoe@optonline.net](mailto:markellshoe@optonline.net)  
[www.markellshoe.com](http://www.markellshoe.com)





## Mobility-enhancing care in CP helps strengthen bones

Cerebral palsy (CP) can decrease mobility, which is key to quality living. Children with CP and compromised mobility are at risk for low bone mineral density and fragility fractures, but physical therapy programs and orthoses can help kids be more active to build stronger bones.

By Hank Black

Normal childhood development of a strong skeleton, which is dense in minerals such as calcium and required for optimal mobility, depends partly on the ability to load weight through the long bones of the legs. Children who may not be able to stand independently or ambulate, including many with CP, are at risk of having low bone mineral density (LBMD) and fragile bones, comorbidities that can have long-term consequences. Inactive younger adults are at risk of increased morbidities that adversely affect the quality of their lives, and sedentary older adults are prone to earlier death.

CP is the most common pediatric physical disability and affects 3.6/1000 of children.<sup>1</sup> Their caregivers and practitioners have a number of ways to cope with LBMD, including supported standing programs and weightbearing activities, as well as lower extremity orthoses to enable those interventions. More recently, medical therapies previously used primarily in adults have become an option in the pediatric population.

Major gaps in research, however, bedevil the field, partly due to adult and pediatric funding disparities. Dino Scanio, CO, LO, of Pediatric Orthotics and Prosthetics Services of Tampa, FL, who works with many children with CP, said orthotics research is one area of concern. "It's more common that orthotic research advances are mainly in the adult arena. There needs to be equal effort in helping children with special needs. We have seen advances in the last several years, but most significantly in prosthetics, while orthotics falls behind," he said.

Parents of children with CP at risk of having LBMD eagerly await the availability of technological advances such as whole body vibration (WBV), exoskeletons, and newer orthotic materials. New research findings, however, are sometimes slow to filter down to parents.

Jennifer Lyman of New Orleans, LA, cares for her son Bower, aged 11 years, who is classified as having moderate to severe CP (levels IV to V on the five-step classification of the Gross Motor



Photo courtesy of Children's Healthcare of Atlanta.

AFO tuning and energy-storing materials used in dynamic bracing are now being introduced into pediatric practice and will help with mobility in children with CP.



The Center for Advanced Technology and Robotic Rehabilitation uses many modalities to improve mobility in kids with CP and other disorders. (Photo courtesy of Children's Healthcare of Atlanta.)

Function Classification System [GMFCS]).<sup>2</sup> Lyman said, "I help coordinate a collaborative of national cerebral palsy organizations but had never heard of whole body vibration until just last year."

## Understanding fracture risk

Bones with LBMD are prone to fracture even in the absence of discernible trauma.<sup>3</sup> Over their lifetime, children with higher levels of movement disorders such as CP show a diminishing rate of mineralization compared with that of healthy children.<sup>4</sup> Nonambulatory children and young adults with CP have close to a 20% prevalence rate for fracture, and a 4% annual fracture incidence.<sup>3</sup> Most commonly, lower extremity fractures involve the distal femur.<sup>5</sup>

Approximately 80% of patients with severe CP have LBMD,<sup>3</sup> and the overall incidence rate of fracture in that classification is between 7% and 9.7%.<sup>6</sup> Wort et al<sup>7</sup> in a 2013, nine-year epidemiological retrospective study of 536 children in Sweden, found higher functioning children (GMFCS levels I to III) had a similar incidence of fractures as children with normal development. Among children in levels IV to V (28%), however, risk of nontraumatic fracture was significantly increased in those who did not use standing devices (18%) and had stunted growth (height for age < -5 SD; 31%), which the investigators attributed largely to suspected nutritional deficiency. In addition, participants who took antiepileptic drugs (64%) had twice the risk of fracture, and children in GMFCS levels IV to V who had a gastrostomy (typically performed for dysphagia or nutritional support) also had an increased risk of nontraumatic fractures.

Typically, density of bones is measured by dual x-ray absorptiometry (DXA) and results expressed as z scores calculated from age, gender, and ethnicity-adjusted norms.<sup>2</sup> Children are diagnosed with fragile osteoporosis in the presence of LBMD (z scores < -2) together with a history of a fracture of the long bones of the legs, a vertebral compression fracture, or multiple fractures of the upper extremities.<sup>3</sup>

Conducting DXA on children with CP can be problematic due to contractures and other intrinsic problems, so scans often are not prescribed until a bone is broken. Emerging diagnostic technologies such as 3D quantitative computed tomography and, more recently, quantitative ultrasound offer additional information, but their use is limited by higher radiation exposure and lack of standardization, respectively.<sup>8</sup>

## Weightbearing programs

Pediatric supported-standing programs are in widespread clinical use. There is some evidence that such programs increase BMD but

not that they decrease fragility fractures. In a 2011 review, Fehling et al found inadequate data to support a recommendation for weightbearing activities to improve BMD or for decreasing fragility fractures in children with CP.<sup>9</sup> In a 2010 review, Hough et al<sup>10</sup> found a significant increase in BMD of the lumbar spine but not the proximal tibia for one small trial of static standing involving nonambulatory patients.<sup>11</sup> A 2010 review by Glickman et al included 10 studies of children with neuromuscular disorders including CP and reported moderately strong evidence that supported-standing programs increased BMD in the legs and spine, and also some evidence that it decreased spasticity and improved range of motion.<sup>12</sup>

In the absence of negative side effects of these activities, practitioners and caretakers have been using them for the possible BMD benefit as well as for stretching, range of motion maintenance, pressure relief, mental clarity, and because children often enjoy the activity.<sup>9,13</sup>

The optimal dose for supported standing to positively affect BMD in pediatric patients is 60 to 90 minutes per day for five days a week, according to Ginny S. Paleg, PT, DScPT, of Silver Spring, MD, who led a 2013 review on the topic. Based on evidence from 30 studies as well as the authors' opinions, the review also recommended dosing standards for hip stability (60 mins/d); range of motion for hip, knee, and ankle (45 to 60 mins/d); and spasticity (30 to 45 mins/d).<sup>13</sup>

Some studies analyzed in the review showed standing programs can be safely started as early as nine to 10 months of age, Paleg said. Lyman, the New Orleans parent, said, "There's really no way to tell why my son seems to have strong bones with no fractures to this point, but when he was 18 months old, he started using a jumper seat that hangs from a doorway and allowed him to put weight through his legs." A year later, Bower was using a gait trainer, an assistive tricycle, and other devices for weightbearing and muscle development. She also has provided him with good nutrition and vitamin D supplementation for bone health.

Paleg, a pediatric and early intervention physical therapist, said, "Interventions should be multifactorial. We find standing or exercise programs by themselves help in many ways, and should be accompanied by good nutrition, sunlight, vitamin D and calcium supplementation, and medications as needed. I am most excited about combining the emerging technology of whole body vibration with activity programs that include concepts of explorative play [that are new to the US] as developed by Swedish physical therapist Ylva Dalén some 10 years ago."

WBV training uses oscillatory motion around an equilibrium point and is used as a coadjuvant modality to improve motor function and functional performance.<sup>14</sup> It's practiced on a vibrating standing platform in a static or dynamic position.<sup>15</sup> Saquetto et al in a 2015 meta-analysis of six randomized controlled studies found WBV may improve BMD, gait speed, and standing function in children with CP, but could not make detailed recommendations due to small study size and variability in protocols and patient characteristics.<sup>14</sup>

Therapists at Children's Healthcare of Atlanta's Center for Advanced Technology and Robotic Rehabilitation have used WBV with children with CP and other disabilities since 2014 and have treated about 40 children with CP of different levels, according to physical therapist Erin Eggebrecht, PT, DPT, NCS.

"Our kids call the vibration device the 'milkshake machine,' and we're glad to have it as part of our overall program," she said. "If the children have a lot of spasticity the device helps them relax, but





Kids at the Atlanta center work on improving motor function and functional performance. (Photo courtesy of Children's Healthcare of Atlanta.)

if they are hypotonic, it allows them to stand up longer. There seem to be good immediate effects as a warm up to functional skill training such as grasp-and-release for upper extremities. For lower extremities the effect may not be as dramatic, but it is still beneficial. Our ambulatory patients have experienced gains in holding a single-leg stance immediately after WBV, as well as improved upright positioning with walking."

EGgebrecht said, "We use WBV at the start of a session for up to 15 minutes and find it increases proprioception and balance, setting the stage for following activities with greater sensory awareness. Kids might say their legs itch or feel warm, and the older ones might say they feel lighter when they get off of it. Some take a while to get used to the feeling, but ultimately most of them love the input they receive."

She expressed hope that research will provide more concrete information on the therapy's effect on BMD as well as determining how long effects continue. "This device has the potential to help low BMD, while being easy to set up and operate in a safe environment. We also hope to see our kids return and report changes outside of therapy from using WBV," she said.

## Advances in orthotics

Standing frames and weightbearing therapeutic activities should be used daily for nonambulatory children, according to Curt Bertram, CPO, who practices in Hartland, WI, and is a director of Austin, TX-based Hanger Clinic's National Residency Program. In addition to weightbearing for children with GMFCS levels I to III, mobility is important in maintaining good health. Mobility-enhancing concepts in ankle foot orthosis (AFO) alignment and materials such as silicone are entering today's pediatric orthotics practice, he said.

"AFO tuning, as it relates to lower extremity AFO alignment, is a hot topic in pediatric orthoses," Bertram said. Based on research from the UK, tuning puts the gait cycle and the ground reaction vectors in the appropriate alignment with the knee and hip so training can be focused on unrestricted parts of the body over which the patient has better control.<sup>16,17</sup>

Mark K. Taylor, MLS, CPO, of the University of Michigan Orthotics and Prosthetics Center in Ann Arbor, agreed tuning allows for better fitting of AFOs. "Proper hind- and midfoot alignment requires the appropriate degree of range of motion, and the orthotist and physical therapist working together make a great team to ensure the best fit," he said.

Taylor said weight gain is a major problem in CP as children in GMFCS level III become less active with age and stop ambulating.

"Weight is the number one challenge for independence and a big issue in mobility. Obese kids have to work so much harder to get up and be mobile," he said. Composite materials such as carbon fibers can make orthoses stronger, and better knowledge of forces that can control the rotational plane of traditional plastics help practitioners produce more effective AFOs, Taylor said.

Carbon fiber and other energy-storing materials used in dynamic bracing are now being introduced for pediatric orthoses and will help with mobility, Taylor added. "It's neat stuff, but we've got to learn how to work with it properly. We've used it in prosthetics for years because we could put it anywhere inside. In orthoses, we've had to create designs that put material on the outside of the lower extremity."

## Bisphosphonates

Bisphosphonates are used to improve LBMD by inhibiting bone resorption. They are used in adults to reduce bone loss and particularly to prevent fragility fractures in the elderly. Over the past decade, bisphosphonate use has expanded to include certain pediatric patients, including those with CP.


Numerous clinical centers are using pamidronate, zoledronate, and occasionally other drugs to reduce fracture risk in these vulnerable populations, according to Laura L. Tosi, MD, an orthopedic surgeon at Children's National Health System in Washington, DC.

Reports on bisphosphonate use in children with osteogenesis imperfecta,<sup>18</sup> Duchenne muscular dystrophy,<sup>19</sup> and CP<sup>20</sup> underscore this trend in clinical practice. An early report from a small controlled clinical trial demonstrated that pamidronate was a safe and effective agent for increasing BMD in nonambulatory children with CP.<sup>3</sup>

Perhaps most exciting, Julieanne P. Sees, DO, and colleagues at Nemour/Alfred I DuPont Hospital for Children in Wilmington, DE, in a recent retrospective review of 32 children with CP (GMFCS levels III-V), looked beyond BMD and found that pamidronate treatment was associated with a highly statistically significant reduction in fracture rate in those patients with an average follow-up of six years or longer.<sup>21</sup>

Sees said the annual rate of fracture dropped from 2.4 per year pretreatment to .10 per year post-treatment. Of the children studied, 27 were GMFCS level V patients. "We and the parents were very pleased at the results, which give them some relief from stress over the low-energy injuries that usually had no obvious mechanism of injury," she said.

Tosi is coauthor of a 2013 review of treatment with bisphosphonates for children with various disabilities.<sup>22</sup> "As there are still no clear guidelines for children, we generally limit our treatment of children with CP to those who have had two or more fractures," she said.

"Our Achilles heel is the absence of randomized controlled trials that would provide definitive guidance," Tosi said. She is excited that George et al<sup>23</sup> and Otaify et al<sup>24</sup> have provided first steps in defining standardized dosages, intervals, procedures, and anticipated adverse effects in the use of bisphosphonates among children with skeletal dysplasia. 

*Hank Black is a medical writer based in Birmingham, AL.*

References are available at [lermagazine.com](http://lermagazine.com).

# *em*bracing clubfoot around the world



**MD** orthopaedics  
*Design and Manufacture of Ponseti® Clubfoot Products*



## Product List

Preemie AFO Pair and Bar  
Ponseti® AFO Pair, sizes 0000-12  
Ponseti® AFO Pair, sizes 0000-6  
Ponseti® AFO Pair with Toe Stilt, sizes 2-11  
Ponseti® AFO/PFS Pair, sizes 00-12  
Ponseti® AFO/PFS Pair with Toe Stilt, sz 2-11  
Ponseti® Extra Short Bar  
Ponseti® Short Bar  
Ponseti® Long Bar  
Bar Hardware Kit  
Pressure Saddle, small  
Pressure Saddle, large  
AFO Socks, 3 pack  
Dorsi Ramp  
The Parent's Guide to Clubfoot  
My Clever Night-Night Shoes  
Ponseti® Clubfoot Model  
Cast Application Rubber Legs and Stands  
Five Stage Cast Model  
Tenotomy Model

*Find out more about Ponseti® Clubfoot Products  
by visiting [www.mdorthopaedics.com](http://www.mdorthopaedics.com) or calling  
toll-free 877-766-7384*



## Keeping kids in braces can prevent clubfoot relapse

More than a third of Ponseti-corrected clubfeet relapse and require additional treatment. Making a complete initial correction, ensuring optimal brace comfort, and encouraging parental buy-in to bracing over the long term reduces brace non-adherence, a major cause of recurrence.

By Barbara Boughton

Since the 1980s, treatment of idiopathic clubfoot with the Ponseti method has become increasingly popular among orthopedic specialists and surgeons due to the method's superior long-term results. The Ponseti method is minimally invasive since it relies on serial casting, Achilles tenotomy, and bracing, and patients don't suffer the postoperative and long-term consequences associated with comprehensive surgical clubfoot release.

According to recent studies, clubfoot surgeries among children younger than 6 months have declined by 6.7% per year.<sup>1</sup> This shift is primarily due to increased use of the Ponseti method, which is associated with better functional and biomechanical outcomes than more invasive surgical protocols.<sup>2</sup>

Still, studies have reported clubfoot recurrence rates as high as 40% with the Ponseti method.<sup>3</sup> Although research has shown the severity or type of clubfoot deformity can cause recurrence, many studies have highlighted that the strongest predictor of recurrence with the Ponseti method is nonadherence to bracing. In fact, nonadherence is associated with a five- to 183-times greater risk of relapse and need for surgical intervention.<sup>3,4</sup>

A number of studies have investigated the reasons for parental nonadherence to bracing. Studies have revealed that skin irritations, practical problems in applying the brace, and a child who fusses and cries with brace wear are significant barriers to use. Failure to understand the importance of bracing, forgetting or confusing instructions about brace use, and lack of continuity in medical care are also significant predictors of nonadherence. The treatment regimen is a significant—and sometimes overwhelming—challenge for parents, since it involves keeping the child in the brace for at least 23 hours at the start, with wear time gradually decreasing until the brace is worn only at night and during sleep.

Bracing also needs to be continued for three to five years, and studies have shown that by the time the child is aged 3 years, parents are often no longer able to convince them to sleep with the

Three to five years of bracing is generally recommended, but research indicates that many orthopedic surgeons believe it can be discontinued after two to three years.

Large photo courtesy of Markell.

# Pediatric Noodle AFO

## Advanced Carbon Fiber Brace



Posterior Cuff

Anterior Cuff



**Handcrafted  
in the USA**

### 30 Day Unconditional Guarantee!

If for any reason during the initial 30 day trial period the practitioner or wearer is not completely satisfied with the Pediatric Noodle AFO it may be returned for a refund.

### FUNCTION - STYLE - VALUE



**CARBON FIBER SPECIALISTS**

**800-919-3668**

**WWW.KINETICRESEARCH.COM**



Photo courtesy of Markell.

brace.<sup>3</sup> Difficulties in incorporating the brace into the family's social life, lack of a sufficient support system at home, and language and cultural barriers can also lead to nonadherence, according to recent research.<sup>3,5</sup>

"Using the brace does require careful parental compliance for the entire duration of the patient's childhood, and that can feel overwhelming," said Rachel Goldstein, MD, MPH, assistant professor of pediatric orthopedics at Children's Hospital in Los Angeles. Goldstein has studied risk factors for recurrence—as well as nonadherence—in patients with idiopathic clubfoot who undergo the Ponseti method.<sup>4</sup>

Yet, whether parental nonadherence is due entirely to these challenges is open to question, she noted.

"The question that research has not answered is whether kids stop tolerating the brace and parents stop putting it on because the feet are recurring—or is it that parental nonadherence leads to the recurrence?" Goldstein said.

Several studies have noted that brace intolerance can contribute to nonadherence. To reduce brace intolerance, review studies and clinicians interviewed by *LER: Pediatrics* emphasize the importance of obtaining a complete correction from casting and tenotomy.<sup>3</sup>

"Casting and tenotomy has to completely correct both abduction and dorsiflexion, so that the feet fit comfortably in the brace," said Peter Smith, MD, a pediatric orthopedist at Shriners' Hospital for Children and professor of orthopedic surgery at Rush University Medical Center, both in Chicago. "Not completely correcting the deformity is a common mistake that can lead to poor compliance.



Braces can only maintain the correction to prevent recurrence—they don't actually correct the clubfoot deformity."

By striving to attain 75° of abduction and 15° of dorsiflexion through casting and tenotomy, and providing careful education to parents, the Shriners' Hospital for Children has attained what Smith estimates to be a 90% compliance rate.

Review articles have highlighted the difficulties parents face while trying to use braces over an extended time.<sup>3</sup>

"It is not that easy to put a brace on a child every day. At first, during infancy, brace wear is not that problematic, because the child is sleeping most of the time," said Jose Morcuende, MD, PhD, professor in the department of orthopedic surgery and rehabilitation at the University of Iowa in Iowa City.

When the child begins walking and becomes more verbal, however, he becomes more aware of the discomfort and awkwardness of the brace, Morcuende said.

Parents can become less adherent when the child begins to walk because the foot appears to have regained normal function once the child becomes more active, said Lewis Zions, MD, a clinical professor of orthopedics at the David Geffen School of Medicine at the University of California, Los Angeles.

Parents also cannot always distinguish between discomfort and pain when a child cries, so they may take the brace off if they assume it is painful. Frequent removal of the brace over time can increase the risk of relapse; the brace becomes more difficult to apply properly, because it no longer fits the child's leg correctly. The child then experiences increased discomfort with brace wear and is more likely to become fussy or complain about wearing the brace—creating a vicious cycle that leads to recurrence, Zions said.<sup>3</sup>

Research shows there is little difference between different types of braces in terms of adherence.<sup>6</sup> However, addressing skin irritations or sores promptly by adjusting the fit of the brace, using a pressure saddle, or putting the foot in a cast if ulcers develop can improve adherence, experts say.<sup>3</sup> Redness or skin irritation around the ankle affects about 30% to 40% of patients who undergo treatment with the Ponseti method, Morcuende estimated—often because the braces are not tight enough and the foot is able to move up and down in them. Yet true sores or ulcers are uncommon, and most skin problems are unlikely after the first month if the parent is using the brace properly, he added.

"Serious skin problems [sores or ulcers] with bracing are rare, and are almost always associated with pulling the straps too tightly," said John Herzenberg, MD, head of pediatric orthopedics at Sinai Hospital in Baltimore and clinical professor of orthopedics at the University of Maryland Medical School in Baltimore. "These problems can generally be addressed successfully by educating the parents about how to properly apply the shoes of the brace," he added.

For compliance, experts say, it's crucial for physicians to engage parents with educational strategies, including detailed instructions and continued education over time about brace wear, and continue to stress to them the importance of bracing.

"The parents need to understand the mechanism of the bracing, and they have to buy in to the treatment," Morcuende said. "The doctor has to continually reinforce the concept that bracing is crucial to the child's recovery, and to tell the parent that, without bracing, the child may need to go back to casting or surgery."

Yet, it is not only parents who have an important role to play in adhering to the bracing regimen. Practitioners have to be dedicated

*Continued on page 18*

small feet



## BIG solutions

### Children's Prefabricated Functional Orthotics

By utilizing a progressive arch design system, **ARCH ANGELS** support the natural development of a child's foot. These insoles are constructed of non-toxic materials, are hand washable and are designed to last through two shoe sizes. \$12.00/pair boxed.



The **COMFORT-GAIT PLATE** helps prevent in-toe gait by reducing the tendency to walk over the lateral border and encourages correct first metatarsal-phalangeal joint propulsion in children. The rigid polydior thermoplastic design provides maximum control and it fits comfortably in most footwear. \$25.50/pair.

The **COMFORT KID** provides effective therapy for children needing control of severe pronation and ankle instability. This device features a multi-layer shell with firm medial and lateral flanges and a foam Pelite soft top cover and anti-slip silicon bottom. \$32.99/pair.



1-888-523-1600

[www.comfortfitlabs.com](http://www.comfortfitlabs.com)

[info@comfortfitlabs.com](mailto:info@comfortfitlabs.com)

Over 15 Years  
of Quality  
Craftsmanship

educators, and knowledgeable about the time commitment needed to prevent recurrence with bracing.

"The doctor has to be one-hundred percent convinced that the brace should be worn over several years," Morcuende said.

Three to five years of bracing is generally recommended, but Morcuende's research indicates that many orthopedic surgeons believe it can be discontinued after two to three years. A recent survey by Morcuende and colleagues of 321 members of the Pediatric Orthopaedic Society of North America (POSNA) indicated that 23% recommended bracing for just two years and 32.6% recommended bracing for three years. The researchers will present the survey results at the April 2016 POSNA meeting in Indianapolis, IN.<sup>7</sup> A similar survey of 323 POSNA members published in 2012 by Morcuende et al revealed that, among patients with clubfoot who underwent the Ponseti method, braces were worn for an average of 33 months.<sup>8</sup>

Morcuende told *LER: Pediatrics* that his group's recent research, based on a national database of pediatric hospitalizations, indicates the rate of surgical clubfoot correction after children are aged 1 year has risen slightly from 1997 to 2012. (This research has not yet been published or presented.) If Ponseti treatment is initiated by age 26 weeks, as recommended,<sup>3,9</sup> casting and the first three months of 23-hour bracing should be completed well before the child's first birthday.

"Doctors are doing a good job of correcting the deformity with the Ponseti method before one year of age, but after that, they are performing surgeries that are unnecessary," Morcuende said. "The increased rates of surgery after one year of age represent the failure of bracing adherence, and point out that doctors need to understand the value of bracing for a sufficient amount of time."

Experts recommend that physicians explain the importance of bracing at the initial appointment—even before casting. At each clinic visit, the doctor should emphasize the crucial role of bracing in achieving a successful outcome, and why it helps avoid recurrence and corrective surgery. Most clinicians interviewed by *LER Pediatrics* said they provide parents with verbal instructions about bracing before the parents receive the brace. The parents also practice applying a sample brace or the patient's actual brace on a large teddy bear or doll under the supervision of a nurse or medical assistant.

"Using a doll is less distracting during a twenty-minute practice session [than practicing on an actual child], because a doll will not fuss or cry," Morcuende said.

When the brace is ready, the parents will be asked to apply and take the brace off the child in the clinic and under supervision to ensure they are comfortable with it and are using correct technique, Smith said.

A review by Zions and colleagues indicated that using written instructions tailored to the parents' education level as well as explanatory videos parents can take home may help improve adherence.<sup>3</sup> Most experts recommend that printed patient educational materials be written at or below a sixth-grade reading level (see "Health literacy: The challenge of making clinical information accessible to patients," *LER*, September 2015, page 18). Studies have shown anxiety impairs memory, and lack of adherence has been linked to misunderstood or forgotten instructions.<sup>3,10</sup> So, Zions noted, physicians should urge parents to ask questions during instructional sessions.

In addition, physicians should encourage parents to call or visit the clinic if they encounter any difficulties, especially any skin irritation or brace-related pain. Zions also advises that a clinic nurse call the parents the day after they receive the brace to make sure they're not having problems. Most clinicians interviewed for this article also follow the patient with weekly clinic visits until they are sure the child is tolerating the brace.

Although patients will be seen less frequently after the initial period of adjustment—with visits typically every six months—it's vital to continue assessing adherence by querying parents about how long the brace is being worn. Doctors should also strive to continue to educate parents and discuss any difficulties, Zions said.

"It's important to address and try to resolve any problems that have arisen, especially after the

child begins to walk. After the child starts to walk, and the parents see that the foot is corrected, brace use tends to fall off, in my clinical experience," he said.

Zions and other experts also said physicians should avoid being judgmental when discussing nonadherence with parents who are failing to use the brace.

"There are barriers to compliance that are outside the control of the parents, including financial problems and transportation difficulties that affect childcare or missed appointments," Herzenberg






said. "It's worthwhile to recognize and be understanding about the difficulties the parents are facing, and work to lower any barriers. It's not helpful to be pejorative and critical—that does not encourage adherence."

Parent support groups, including web-based groups such as "nosurgery4clubfoot" on yahoo.com, allow parents to gain encouragement from and commiserate with their peers. Rachel Goldstein sometimes puts parents who are new to bracing in touch with others who are further along in the treatment process. That way, parents with less bracing experience have more realistic expectations about the treatment regimen, and can gain insight into solving practical problems, she said.

For instance, one set of parents in Goldstein's practice found their child would regularly bang the brace against the wall and crib to express frustration with its awkwardness. Other parents who had experienced the same problem were able to advise them to cover the brace with a towel to minimize damage to the brace or crib and resist the temptation to remove the brace.

"This is the kind of problem that I, as a physician, couldn't anticipate, and I probably would not hear about it in a clinic visit once a week," Goldstein said. "By connecting with other parents, who have practical solutions to the problems they encounter, it's easier for parents to comply." 

*Barbara Boughton is a freelance writer based in the San Francisco Bay Area.*

References are available at [lermagazine.com](http://lermagazine.com).

## ad index

|                            |  |
|----------------------------|--|
| <b>Allard USA</b>          | <b>4</b>   |
| 888/678-6548               | <a href="http://allardusa.com">allardusa.com</a>                         |
| <b>Anatomical Concepts</b> | <b>6</b>   |
| 800/837-3888               | <a href="http://anatomicalconceptsinc.com">anatomicalconceptsinc.com</a> |
| <b>Cascade Dafo</b>        | <b>19</b>  |
| 800/848-7332               | <a href="http://cascadedrafo.com">cascadedrafo.com</a>                   |
| <b>ComfortFit</b>          | <b>17</b>  |
| 888/523-1600               | <a href="http://comfortfitlabs.com">comfortfitlabs.com</a>               |
| <b>Kinetic Research</b>    | <b>16</b>  |
| 800/919-3668               | <a href="http://kineticresearch.com">kineticresearch.com</a>             |
| <b>M.J. Markell Shoe</b>   | <b>10</b>  |
| 914/963-2258               | <a href="http://markellshoe.com">markellshoe.com</a>                     |
| <b>MD Orthopaedics</b>     | <b>14</b>  |
| 877/766-7384               | <a href="http://mdorthopaedics.com">mdorthopaedics.com</a>               |
| <b>Protokinetics</b>       | <b>back cover</b>  |
| 800/352-2301               | <a href="http://protokinetics.com">protokinetics.com</a>                 |
| <b>SureStep</b>            | <b>2, 3</b>  |
| 877/462-0711               | <a href="http://surestep.net">surestep.net</a>                           |

# REDI-THOTICS™

*More Comfort. More Performance.*

## Try a pair on us!

### PEDIATRIC **HEAT** MOLDABLE ORTHOTICS



**RIGID ORTHOTICS**



**SEMI-FLEXIBLE ORTHOTICS**

**Phone: (877)740-3668 Fax (860)417-3592 [www.Redi-Thotics.com](http://www.Redi-Thotics.com)**

# PROTOKINETICS

Leading Innovation in Gait & Balance Measurement

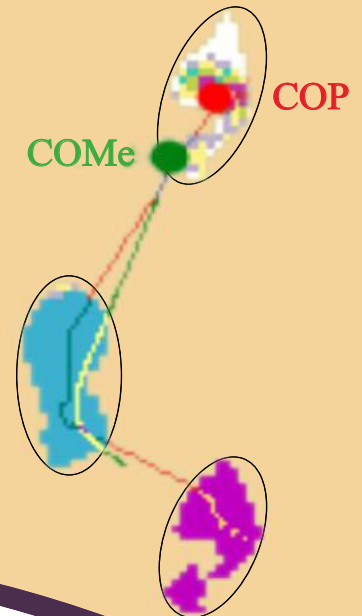
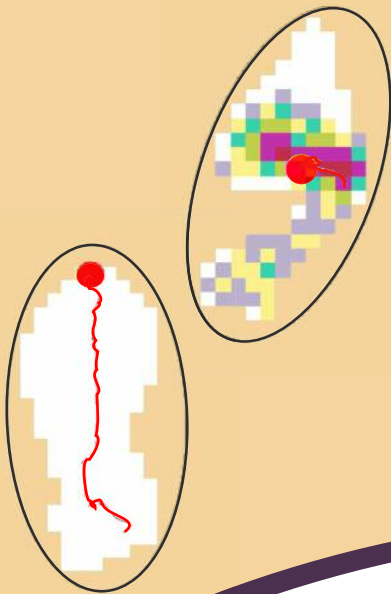
The Most Popular  
“gait mat” Technology  
In the World!



Best In Class  
Product Knowledge  
Combined with  
Amazing Customer Service

## PKMAS/Zeno

### The Gait & Balance Performance Solution



info@protokinetics.com  
610.449.4879



www.protokinetics.com  
facebook.com/protokinetics