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february 2015



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Knee pain is common in children with CP, but given the many health challenges facing this patient population, knee symptoms may not be given high priority. Proper diagnosis and treatment of knee pain, however, can be key to maximizing a child's mobility and quality of life.

By Shalmali Pal

## From the editor: Sizing up the evidence



Evidence-based medicine, defined literally, depends on the existence of studies that justify treatment decisions. But, too often, practitioners who specialize in pediatric lower extremity care find that the only evidence they have to draw on involves studies done in adults, not children.

In some cases, the same concepts seem to apply to both patient populations. Research from the University of Wisconsin in Madison, for example, suggests that balance training and prophylactic ankle bracing can be just as effective for preventing ankle sprains in high school athletes as in their adult counterparts (see "Treating and preventing ankle sprains in children," page 9).

But other examples serve as a reminder that children are not just small adults. Researchers from Cincinnati Children's Hospital have found that the Balance Error Scoring System, a popular test for identifying and monitoring postconcussion balance deficits, is not as clinically useful in children as it is in adults (see "Study questions utility of adult balance test in concussed kids," page 6).

The problem is that studies like those mentioned above are rare. That means pediatric clinicians often must decide on their own whether to base treatment for children on research done in adults. This requires practitioners to rely on their clinical experience and knowledge of key differences between adults and children with regard to such factors as anatomy, biomechanics, lifestyle priorities, and ability to follow instructions.

In the real world, evidence-based medicine isn't just about blindly following the literature. It can also be about using published studies as a starting point, and then making educated decisions about the extent to which those studies apply to your patients—no matter how old they are.

Jordana Bieze Foster, *Editor*



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# Soft tissues may help determine response to Ponseti treatment

## Analysis focuses on muscle deficits

By Erin Boutwell

Children with idiopathic clubfoot who have relapses after treatment with the Ponseti method demonstrate different soft tissue abnormalities than children whose clubfoot is permanently corrected, according to research published in the August issue of the *Journal of Bone & Joint Surgery*.

"Once we gain correction with the Ponseti method, we still have a number of kids who go on to have trouble with the deformity recurring," according to Matthew Dobbs, MD, professor of orthopedic surgery at Washington University in St. Louis, MO, and study author.

Dobbs and colleagues recruited 20 patients with clubfoot who had previously undergone treatment using the Ponseti method of serial manipulation and casting. Patients were categorized as "treatment-responsive" (no relapses) or "treatment-resistant" (relapses that did not require extensive surgery), and had completed their final casting a minimum of one year prior to the study. The soft tissue composition of both limbs was evaluated using magnetic resonance imaging (MRI). Researchers measured the total cross-sectional area of the limb, as well as the relative amounts of muscle and fat, and, in unilateral patients, compared the affected and unaffected limbs.

In the six patients with unilateral treatment-responsive clubfoot, the affected limb had a 15.3% smaller mean cross-sectional area and 26.6% less mean muscle tissue than the unaffected limb. The five unilateral patients in the treatment-resistant group demonstrated a larger between-limb difference in intracompartment adiposity index (IAI, the ratio of fat tissue to overall soft tissue) than the treatment-responsive group. The treatment-resistant limbs were also characterized by more intracompartment fat tissue than the unaffected limbs. Further, these patients exhibited an even more pronounced between-limb imbalance in muscle tissue (47.8% less muscle tissue on the affected side than the unaffected side) than the treatment-responsive patients (26.6%).

Dobbs suggested that detecting soft tissue abnormalities such as muscle weakness or absence through physical clinical

examination may permit more individualized prescriptions for children with clubfoot, in which casting and manipulation procedures could be personalized based on features of their individual presentation. Specifically, the findings of this MRI study may assist in identifying abnormalities associated with clubfoot presentations that are less responsive to the standard Ponseti method.

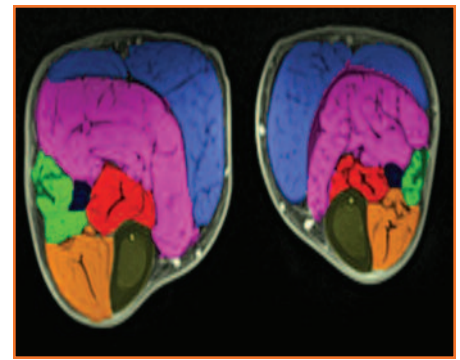
Jose Morcuende, MD, PhD, chief medical director of the Ponseti International Association, challenged the "treatment-resistant" label used within this study for cases of clubfoot that did not respond to the usual Ponseti method. Morcuende noted that, in an earlier study, co-authored by Morcuende and Dobbs and published

Detection of soft tissue abnormalities may allow for more individualized prescriptions for children with clubfeet.

in the October 2006 issue of *Clinical Orthopaedics and Related Research*, all but two of 50 "complex" idiopathic cases were successfully treated using the Ponseti method. The distinction between "resistant" and "complex," Morcuende asserted, has more to do with the skill of the practitioner than differences in soft tissue characteristics: "It's not the foot per se, but the hands of the doctors."

Still, identification of children who are less likely to be treated successfully with the standard Ponseti method could be another advantage of detecting soft tissue differences.

"Knowledge of abnormalities in certain muscle groups...may lead one to increase the time in the post-corrective brace or, more likely, recommend early anterior tibial tendon transfer," said Lewis Zions, MD, a clinical professor of orthopaedic surgery at the David Geffen School of Medicine at UCLA.



MRI images show the lower legs of a child with bilateral clubfoot. The smaller leg is the affected side, showing smaller muscles. (Image courtesy of Matthew Dobbs, MD.)


Morcuende cautioned against using the MRI findings to recommend premature surgery for children whose soft tissue composition seems to predispose them to be resistant to Ponseti treatment.

"It will take you ten casts or twelve casts, but you can get those feet corrected," he said.

A third possible benefit of knowing the soft tissue characteristics associated with clubfoot is a more reliable classification system to improve the prediction of treatment responsiveness, the need for which was mentioned by both Dobbs and Zions.

"Unfortunately, current clinical examination techniques do not accurately predict the likelihood of the response to Ponseti treatment," Zions said.

Dobbs and his fellow authors anticipate that these MRI studies of soft tissue abnormalities may be used in the future development of a new clinical classification method for clubfoot, in which functional and structural characteristics of the affected limb are assessed.

"Our ultimate goal with this MRI study is to take it back to the physical exam, and turn this into a new classification system for clubfoot that's going to be prognostic," Dobbs explained, "because it shouldn't be one global treatment for all clubfeet when all clubfeet are not alike." 

Erin Boutwell is a freelance writer based in Chicago, IL.

### Sources:

Moon DK, Gurnett CA, Aferol H, et al. Soft-tissue abnormalities associated with treatment-resistant and treatment-responsive clubfoot: Findings of MRI analysis. *J Bone Joint Surg Am* 2014;96(15):1249-1256.

Ponseti IV, Zhivkov M, Davis N, et al. Treatment of the complex idiopathic clubfoot. *Clin Orthop Relat Res* 2006;451:171-176.



# Study questions utility of adult balance test in concussed kids

## Experts call for age-specific options

By Chris Klingenberg

With head trauma becoming increasingly worrisome in sports these days, a significant concern is whether the same protocols for clearing an athlete to return to sports should be used in both adults and children. Research from Cincinnati Children's Hospital Medical Center suggests that the Balance Error Scoring System (BESS) may not be as useful for assessing postural sway after concussion in children as it is in the college athletes for whom it was originally developed.

"The BESS has a number of limitations when being applied to the pediatric population," said Catherine Quatman-Yates, DPT, PhD, an assistant professor in the Department of Pediatrics and first author of the study. "First, it was designed as a sideline test and is best when you have preinjury baseline scores to compare to a postinjury performance. These are rarely available for children. Second, the balance challenges that the BESS utilizes are not specific to postinjury changes. Age- and maturation-related factors can also significantly affect a child or adolescent's performance on the BESS, so it can be difficult to know if the errors are related to an injury or to other factors, even when baseline scores are available."

Quatman-Yates and colleagues assessed the reliability and validity of the BESS for use with children and adolescents with a recent diagnosis of mild traumatic brain injury and a cohort of age-, sex-, and activity-matched healthy peers. There were 20 children (13 boys) in each cohort; the mean age was 13.24 years. Participants from the injured cohort were assessed within 14 days of injury (mean, 7.42 days).

The researchers found significant differences between the injured and control participants for single-leg firm stance, tandem firm stance, single-leg foam stance, and total BESS score. Injury status uniquely explained 18.9% of the variance for single-leg firm stance, 20.7% of the variance for single-leg foam stance, and 19.5% of the variance for total BESS score.

Actual between-group differences for

the corresponding mean BESS scores were small, however, ranging from 1.1 (out of 10) for single-leg foam stance to 3.45 (out of 60) for total score. The differences were not great enough to fall outside the within-rater and between-rater minimal detectable change estimates of 7.3 and 9.4 points, respectively, for youth athletes. The findings were published in the September 2014 issue of *The Physician & Sportsmedicine*.

The Cincinnati researchers found that, within the injured cohort, younger children were more likely than older children to commit errors during the BESS test, which raises another potential concern specific to youth athletes: A greater potential for errors also means a greater potential for rater mistakes

Differences between concussion and control groups were statistically significant but unlikely to be clinically relevant.

in observing and recording errors correctly.

Typically in college athletes, using the BESS as part of a postconcussion assessment is more valuable when an athlete's scores can be compared with a previously performed baseline test. In youth athletes, however, that isn't always possible, Quatman-Yates said.

"A lot of times with kids the problem is there is no baseline," she said. "Another problem is that when the kids go through puberty it is harder to hold a baseline. Plus, all kids go through changes at different times."

Tamara McLeod, PhD, ATC, professor and director of the Athletic Training Program at A.T. Still University in Mesa, AZ, agreed that postconcussion assessment protocols for children should indeed be different from adult protocols.

"Yes, I think postural control is an im-



portant part of the assessment piece and should be done in all athletes," McLeod said. "We do know that postural control is usually worse in younger children as they have not fully developed their postural control systems, so getting a baseline for them is important to have an individualized healthy comparison. We have used the Balance Error Scoring System in children as young as eight years. I think balance tests need to be developed for children that are age-specific."

Researchers and clinicians are starting to explore other options for balance testing in children. Quatman-Yates said she is seeing increased use of the Force Play Test in children, in which postural control is assessed while the kids stand with two feet together and have their eyes open and closed for two minutes. And McLeod and colleagues have submitted an abstract to the upcoming 2015 annual meeting of the National Athletic Trainers Association that shows even children have good reliability in postural control when measured using Sway, an app that evaluates stability and reaction time, she said. (ler)

Chris Klingenberg is a freelance writer based in Massachusetts.

Source:

Quatman-Yates C, Hugentobler J, Ammon R, et al. The utility of the balance error scoring system for mild brain injury assessments in children and adolescents. *Phys Sportsmed* 2014;42(3):32-38.

# Shoe flexibility influences gait characteristics in early walkers

## Sole stiffness affects stance time

By Erin Boutwell

A recent study published in the winter issue of *Pediatric Physical Therapy* found that children just learning to walk may have altered gait characteristics when wearing flexible shoes.

Whether novice walkers should wear flexible or stiff shoes is not a new question, said Melanie Buckland, DPT, at the Hospital for Special Surgery in New York City and study author, but it is a frequent question fielded by pediatricians and physical therapists.

Previous studies have associated stiff shoes with the delayed development of arches in early walkers, and arch development is often the primary focus of the flexible versus stiff shoe debate. However, Buckland and her coauthors contend that shoe flexibility may also have an important influence on children's functional activities, especially walking and balance.

Buckland's study investigated the gait and stability of 25 early walkers, children aged 9 to 24 months who had been walking for less than five months. Four shoes with different torsional flexibilities (from most flexible to least: UltraFlex, MedFlex, LowFlex, and Stiff) and a barefoot condition were compared during level walking.

While walking speed and step length were not affected by shoe flexibility, stance time was significantly lower for the most flexible shoe (UltraFlex) than the LowFlex shoe. Additionally, the barefoot condition was associated with a significantly shorter stance time than any shod condition.

Buckland attributed the shorter stance time in the UltraFlex condition to improved sensory feedback, saying, "We believe they were able to feel the ground better with the more flexible shoe...and they were able to accommodate and go ahead and take another step."

Elaine Owen, MSc, superintendent physiotherapist at the Child Development Center in Bangor, North Wales, UK, proposed an alternative explanation: Reduced stance time could be a result of biomechanical effects of the footwear.

"The stiffer the material...the longer it will take for the MTPJs [metatarsophalangeal joints] to extend to the amount they need to by end of stance," Owen explained.

In addition to gait, Buckland and her coinvestigators designed an obstacle course

to assess the stability of these early walkers by counting the number of falls and stumbles. No significant differences were found among the various shoes, nor did children perform better when barefoot than when shod.

That stability was unaffected by shoe flexibility is a surprising result, as work published in 2013 by researchers at the Hospital for Special Surgery in the *Journal of the American Podiatric Medical Association* demonstrated that increasingly flexible shoes were associated with greater plantar loading in the same group of early walkers.

The authors of that paper, Buckland among them, identified plantar loading as a mechanical feedback mechanism that could improve these early walkers' proprioception. The authors also anticipated that stability might be improved in a more flexible shoe if the child was able to take advan-

Stance time during walking was significantly shorter for the most flexible shoe than the least flexible shoe.

tage of the intrinsic structures of the foot.

"The foot is made up of many small bones and joints for mobility," Buckland explained, "so the foot needs to be very mobile, flexible, able to accommodate to the ground for balance."

In the current study, stability—as evaluated through stumbles and falls—was not related to shoe flexibility. However, step width was larger in the UltraFlex shoe compared with the MidFlex and LowFlex shoes. According to the study authors, this finding is a possible indication of reduced gait stability with the most flexible shoe.

Increased step width is often associated with a reduction in stability, but other explanations are possible. Coronal plane curvature in the shoes themselves may have contributed to an unstable base in the mediolateral direction, Owen suggested.

Three of the four tested shoes were made by the same manufacturer, while the



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Stiff shoe was produced by a different company. Buckland acknowledged that factors such as heel height, position of the toe break, and insole materials—none of which were controlled in the current study—could influence how children walk in these shoes.


Owen asserted that the shoe profile is a primary consideration when considering gait biomechanics.

"You can walk very well in a stiff shoe as long as you have the right profile on the shoe," she said. "A lot of stiff shoes actually have a rounded profile."

Nonetheless, Owen affirmed that flexibility is a significant factor in shoe design.

"I feel that the footwear should be very flexible, the most important reason being to use the windlass mechanism [critical in arch development]...if stiffness is introduced, this does not occur," she said.

Similarly, Buckland emphasized the importance of continuing to explore the effects of shoe flexibility.

"With further research, we can really help these kids promote their development and their gross motor skills," she said. 

Erin Boutwell is a freelance writer based in Chicago, IL.

### Sources:

Buckland MA, Slevin CM, Hafer JF, et al. The effect of torsional shoe flexibility on gait and stability in children learning to walk. *Pediatr Phys Ther* 2014;26(4):411-417.

Hillstrom HJ, Buckland MA, Slevin CM, et al. Effect of shoe flexibility on plantar loading in children learning to walk. *J Am Podiatr Med Assoc* 2013;103(4):297-305.



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## Treating and preventing ankle sprains in children

High rates of chronic ankle instability in children suggest a need for better prevention and treatment of ankle sprains in young patients, but researchers are just starting to explore whether clinical approaches designed for adults will also be effective in their younger counterparts.

By P.K. Daniel

Study findings of surprisingly high rates of chronic ankle instability in children suggest there is a need for increased emphasis on ankle sprain prevention and rehabilitation in the pediatric population. There is some evidence that clinical strategies designed for adults can also be effective in children, but practitioners must often improvise in determining the best approaches for younger patients.

Ankle sprains and resultant chronic ankle instability are common issues among the younger population. More than half of all ankle sprains occur in individuals aged between 10 and 24 years. Teenagers and young adults have the highest rates of ankle sprain, with a peak incidence of 7.2 per 1000 person-years for those aged 15 to 19 years.<sup>1</sup>

The injury is most commonly seen in basketball, soccer, running, and ballet and other dance disciplines. Ankle injuries are the most common sports injury suffered by high school athletes, with more than 325,000 occurring each year.<sup>2-4</sup>

The only known predictor of an ankle sprain is a previous ankle sprain. It is estimated that half of people who experience an ankle sprain will have a recurrence. But, because most ankle sprains appear to resolve in two to six weeks, many patients do not seek follow-up care. A more aggressive approach to follow-up care is indicated, according to a 2012 article published in *American Family Physician*.<sup>5</sup>

"One of the highest risk factors [for an ankle sprain] is indeed previous history of sprain," said Thomas W. Kaminski, PhD, ATC, director of athletic training education and professor in the Department of Kinesiology and Applied Physiology at the University of Delaware in Newark.

With the utilization of preventive tools and rehabilitative methods, this problem could be better managed, in children in particular, researchers said.

"Kids are not often rehabilitated like adults, not because we don't know what to do, but because they are not brought to the attention of a medical practitioner or clinician," said Australian

A recent study revealed a need for further research regarding chronic ankle instability in children to help practitioners understand that there is a problem.



Photo courtesy of Pro-Tec Athletics.

researcher Claire Hiller, PhD, who coauthored a study on chronic ankle instability in children in the *Journal of Foot and Ankle Research*.<sup>6</sup>

"Older children who partake of organized sports may attend clubs or schools with an athletic trainer, but in other parts of the world it is usually only people who are aware of rehabilitation and have money who will take kids to be treated."

## The numbers

In the study<sup>6</sup> coauthored by Hiller, a postdoctoral fellow at University of Sydney's Arthritis and Musculoskeletal Research Group, 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).

The ankle sprain is the most common athletic injury in the US, accounting for an estimated 2 million injuries per year and an estimated \$4 billion in medical costs.<sup>7</sup> And yet, ankle sprains are one of the most undertreated injuries. About half of adults do not seek initial treatment for ankle injuries.<sup>8</sup>

Practitioners suspect the number is even higher among children. Untreated, ankle sprains can result in chronic pain, muscular weakness, and instability. In fact, 30% of first-time sufferers develop chronic ankle instability (CAI).<sup>9</sup>

"It is still widely assumed by many that ankle sprains are a minor injury which will heal and don't have long-term implications," said Elizabeth Jean Nightingale, BAppSc(Physiotherapy), PhD, University of Sydney research fellow with the Arthritis and Musculoskeletal Research Group in Australia.

Of those who do receive initial treatment, few are referred to a

certified athletic trainer or a physical therapist for rehabilitation, noted Phillip Gribble, PhD, ATC, an associate professor in athletic training at the University of Kentucky in Lexington.

"That means treatment for children falls on parents who likely don't have adequate information to make good decisions on how to proceed with care for their child," Gribble said.

Those who have CAI ultimately become less active because of pain, weakness, recurring sprains and episodes of "giving way." CAI is also a known factor in development of post-traumatic ankle osteoarthritis, for which there are no effective conservative treatments.<sup>10</sup>

## Lack of awareness

Lack of treatment, improper initial management, and failure to rehabilitate contribute to the risk of chronic ankle injury. Tricia Turner, PhD, ATC, associate professor in the Department of Kinesiology at the University of North Carolina at Charlotte, pointed to a lack of awareness among some practitioners as a factor contributing to potentially preventable cases of CAI. Part of the preventive process has to include the medical community, she said.

"My opinion is that most primary care or general medical physicians do not think an ankle sprain is a significant injury or that there is a need for proper rehabilitation to prevent long-term pathology [in children]," Turner said.

She attributed part of the problem to the limited numbers of studies involving children. Turner praised the study by Australian researchers but noted that it also revealed the need for further research regarding children to help practitioners understand that there is a problem.

Kaminski acknowledged practitioners are generally unaware that children are at risk for CAI.

"For the majority of us, it's probably an afterthought," he said. "Maybe we need to look at these kids when they're younger and make sure that the initial ankle sprain is treated with the utmost care, and that we don't push it and don't get them back into competition too soon and have the risk of reinjury."

Gribble surmises that awareness is low among the youth population because awareness is low among the adult population. He also cites a lack of access to care.

"This is probably an important cog in the problem," he said. "Access to allied health care professionals, especially certified athletic trainers, is limited for the adolescent population in many locations."

However, recent National Athletic Trainers Association (NATA) figures suggest this is improving. There are more than 43,000 certified athletic trainers nationally, according to the website of the Board of Certification for the Athletic Trainer. As recently as 2009, NATA estimated that only about 40% of high schools had access to a full- or part-time athletic trainer.<sup>11</sup> But, as of 2014, approximately 55% of public high school athletes nationwide had access to a full-time certified trainer, according to the NATA website. College and professional sports groups regularly use athletic trainers.

## Treatment strategies

The reported levels of ankle instability in children suggest that a majority are not seeking treatment for ankle sprains, Turner said.

"Ideally, treatment would focus initially on allowing tissue healing to occur [crutch use, bracing] and then functional rehabilitation programs would focus on strengthening the ankle and doing bal-





Photo courtesy of Topical Gear.

ance exercises,” she said. “I do not think this is practiced with the majority of children who suffer from an ankle sprain. At best they may do the acute management [ice, brace], but few go through a functional rehabilitation program [motion, strength, balance exercises].”

In the 1970s, sports medicine specialist Gabe Mirkin, MD, introduced the commonly used practice of RICE (rest, ice, compression, and elevation) for treating acute ankle sprains. However, he has reversed course, asserting on his website, (DrMirkin.com) that lengthy icing of an injury inhibits healing by reducing inflammation (drmirk.com/fitness/why-ice-delays-recovery). He cites a review summary of 22 scientific articles that found almost no evidence that ice and compression hastened healing over the use of compression alone. However, the review said ice plus exercise may provide marginal help in healing ankle sprains.<sup>12</sup>

Limited icing immediately following an injury is acceptable, said

*Continued on page 12*

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orthopedic surgeon Howard J. Luks, MD. Luks, who is associate professor of orthopedic surgery at New York Medical College and chief of sports medicine and arthroscopy at Westchester Medical Center in New York, recommends icing in short bursts.

"Ice for five minutes at a time and then leave it off for at least thirty minutes to allow the blood flow to return to the area," Luks said. "After a few hours, the ice will no longer be effective in managing the swelling and should be avoided."

The American Orthopaedic Foot and Ankle Society (AOFAS), as reported on its website (aofas.org), recommends that once the pain and swelling subsides, which is typically within five to seven days, stretching exercises should be performed. According to AOFAS, the first objective is to restore ankle range of motion, followed by ankle strengthening. Working toward comfort and stability, or proprioception, is the final stage.

Established evidence<sup>13</sup> has shown that balance training exercises, taping, and prophylactic bracing can minimize the risk of future instability in adults, and a few studies conducted in adolescents suggest that similar strategies can also be effective in pediatric populations.

"If we look at the successful interventions from the literature on CAI in adults, perhaps protocols addressing deficits in neuromuscular control and balance, as well as potential restrictions in range of motion and arthrokinematics that have exhibited success in adult

populations may prove useful for the prepubescent populations," Gribble said.

Nightingale concurred.

"The treatment of primary ankle sprains is practitioner-dependent, but rehabilitation in children is as for adult sprains—with balance as a part of regular practice, and strapping tape or braces may be used," she said.

In adults, one of the best methods to improve function in patients with chronic ankle instability is through a balance training program, Turner said. Most of these balance training protocols are four to six weeks in duration. They incorporate both static balance (balancing on one leg), as well as dynamic balance (standing on one leg while reaching or performing sport-specific skills). Studies<sup>14,15</sup> have demonstrated the usefulness of gaming programs (eg, Wii Fit balance platform) for balance training in adult populations, and the same technology could potentially be used in children.

## Evidence in adolescents

Tim McGuine, PhD, ATC, a senior scientist in the Department of Orthopedics and Rehabilitation at the University of Wisconsin in Madison, coauthored a 2006 study in the *American Journal of Sports Medicine (AJSM)* on balance training in high school basketball players. There was a significantly lower rate of ankle sprains among 765 high school soccer and basketball players who participated in a balance training program than in a control group that performed standard condition-



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ing exercises. In athletes with a history of ankle sprain, the risk of a recurrent sprain was cut in half in those who participated in the intervention.<sup>16</sup>

Athletes in the intervention group participated in preventive exercises for 10 minutes per day, three times per week during the season. The balance training program included five phases: (1) maintaining a single-leg stance on a flat surface with eyes open and closed; (2) performing functional sport activities such as throwing, catching, and dribbling on one leg; (3) maintaining a double-leg stance while rotating the balance board; (4) maintaining a single-leg stance on the balance board with eyes open and closed; and (5) performing functional sport activities while in single-leg stance on the board.

A 2011 AJSM study by McGuine and colleagues on high school basketball players and lace-up ankle braces also had positive results.<sup>17</sup> The researchers found that there were 68% fewer ankle injuries in those who wore them versus those who did not. Gender differences had no bearing on the results, nor did having a previous history of ankle injury. The rate of acute ankle injury (per 1000 exposures) was .47 in the braced group and 1.41 in the control group of unbraced athletes. While braces were associated with a lower incidence of ankle injuries, bracing did not have an effect on injury severity, the study authors concluded.<sup>17</sup>

"We know now that bracing's effective, these exercise programs are effective," McGuine told *LER*.

Kaminski questioned whether the way children's ankle injuries have been treated has been less conservative than necessary.


"Maybe we need to think in the reverse manner," he said. "Maybe we need to be extremely cautious and extremely conservative with these young children who do suffer ankle sprains to prevent them from having recurrent instability."

Kaminski said children should be immobilized initially and their

return to activity slow and gradual. He recommended using balance training in prevention of ankle sprains, particularly in those who have had previous sprains. Kaminski also pointed to the need for preventive care and the strong evidence that prophylactic bracing, taping, and balance training can help reduce first-time ankle sprains.

Taking a conservative approach to returning to play seems to be gaining popularity among adults, as well. Minnesota Timberwolves point guard Ricky Rubio went down with a severely sprained left ankle on November 7, 2014. Rubio remained sidelined until February 2, frustrating T-Wolves fans. But Rubio's recovery process was delayed—perceived instability in his ankle or not—because of muscle and ligament damage. Minnesota coach Flip Saunders said two medical specialists who consulted with Rubio advised that returning too soon could increase the risk of a stress fracture.

But practitioners need to remember that children are not just small versions of adults, and some aspects of ankle instability prevention may need to be managed differently for a younger population, Hiller said.

"We can certainly apply what we know about treating CAI in adults to kids, but often need to modify the regime to be age appropriate," she said. "For example, exercises are often repetitive and adults can be assisted in compliance by logic and reason. Kids need to be given greater variety in shorter bursts. Some practitioners do not recognize this and rehabilitation may not be as successful." 



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## Cerebral palsy and knee pain: management tips

Knee pain is common in children with CP, but given the many health challenges facing this patient population, knee symptoms may not be given high priority. Proper diagnosis and treatment of knee pain, however, can be key to maximizing a child's mobility and quality of life.

By Shalmali Pal

Knee pain affects one in five ambulatory children with cerebral palsy (CP).<sup>1</sup> But these patients have a range of health concerns—behavioral, cognitive, psychological, emotional, and biomechanical—and all require different levels of management. That's why practitioners may not be aware of knee pain in children with CP unless they go looking for it.

"Clinicians are usually focusing on the bigger issues, so knee pain kind of falls down their checklist," explained Frances Gavelli, PhD, lab chief of the National Institute of Biomedical Imaging and Bioengineering at the National Institutes of Health (NIH) in Bethesda, MD. "The child may not even mention it because what's a little knee pain when they have more complex issues to deal with?"

Katharine Alter, MD, medical director of the NIH's Gait Lab, agreed that if clinicians don't ask about knee pain in this population, they won't hear about it.

"A lot of practitioners don't ask children with CP specifically about musculoskeletal pain, especially if they are under the age of twelve," Alter said. "Of course, part of the problem is communication—how accurately can a three-year-old answer the question, 'Are you having knee pain?'"

And yet, a recent study from the Children's Orthopaedic Center in Los Angeles found a 21% prevalence of knee pain in ambulatory kids with CP. Susan Rethlefsen, PT, DPT, and colleagues retrospectively reviewed the records of 121 children with CP. Rethlefsen is the lead physical therapist (PT) at the center's John C. Wilson Motion Analysis Lab.

The authors noted the following:

- The likelihood of knee pain was almost five times higher in girls than boys.
- The likelihood of knee pain increased with age by about 13% per year.
- The presence of malignant malalignment syndrome showed an association with knee pain severity, which trended toward statistical significance.

Regardless of a child's level of ambulation, experts say, his or her knee pain needs to be evaluated and managed to keep the patient as mobile as possible.



A patient at Gillette Children's Specialty Healthcare undergoes gait and motion analysis, which is also used to assess gait in children with cerebral palsy and knee pain. (Photo courtesy of the James R. Gage Center for Gait and Motion at Gillette Children's Specialty Healthcare in St. Paul, MN.)

- The prevalence of knee pain was equal for Gross Motor Functional Classification System (GMFCS) levels I to III.

Finally, the group found that the eight children who walked with the greatest stance knee flexion (GMFCS level IV) did not report knee pain. The finding may seem counterintuitive because a more severe crouch is generally associated with patellofemoral pain (PFP). But the result did not come as a surprise to the authors.

In a joint email to *LER*, Rethlefsen, along with coauthor Robert Kay, MD, vice chief of the center, explained that the patients who

walked with the greatest amount of knee flexion also walked the least.

"So it makes sense that they put less stress on their patellofemoral joint structures than their more ambulatory peers, and did not experience knee pain," they wrote.

But that doesn't mean clinicians can skip asking about knee pain in patients who are mainly sedentary, Rethlefsen and Kay pointed out.

"It is important that practitioners ask about leg and knee pain in children with CP," they told *LER*. "Sometimes, the pain will be worsened by specific activities and/or positions, such as going up and down stairs, squatting, or sitting for prolonged times with flexed knees."

Alter agreed that nonambulatory or less ambulatory patients can experience PFP just as often as ambulatory patients. She said that she'd like to see how the patients in the study by Rethlefsen's group are doing in 10 years—for example, if a CP patient who continues to walk in crouch all day at school has a higher incidence of pain than those who do only household walking.

"There are a lot of different subpopulation studies within the larger population of children with CP that could...fine-tune our knowledge in regard to pain, crouch, and pain markers," Alter wrote.

Rethlefsen said her group's next step would be to investigate whether or not radiographic factors (such as patella alta, patellar pole abnormalities, and tibial tubercle abnormalities) are related to knee pain in children with CP.

## Diagnosis

In 2012, Gavelli, Alter, and colleagues conducted a case-controlled study in 20 CP patients, many of whom were in their teens, to quantify the role of patellofemoral kinematics in the development of anterior knee pain (AKP).<sup>2</sup>

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Patients were assessed using a variety of physical tests and then underwent 3D magnetic resonance imaging (MRI), with images acquired during active leg extension and under volitional control. Kinematic markers associated with AKP included greater patellofemoral extension, valgus rotation, and superior and posterior patellar displacement relative to controls and to the subgroup of participants with CP and no AKP.

While Gavelli and Alter continue their research in this area, they suggest that practitioners be aware of those three markers when trying to get a handle on knee pain in younger CP patients sooner rather than later. That information can be incorporated into the physical exam and shared with the physical therapist, the physiatrist, the orthopedist, or the general pediatrician, Alter said.

The end game with identifying these markers is implementing early intervention, they explained. Regardless of the child's level of ambulation, knee pain needs to be evaluated and managed to keep the patient as mobile as possible.

"The consequences of inactivity and/or a cessation of walking are a cascade that includes atrophy of muscles, deconditioning, increased weakness, joint problems, and loss of function in other areas. So whatever we can do to keep kids active, including walking, is great," Alter wrote.

Tom Novacheck, MD, a pediatric orthopedic surgeon at Gillette Children's Specialty Healthcare in St. Paul, MN, recommended a general gait analysis that includes the assessment of knee function as a reliable assessment tool that may be more accessible than MRI for most practitioners.

"You can get a measurement of the stresses on the knee joint, and that will tell you if the stresses are in the front or the inside or

the outside of the knee," explained Novacheck, who is also director of the James R. Gage Center for Gait and Motion Analysis at Gillette. "I find it more helpful than x-rays. X-rays may be abnormal, but that doesn't necessarily tell you the cause of the pain. It's actually more helpful to know where the stresses are, and I find that gait analysis is better for that."

Malignant malalignment is often missed during a general physical exam, and requires computerized motion analysis to pinpoint, Rethlefsen and Kay explained, but there is a lower-tech screening option.

"An easy way to screen for it is to place a mark on the patient's patellas and video the patient walking from the front. If the knee points excessively in and the foot excessively out during stance phase, malignant malalignment is likely," they wrote.

Gait analysis can also help determine if other biomechanical problems, particularly in the feet, play a role in CP-related knee pain. Novacheck pointed out that if flat foot (pes planus) is an issue for a patient, then patellofemoral pain may follow.

He added that gait analysis data can help practitioners with treatment decisions.

"Your diagnosis after the evaluation will help you decide what the goal is—is it pain management or improving gait? That determination may send your patient down different treatment pathways," he said.

## The treatment spectrum

Experts recommend mixing and matching from a spectrum of treatment options, starting with conservative modalities.

*Continued on page 18*



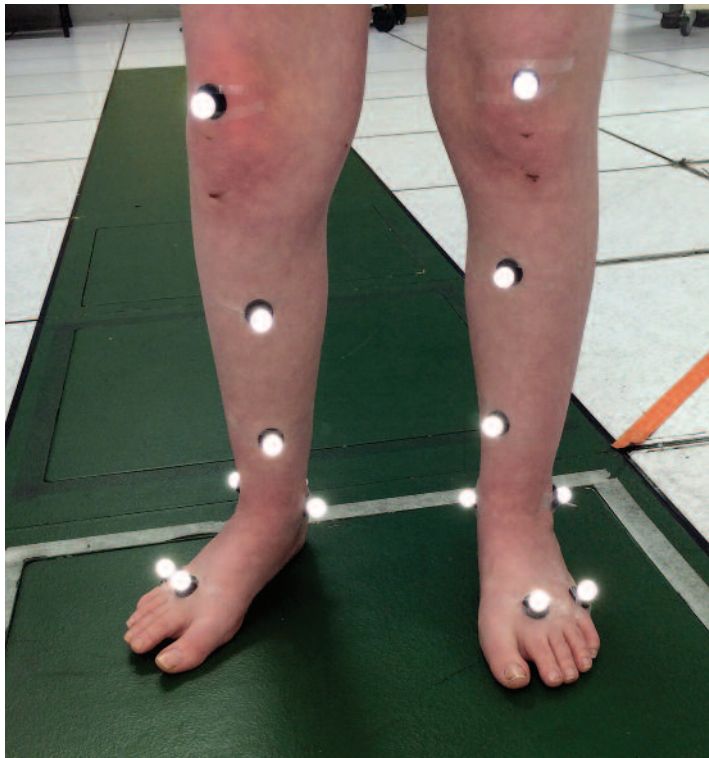
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A 12-year-old girl with developmental delays has motion capture markers in place that will be used to collect 3D joint motion and force data to help determine the cause of her knee pain. (Photo courtesy of the John C. Wilson Motion Analysis Lab, Children's Orthopaedic Center, Los Angeles.)

"For all treatment, there is a continuum where you may pick one or more treatments at different times, depending on the patient's age and functional skills," Alter explained.

For instance, spasticity is a major issue in the majority of patients with CP. As the leg muscles grow less and less elastic, increased pain and stiffness can lead to PFP. If an immediate goal is to diminish pain, then botulinum toxin injections are a good route. The pain reduction seen after toxin injections may be because of spasticity reduction or because of antinociceptive effects that maintain or increase the patient's mobility, Alter said.

Novacheck also recommended toxin injections for addressing high muscle tone and managing pain, as well as other tried-and-true methods such as ice and heat or anti-inflammatory medications.

Taping is another treatment option, the NIH specialists said, as it may reduce some of the abnormal movements of the patella during knee extension, thereby stopping it from subluxing up and over the lateral condyle (see "Patellofemoral taping: Pain relief mechanisms," *LER* August 2010, page 25).

"Kids with CP tend to be hypomobile when it comes to the patella," Gavelli explained. "There is such tension created by the spastic or shortened quadriceps that it has pulled the patella up too high and it's like a bow string. So a small bit of extra force can offset the balance and cause dislocation. The constant wear and tear from the abnormal position of the patella and dislocation lead to joint problems and pain."

Also on the treatment spectrum is physical therapy, which may include hip strengthening for reducing pain and increasing lower body strength or quadriceps and hamstring stretching to aid mobilization (see "Strength training improves function in children with CP," *LER: Pediatrics* February 2014, page 15).



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All of the experts agreed that physical therapy can work wonders for diminishing knee pain—but it also requires patient and caregiver commitment to be successful.

Alter stressed that physical therapy programs need to be based on the child's level of engagement and, ideally, tailored to their interests. Possible barriers to physical therapy include language or communication issues, behavioral problems, or difficulty following directions.

As for knee braces and orthoses, the experts offered mixed opinions. As Novacheck pointed out earlier, orthoses may be an option if the patient has a foot health problem that is tied to the knee pain. A recent article in *Current Opinion in Pediatrics* recommended that orthoses be part of the treatment plan for CP-related foot deformities, noting that foot realignment may improve knee function during stance.<sup>3</sup>

Alter agreed that controlling distal biomechanical problems of the foot, ankle, or both may help the knee, but she cautioned that, when it comes to ankle-foot orthoses (AFOs), the style of the device is important.

"There are some braces that are designed to reduce crouch," she explained. "But these may not be useful if the patient has a degree of knee flexion contracture."


Many patients crouch through a combination of weakness and contracture, she said, and "in this subgroup of patients with crouch, these anti-crouch AFOs may not be tolerated or effective," Alter said. She suggested that knee AFOs (KAFOs) may be useful in some patients with crouch because they can limit flexion, which in turn may alleviate knee pain.

But bracing is only valuable if the patient is compliant, and depending on the child's age, that can be a major hurdle (see "Kids, clothes, and AFOs: Finding just the right fit," *LER: Pediatrics* May 2014, page 9). Novacheck noted that it's during adolescence, when growth spurts are occurring, that children with CP are most likely to complain about knee pain—but that is an age group that doesn't smile on anything that makes them more different than their peers.

Finally, there is surgical intervention, which experts agree should be considered only when all other treatments have proven ineffective.

"The vast majority of these children do not require any surgery for their knee pain," Rethlefsen and Kay stressed. "Surgery should only be considered if conservative measures have failed after a diligent nonoperative trial."

Surgical options for addressing crouch or limited knee extension include quadriceps lengthening, patellar tendon advancement, surgery on the femur itself, or taking a wedge out of distal femur to improve the patellofemoral kinematics.

"I would say that, if the patient has a lot of bone and joint deformity—some of the common things are femoral anteversion, tibial torsion, knee contracture, foot deformity, patella alta, and patellar stress fractures—those are all things that don't respond to conservative treatment," Novacheck said. "Those require surgery." 

*Shalmali Pal is a freelance writer based in Tucson, AZ.*



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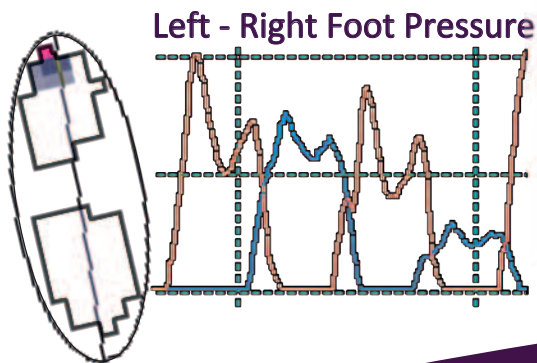
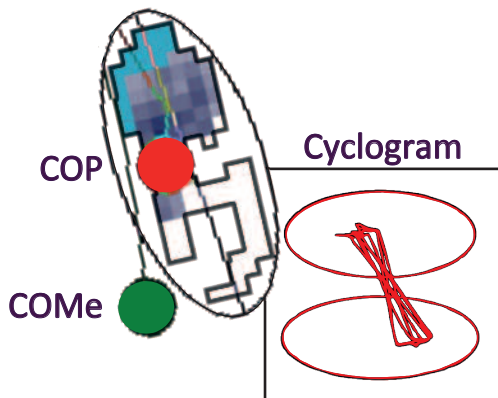
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