• REHABILITATION • TRAUMA • DIABETES • BIOMECHANICS • SPORTS MEDICINE

ler

LOWER EXTREMITY REVIEW
June 16 / volume 8 / number 6

CONFERENCE COVERAGE:
American College of Sports Medicine 2016 Annual Meeting

A Finer Pointe:

Visualizing the ankle's response to ballet's toughest task

+

OSTEOARTHRITIS
WHEN KNEE OA RESEARCH BECOMES LEGAL TESTIMONY

REHABILITATION
STRATEGIES TO IMPROVE GAIT SPEED AFTER STROKE

SPORTS MEDICINE
POSTURE-SPECIFIC STRENGTH AND LANDING MECHANICS

DIABETES
TREATMENT OF DISTAL TOE CALLUSES AND ULCERATIONS

Positive Outcomes for Successful Practitioners

IT SOFTEN HEAT PATC

IT CAN BE ON SITE.

Introducing EXOS® functional inserts featuring our proprietary carbon nano-tube shell for easier reform-ability. It will change the way you fit your patients because it softens with moderate heating from an exothermic patch, allowing you to make adjustments in front of your patient before it hardens back to a carbon graphite-like state when cooled.

S WITH A H.

ADJUSTED

IT'S TIME TO EMBRACE THE RE-FORM.

Dr. Comfort

No more sending inserts back to the manufacturer or rescheduling patients. It's the technology you expect from the leader in therapeutic footwear. Contact: **(877) 728-9917** or **drcomfort.com/exos2**

exos®

DJO GLOBAL

Shoes your patients **WANT** to wear.

TO LEARN MORE, visit
www.anodyneshoes.com

ANODYNE

Built for comfort. Designed for style.

No. 101
Full Fitting
Center

No. 45

Women's
Sport

No. 4

Partial
Foot Toe
Filler

iPad

Scanner

Acor Orthopaedic
www.acor.com

Allied OSI Labs
www.aolabs.com

ComfortFit Orthotic Labs
www.comfortfitlabs.com

Eastern Podiatry Lab
www.eplorthotics.com

Fiber Orthotics
www.fiberorthotics.com

Hersco Ortho Labs
www.hersco.com

Integrity Orthotics
www.integrityortho.com

JSB Orthotics
www.jsbinc.com

KLM Orthotic Labs
www.klmlabs.com

Marathon Orthotics
www.marathonortho.com

Root Lab
www.root-lab.com

SOLO Labs
www.sololabs.com

STJ Orthotic Services
www.stjorthotic.com

SureFit
www.surefitlab.com

For our distributor's bios, go to www.richiebrace.com

Celebrating 20 Years

In 1995 the Richie Brace was introduced and revolutionized the industry.

Over 20 years, many have attempted to emulate, but none have surpassed the proven quality and performance of the Richie Brace and its family of products.

Our success is founded on our innovative and dependable products which are delivered to the practitioner by our outstanding Richie Brace family of distributors.

Together, we look forward to the next 20 years of positive patient outcomes!

Thank you for your Support!

For more information visit:
richiebrace.com

THE Richie BRACE
RESTORING MOBILITY®

Lower Extremity Review

ler

June 2016

VOLUME 8 NUMBER 6 LERMAGAZINE.COM

features

18 COVER STORY

A finer pointe:

VISUALIZING THE ANKLE'S RESPONSE TO BALLET'S TOUGHEST TASK

The use of detailed orthopedic imaging to examine dancers' ankles while in the en pointe position offers insight into the biomechanical demands associated with a position that, although highly unnatural, is nevertheless essential to a ballerina's performance.

By Jeffrey A. Russell, PhD, AT, FIADMS

IN THE MOMENT

plus...

ACOR® NOW HAS A Brand New Website!

We are now Mobile-Friendly!

As a company on the cutting edge of our industry, we know that you – our loyal and future customers – would expect nothing less than the latest in technological innovation from ACOR; you expect us to be up-to-date, progressive and pioneering. And that's not just in terms of the products we supply but also in the way we think and do business, so that we can help you to grow your business as well.

And as a contemporary business, we understand that this expectation extends to our website too. The old one, which has served us well since its last update several years ago, was starting to feel a little long in the tooth and was struggling to keep up with all the refinements we've put into our processes and products. So we put it out to pasture.

When it came to redesigning the website, we wanted to focus on three key areas:

- **Customer Experience**
- **Functionality**
- **Responsive Design**

We have a completely new navigation structure, hopefully making searching for what you need even faster. Our website now has a fully responsive design, which means whether you're browsing on a dekstop computer, tablet, laptop or smartphone, you can access every bit of it, without having to pinch and zoom to be able to read what's there .

We hope you like the new webpages. Moving forward, consistency is really important to us. If you have any issues with the new site, please contact us, let us know where we've fallen short and we'll make it a better experience for everyone!

Fill out our "Contact Us" form on our home page and we will give you a FREE PAIR of our new EZ-Fit orthotics! Just mention you saw this ad and put your address, choice of which style and size in the "Message" section of the contact form.

www.acor.com
orderentry@acor.com

800-237-2267
(option 2)

Scan this barcode with your smartphone QR reader
or visit:
www.acor.com
to peruse our new website

Look for us:

Lower Extremity Review
ler

out on a limb: Subjectivity & sensitivity

Listening to what patients have to say is an important part of healthcare. But, as research continues to demonstrate, it's no substitute for objective measurements.

It's well documented that patients are not necessarily reliable when it comes to self-reporting information such as height, weight, shoe size, dietary practices, and physical activity levels. So it shouldn't be surprising that preoperative scores on an assessment tool focused largely on self-reported pain and function isn't ideal for predicting clinical outcomes after total hip arthroplasty (THA).

A recent study from the University of Illinois at Chicago (UIC) found that preoperative measures predicted clinical response after THA much more accurately when objectively measured preoperative gait mechanics were considered along with the largely subjective Harris Hip Score (HHS) (see "Gait and THA outcomes: Hip mechanics have predictive value," page 15).

Preoperative HHS alone predicted clinical response with a sensitivity of 57%, which is actually pretty impressive for a subjective test. But, when preoperative peak hip external rotation moment was added to the predictive model, the sensitivity improved to 71.4%.

Including gait mechanics in the predictive equation doesn't just make it more accurate—it also makes it more useful. Even knowing that higher preoperative HHS values are associated with nonresponse after THA, implementing an intervention to reduce those HHS values preoperatively makes little clinical sense, and is likely unethical as well. But, knowing that low preoperative hip external rotation moments are associated with nonresponse after THA—and that those moments remain low postoperatively in nonresponders, which the UIC group also found—suggests such patients could benefit from physical therapy interventions to improve hip function postoperatively, and likely also improve clinical response by doing so.

Clinical nonresponse after THA affects a considerable number of patients. In the 124-patient UIC study, the clinical nonresponse rate was 11%, which is consistent with reports in the literature that range from 5% to 15%. Given that more than 300,000 procedures are done annually just in the US, up to 45,000 patients will not have a positive response.

And there's reason to believe the actual number of THA nonresponders might be even higher. In a study published in the February issue of the *American Journal of Physical Medicine & Rehabilitation*, researchers from the University of Colorado in Aurora reported that patients tend to overestimate their level of function following total hip replacement, compared with performance-based tests; this may be because the degree of pain relief they experience makes them feel able to function at a higher level than they actually can.

> Self-reported information is convenient and inexpensive to obtain, but on its own may be too unreliable to drive clinical decisions.

It would be nice if more THA nonresponders could be identified using the HHS alone. It certainly would be more convenient and less expensive than conducting detailed gait analysis on every THA patient. But it also would be much less accurate, which would mean thousands of patients not receiving the rehabilitation they need to address specific underlying mechanical issues.

What patients have to say is important. But what objective data have to say is too important to ignore.

Jordana Bieze Foster, *Editor*

AFFORDABLE

Custom Foot Orthotics
AS LOW AS $20/Pair

ASK FOR DETAILS TODAY

- Diabetic A5513 Approved - shipping included
- Milled Polypro - Flex, Semi-flex,
- TL 2100 Carbon Fiber - Flex, Firm
- 5 EVA Options

TRUSTED

sales@amfit.com · +1-800-356-3668 · AMFIT.COM · @Amfitinc

Lower Extremity Review
ler

Publisher
Richard Dubin | rich@lermagazine.com

Editor
Jordana Bieze Foster | jordana@lermagazine.com

Senior editor
Emily Delzell | emily@lermagazine.com

Associate editor
P.K. Daniel | pk@lermagazine.com

Operations coordinator
Melissa Rosenthal-Dubin | melissa@lermagazine.com

Social media consultant
Kaleb S. Dubin | kaleb@lermagazine.com

New products editor
Rikki Lee Travolta | rikki@lermagazine.com

Graphic design & production
Christine Silva | MoonlightDesignsNC.com

Website development
Anthony Palmeri | PopStart Web Dev
webmaster@lermagazine.com

Circulation
Christopher Wees | Media Automation, Inc

Editorial advisors
Craig R. Bottoni, MD, Jonathan L. Chang, MD, Sarah Curran, PhD, FCPodMed, Stefania Fatone, PhD, BPO, Timothy E. Hewett, PhD, Robert S. Lin, CPO, Jeffrey A. Ross, DPM, MD, Paul R. Scherer, DPM, Erin D. Ward, DPM, Bruce E. Williams, DPM

Our Mission:

Lower Extremity Review informs healthcare practitioners on current developments in the diagnosis, treatment, and prevention of lower extremity injuries. LER encourages a collaborative multidisciplinary clinical approach with an emphasis on functional outcomes and evidence-based medicine. LER is published monthly, with the exception of a combined November/ December issue and an additional special issue in December, by Lower Extremity Review, LLC.

Subscriptions may be obtained for $38 domestic. and $72 international by writing to: LER, PO Box 390418, Minneapolis, MN, 55439-0418. POSTMASTER: Please send address changes to LER, PO Box 390418, Minneapolis, MN, 55439-0418.

Lower Extremity Review
292 Washington Ave. Ext. #105, Albany, NY 12203
518/452-6898

GET INVOLVED AND STAY CONNECTED WITH THE GROWING LER SOCIAL MEDIA NETWORK!

Visit lermagazine.com today to stay up to date on critical lower extremity information, subscribe to our monthly e-newsletter, and join the conversation on our vast, ever-expanding social media network.

facebook.com/LowerExtremityReview
23,380 likes

@lowerextremity
2,909 followers

youtube.com/user/LowerExtremityReview
142,000 video views

instagram.com/lowerextremity/
343 followers

pinterest.com/lowerextremity/
294 followers

APEX
An OHI Company

2016 Spring Collection

The same industry-leading construction, finest materials and exceptional comfort that you and your patients have come to expect.

A fresh and exhilarating focus on style that you and your patients will absolutely love.

A commitment to service excellence unparalleled in our industry.

WELCOME TO THE 'NEW' APEX

View the complete 2016 Spring Collection @ apexfoot.com
To order, phone 800-252-2739

The OHI Family of Brands

APEX · AZafo ARIZONA · Langer Biomechanics · PedAlign · safestep PREVENTION PAYS · The Orthotic Group

Concussion repercussions

Studies explore lower extremity effects

By Jordana Bieze Foster

The adverse biomechanical effects of concussion can persist for up to two years, but short-term visual deficits may help identify athletes who are most at risk for gait-related effects, according to multiple studies presented in early June at the annual meeting of the American College of Sports Medicine (ACSM) in Boston.

Shutterstock.com #341730932

Researchers from the University of Michigan in Ann Arbor found significant differences in stop-jump kinetics between eight young adults (three women) with a history of concussion (mean 2.4 years from injury) and eight young adults (five women) with no history of concussion.

The study participants performed a horizontal jump equal to 120% of leg length, landed on the dominant leg (all were right-leg dominant), and then jumped to the right or left based on instructions received before the task. For the leftward trials, the mean peak mediolateral ground reaction force was significantly higher for the concussion group than the no-concussion group.

Although there were no significant between-group differences for the rightward trials for the initial 16 participants for whom data were presented, the researchers did see between-group differences for both directions once the number of participants reached 20, according to Andrew Lapointe, MS, a doctoral student in the university's School of Kinesiology, who presented the results.

"These findings do support the body of evidence showing an

Continued on page 14

Preseason hip weakness contributes to ankle sprain risk in soccer players

Preseason hip abductor strength is associated with risk of lateral noncontact ankle sprain in soccer players, according to research presented in early June at the annual ACSM meeting in Boston.

Investigators from the University of Southern California (USC) in Los Angeles and the University of Isfahan in Iran performed hip strength testing in 185 male professional soccer players with no history of lower extremity injury in the previous six months. Of those, 25 went on to suffer an ankle sprain during the soccer season.

Preseason hip abductor strength was significantly greater for the uninjured players than the injured players. Using a clinical cutoff value for hip abductor strength of 33.8% of body weight, those above the cutoff had a 26.7% risk of ankle sprain while those below had an 8% risk.

However, hip abductor strength explained only 7.1% of the variance in injury status.

"Hip strength is only one of the variables to consider in preventing ankle injury," said Rachel K. Straub, MS, CSCS, a graduate student in USC's Division of Biokinesiology and Physical Therapy, who presented the findings. ler

Source:
Straub RK, Khayambashi K, Ghoddosi N, Powers CM. Hip abductor strength predicts lateral noncontact ankle sprains in male soccer players. Presented at the 2016 annual meeting of the American College of Sports Medicine, Boston, June 2016.

Gluteal muscle fatigue affects shoulder kinematics during throwing in softball

Gluteal muscle fatigue is associated with altered upper extremity kinematics in collegiate softball players, according to findings from the University of Auburn in Alabama that add to the body of research supporting the importance of the lower body in throwing athletes.

Investigators analyzed the upper extremity throwing kinematics of 10 collegiate softball players before and after a gluteal fatigue protocol on three consecutive days (to simulate the effects of tournament play).

Shoulder elevation during a 60-foot throw was significantly lower after the fatigue protocol than before, and on the second and third days compared with the first day. Measures of scapular anterior/posterior tilt and scapular up/down rotation also differed significantly from prefatigue to postfatigue.

"Most of the time the athletes felt pretty good after the fatigue protocol and felt like they had recovered, but their motor function was only about eighty percent," said Sarah S. Gascon, MS, a doctoral student in the School of Kinesiology at the university, who presented the findings in early June at the ACSM annual meeting in Boston. ler

Source:
Gascon SS, Washington JK, Rhoads JA, et al. Effects of gluteal fatigue on shoulder and scapula kinematics among NCAA Division I softball athletes. Presented at the 2016 annual meeting of the American College of Sports Medicine, Boston, June 2016.

Continued from page 13

effect of concussion on gait and that motor dysfunctions remain long after the acute injury," Lapointe said.

The long-term kinetic effects observed by the Michigan researchers may in part explain the results of a US Army study presented at the ACSM meeting, in which soldiers who sustained a concussion were significantly more likely to sustain a lower extremity injury in the next two years than nonconcussed controls.

Investigators from the US Army Research Institute of Environmental Medicine in Natick, MA, reviewed medical encounter data for nearly 8000 soldiers who had no history of lower extremity injury before experiencing a concussion. Of those, 1892 suffered a lower extremity injury within two years postconcussion; this 24% injury rate was 52% higher than for 11,602 matched controls during the same two-year periods. The greatest between-group differences in lower extremity injury rate were seen during the first six months postconcussion.

Joseph Kardouni, MPT, research director of the Total Army Injury Health Outcomes Database, who presented the findings at the ACSM meeting, said that further analysis of the same database (not presented) suggests the inverse of the presented findings is also true: Risk of concussion is higher in soldiers who sustain a lower extremity injury than in uninjured controls.

"If you're at risk of getting hurt, you're at risk of getting hurt," Kardouni said. "Perhaps some of the factors that lead to getting concussions are the same risk factors that lead to other types of injuries."

Although a number of studies have reported gait-related effects of concussion, few have examined how to identify which athletes are most likely to develop gait alterations. Research from Boston Children's Hospital, presented at the ACSM meeting, suggests a visual deficit test may help.

In 31 adolescents examined within three weeks of a concussion (mean, 10 days), the Boston investigators found that 19 presented with deficits related to the near point of convergence (NPC; the ability to clearly see a target moving toward the tip of the nose). Those with NPC deficits walked more slowly and with shorter strides than 12 concussed participants with normal NPC and 28 uninjured controls.

"Theoretically, if you can train the visual system, you might have better recovery in terms of gait," said David R. Howell, PhD, ATC, a postdoctoral research fellow at the Micheli Center for Sports Injury Prevention in Waltham, MA, who presented the findings at the ACSM meeting. ler

Sources:

Lapointe A, Sosnowski A, Andrews E, et al. Landing kinetics differences in individuals with and without a history of concussion. Presented at the 2016 annual meeting of the American College of Sports Medicine, Boston, June 2016.

Kardouni JR, Shing TL, McKinnon CJ, et al. Risk for lower extremity injury following concussion: a retrospective cohort study in soldiers. Presented at the 2016 annual meeting of the American College of Sports Medicine, Boston, June 2016.

Howell DR, O'Brien M, Raghuram A, et al. Adolescents with convergence insufficiency exhibit gait stability deficits acutely after concussion. Presented at the 2016 annual meeting of the American College of Sports Medicine, Boston, June 2016.

Gait and THA outcomes

Hip mechanics have predictive value

By Katie Bell

Preoperative hip mechanics during gait can enhance clinical scores for identifying patients who are less likely to have an adequate clinical response after total hip arthroplasty (THA), according to research from Chicago that may have implications for both preoperative analysis and postoperative rehabilitation.


Istockphoto.com #56292064

"I don't know that gait variables influence postoperative response. I think of these more as indicators of who may need extra attention to achieve a clinically significant response, and what types of interventions they may benefit from," said study author Kharma Foucher, MD, PhD, assistant professor in the Department of Kinesiology and Nutrition at the University of Illinois at Chicago.

The retrospective analysis of data from a series of prospective longitudinal studies included 124 patients (62 women, mean age 61 years) who had been assessed before and one year after primary unilateral THA using quantitative gait analysis and the Harris Hip Score (HHS), which is largely based on self-reported pain and function. Gait analysis was performed as patients walked at a self-

Continued on page 16

ACL bracing study suggests subgroup of athletes most likely to be responsive

Preliminary findings presented in early June at the 2016 American College of Sports Medicine (ACSM) meeting in Boston suggest there may be a subgroup of athletes who are most likely to respond positively to knee bracing after anterior cruciate ligament (ACL) reconstruction.

Researchers from Virginia Tech in Blacksburg analyzed landing mechanics with and without a custom-fit functional knee brace during a stop-jump task in 20 adolescent athletes who had undergone ACL reconstruction six months earlier. All participants were asked to wear the brace on the injured limb during activities more dynamic than walking for four to six weeks prior to testing.

For the group overall, the brace condition did not differ significantly from the no-brace condition with regard to between-limb symmetry of knee angles, knee moments, or ground reaction forces (GRF). However, 12 participants experienced more symmetrical knee flexion with the brace than without; in those athletes, brace wear was also associated with greater GRF symmetry, according to Evan McConnell, MS, a graduate research assistant in the Department of Biomechanics at Virginia Tech, who presented the findings. ler

–Jordana Bieze Foster

Source:

McConnell E, Queen R. Movement and loading symmetry changes when wearing a functional knee brace following ACL reconstruction. Presented at the 2016 annual meeting of the American College of Sports Medicine, Boston, June 2016.

Runners' baseline may determine effect of barefoot switch on loading symmetry

Among habitually shod runners with a recent history of injury, those with the greatest magnitudes of loading asymmetry are those who are most likely to become more symmetrical after switching to barefoot running, according to research presented in early June at the ACSM annual meeting in Boston.

Investigators from Spaulding National Running Center in Boston analyzed 67 habitually shod runners as they ran on an instrumented treadmill, first while shod, then barefoot with instructions and visual cues to use a forefoot strike pattern.

For the group overall, switching to barefoot running was not associated with greater symmetry for vertical average loading rate (VALR), vertical instantaneous loading rate (VILR), vertical force peak, or stance time. In fact, VALR and VILR were more asymmetrical during the barefoot condition than the shod condition.

However, the runners in the most asymmetric quintile for each of the loading variables did become more symmetrical when running barefoot than when shod, according to Adam Tenforde, MD, an attending physician at Spaulding Rehabilitation Hospital, who presented the findings. ler

–Jordana Bieze Foster

Source:

Tenforde AS, Ruder MC, Davis IS. Influence of shod and barefoot running conditions on gait symmetry for injured runners. Presented at the 2016 annual meeting of the American College of Sports Medicine, Boston, June 2016.

Continued from page 15

selected speed along a 10-m walkway. Responders and nonresponders were identified using the Outcome Measures in Rheumatology and Osteoarthritis Research Society International (OMERACT-OARSI) consensus responder criteria, modified for use with the HHS.

Of the study participants, 110 were classified as responders and 14 as nonresponders. The sensitivity of predicting a nonresponder based on preoperative HHS alone was 57.1%. However, the combination of preoperative peak hip external rotation moment and preoperative HHS predicted response with a sensitivity of 71.4% and a specificity of 99.1%. The findings were epublished by the *Journal of Orthopaedic Research* in May.

"Any survey instrument like the HHS has a few limitations for predicting response. One is that it's subjective. This isn't bad in and of itself, because obviously the patient is the expert on how he or she feels," Foucher said. "Using gait analysis or another objective physical or functional measure to complement a survey can help us understand what we might do to help a given patient achieve his or her best outcome."

Peak hip external rotation moment was 30% lower in nonresponders than responders preoperatively, and 40% lower in nonresponders than responders postoperatively, both statistically significant differences. Sagittal plane hip range of motion was 26% higher in nonresponders than responders preoperatively, but did not differ significantly between the groups postoperatively.

"I speculate that having as much intact transverse plane abductor function as possible is important for clinical recovery," Foucher said.

Foucher and her colleagues are working to identify simpler clinical tests, or combinations of tests, that do as well or better at predicting THA response, she said. Further, Foucher wrote in the paper, the findings suggest additional analysis of the role of transverse plane hip mechanics could lead to interventions designed to improve clinical response after THA.

However, development of such interventions could be complicated by the surgical techniques used in many THA procedures, said Dana Judd, PT, DPT, PhD, an assistant professor in the Physical Therapy Program, School of Medicine, at the University of Colorado in Denver.

"The presence of preoperative external rotation moment deficits before surgery seems to lend itself to a preoperative training program to improve it before surgery. However, the muscles responsible for stabilizing the hip in this way are either cut or split during the surgery," Judd said. "The shift in current postoperative care would be, in my opinion, to focus on movement retraining and stabilization activities for the hip, pelvis, and lumbar spine." ler

Source:

Foucher KC. Preoperative gait mechanics predict clinical response to total hip arthroplasty. J Orthop Res 2016 May 4. [Epub ahead of print]

COVER MATERIALS
AS INDIVIDUAL AS YOUR INSOLES

We transform your insoles into absolutely unique products, thus guaranteeing a high company value recognition! Experience the whole range of top cover materials to give your orthotics a total **NEW LOOK**. Simply choose between patterns from our existing designs or send yours. We can also include your company logo or other logos of your choice.*

Streifeneder USA

5906 Breckenridge Pkwy, Suite G, Tampa, FL 33610 • PH (800) 378-2480 • F (813) 246-5998

* One time setup fee per design and minimum order quantity applies

A Finer Pointe:

Visualizing the ankle's response to ballet's toughest task

The use of detailed orthopedic imaging to examine dancers' ankles while in the en pointe position offers insight into the biomechanical demands associated with a position that, although highly unnatural, is nevertheless essential to a ballerina's performance.

THE BEAUTY AND GRACE of ballet en pointe disguises an impressive forced arrangement of the bones of the ankle. A look deep down inside reveals a fascinating picture—one might call it a marvel of adaptive anatomy. Looking closely at the actual positions of the ankle bones, one must acknowledge with respect the striking ability ballet dancers possess to stand and dance en pointe.

Dancing en pointe (on the tips of the toes) is not for the faint of heart, nor for the faint of ankles. It is a rigorous subdiscipline of ballet, and one that can be fraught with difficulties and unsafe practices that may lead to foot and ankle injuries in immature or weak tissues. One frequent problem is the practice of allowing young girls to dance en pointe at a younger age than is advisable and without the necessary skeletal, muscular, and technical development.

Unfortunately, age by itself is not an acceptable criterion with which to make decisions about starting pointe work. This is one reason that authors have identified appropriate guidelines for beginning pointe training,[1,2] and why the International Association for Dance Medicine & Science provides a resource sheet (available in several languages) to assist dancers, dance teachers, and dance parents with making wise decisions about initiating pointe.[3]

Only one study is known to have investigated injuries related to dancing en pointe specifically;[4] it was preliminary and had several limitations. However, research has shown repeatedly that a substantial number of injuries occurring in professional ballet—in some reports a majority—occur to the foot and ankle.[5-10] Therefore, the presumption can be made that, because pointe work is

By Jeffrey A. Russell, PhD, AT, FIADMS

Continued from page 19

Figure 1: X-ray of a ballet dancer showing the bony anatomy of the foot and ankle.

integral to the repertoire of most professional classical ballet companies, it is likely that dancing en pointe contributes to this injury rate because of the extreme foot and ankle positioning it requires.[11]

A research window into the relative positions of the bones of the ankle and foot has been opened using orthopedic imaging.[12-15] These studies show precise orientations of the bones, using radiography[12,13] and magnetic resonance imaging (MRI),[14,15] and of the soft tissues, using MRI.[14,15] When viewed with these modalities, it is clear the en pointe position is not natural—and is likely injurious. However, with pointe work so important to the ballet aesthetic, it serves the dance and dance medicine communities well to understand the demands of this position with a view to ensuring that ballet dancers, particularly young ones whose teachers and parents are contemplating starting them en pointe, are as safe as possible in the genre.

Anatomy and stability

The standing x-ray of a ballet dancer in Figure 1 identifies the bones of the leg, ankle, and foot. The talocrural joint comprises the distal portions of the tibia and fibula (which form a box-like mortise) and the talus. The rounded upper part, or dome, of the talus fits into the mortise; in typical standing, primary weightbearing in this joint occurs in the articulation of the distal tibia's hyaline cartilage surface and the hyaline cartilage of the talar dome. However, in an en pointe stance, weightbearing of the tibia moves progressively posterior on the talar dome and, in fact, the posterior portion of the tibia's articular surface leaves the articular surface of the dome to rest on the posterior talus[15] as the posterior tibia, posterior talus, and superior calcaneus converge.[14] The en pointe x-ray in Figure 2 shows this positioning.

The convergence of the three bones is significant because this "locks" the ankle into a more stable position en pointe[16,17] than might otherwise be predicted, based on the fact that the narrowest aspect of the talar dome—the posterior aspect—is placed into the ankle mortise during plantar flexion.[18] That is to say, with the narrow posterior dome in the mortise, one might expect relative joint laxity,[19] but the locking function overrides this. Furthermore, MRI shows more clearly than x-rays how the positioning of the tibia's articular surface is partially incongruent with the joint surface of the talus (Figure 3). This may also provide stability, thanks to the roughness of the nonarticular joint surface of the posterior talus resting under the tibial plafond during full weightbearing en pointe.

Parenthetically, in spite of the extreme plantar flexion seen in the talocrural joint, the position of the foot during pointe dancing cannot rely on this motion alone. Attaining the full en pointe position requires contributions from movements between the bones in the foot.[12,20,21] Examples of such movements include sliding between the talus and the navicular, the navicular and the medial cuneiform, and the medial cuneiform and the first metatarsal. These small increments of motion combine to provide approximately 30% of the plantar flexion range.[12] In addition, it is noteworthy that the talus shifts slightly anterior from under the tibia as the ankle-foot complex moves en pointe.[15] This subtlety arises because the converging tibia, talus, and calcaneus form a fulcrum that applies an anterior force to the talus, somewhat like a watermelon seed being squeezed from between one's thumb and forefinger.

Utility of MRI in visualizing en pointe

MRI is an ideal method of viewing the tissues of the foot and ankle because, unlike x-rays, it provides a visual depiction of multiple

Figure 2: X-ray of a ballet dancer en pointe. The black arrow points to the area where the tibia, talus, and calcaneus converge when a dancer is en pointe. The black dotted line identifies the posterior portion of the talus beyond its articular surface. The white dotted line denotes the corresponding portion of the tibia's articular surface that rests against the posterior talus in this position.

Continued on page 22

Visco-GEL® Hammer ToeCrutch™, #1017

Visco-GEL® ToeBuddy®, #1033

Visco-GEL® Little ToeBuddy®, #1035

Visco-GEL® Stay-Put Toe Spacer®, #1037

Visco-GEL® Stay-Put Toe Separators®, #1104

"Visco-GEL products are really great — consistently good quality, expert designs and my patients love them."
Dr. H., NY

New!
ToeBuddy® Bunion Guard Combo™ #1038

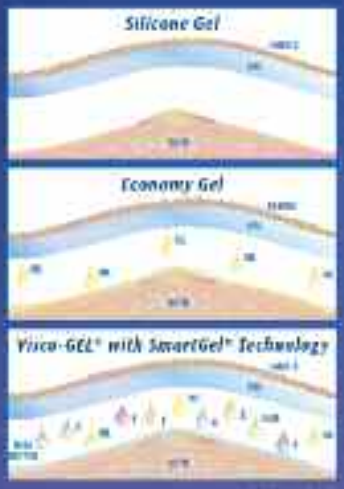
- Protects 1st MP joint
- Contoured spacer separates crooked toes
- Dual toe loops align 2nd digit
- Washable, reusable, durable

Visco-GEL®

Foot Protection Products™ from PediFix® Now With SmartGel® Technology...

Nothing works better to relieve common foot conditions & deformities

Visco-GEL® conforms, cushions, protects and absorbs pressure and friction to relieve pain, often instantly. Exclusive SmartGel® formulas nourish skin to soothe and hydrate. See for yourself how these and dozens more devices will help you, your patients, and your practice. Get your free catalog and samples today.



Visco-GEL® with SmartGel® technology from PediFix®

Effective. Economical. Easy.

PediFix® The Podiatrists' Choice®

To order, get a free sample*, or more information...

Call: *1-800-424-5561*

Fax: *845-277-2851*

E-mail: *info@pedifix.com*

Return this Coupon to:
Dept. LER616, 281 Fields Lane, Suite 1, Brewster, NY 10509

Contact your favorite PediFix distributor — Specify Visco-GEL® from PediFix®

Yes! Please send me: Visco-GEL® with SmartGel® technology from PediFix®

- ☐ Free Catalog
- ☐ Free Visco-GEL® Sample*_____
- ☐ 11-Piece Sample Kit, one each, every item above, just $9.95 ($25 value)* My

Name _____

Practice/Clinic Name _____

Address _____

City _____ State _____ Zip _____

Phone _____

Fax _____

Email _____

In our practice, we see approximately _____ (#) patients each week. My favorite supplier is _____

prefer: ☐ to Dispense ☐ to Prescribe ☐ Patient Direct Order

Mail to: PediFix, Dept. LER616, 281 Fields Lane, Suite 1, Brewster, NY 10509

Fax to: 845-277-2851 Please provide all information requested. Allow 2 weeks for delivery. *For healthcare professionals only.

Continued from page 20

Figure 3: Proton density-weighted magnetic resonance image of the ankle en pointe with spectral attenuated inversion recovery (SPAIR) fat suppression taken by a 3T MR scanner. This dancer was supine with her foot, ankle, and leg bound in the en pointe position according to the method described in the article. The circle shows the area of tibia, talus, and calcaneus convergence. The white dotted line indicates the portion of the tibia's articular surface that lies against the nonarticular posterior talus.

types of structures, not just bones. In addition, MR imaging does not expose patients to ionizing radiation. However, imaging the ankle and foot en pointe presents special challenges, and there is one exception to the utility of MRI for this application: the inability to incorporate a high-field strength scanner (ie, one with a strong magnet that can produce very detailed images) for imaging a dancer in the functional weightbearing en pointe position.

Prior to the work presented in this article, MR imaging was used to assess potential ankle conditions in dancers.[9,11,22] The goal of these studies was primarily the identification of anatomical variants, such as a protruding posterior malleolus of the tibia or superior tubercle of the calcaneus, or the assessment of bone edema. However, more fundamental than these variants is the functional anatomy of the ankle. This is because an understanding of how the components of the ankle and foot align forms the framework for teachers and practitioners for helping dancers be as healthy as possible when they undertake pointe training.

"Open" MR scanners exist that allow an individual to be upright and weightbearing within a scanner instead of in the typical supine position; these have been used previously to scan dancers standing en pointe (Figure 4).[14,23] However, the magnets used in these studies are relatively weak (.25-.30 Tesla). Open scanners also are limited in this application by the short amount of time a dancer can remain en pointe, especially motionless. In addition to the field strength limiting the quality of the images, the scanning parameters must be set suboptimally for the short scans, and any wavering by a dancer as she balances on her toes creates artifacts on the images that can render them difficult, if not impossible, to read accurately.

Incidentally, a technical point of this method is that pointe shoes without sole nails are required, as ferromagnetic nails disrupt the magnetic field, creating unusable MR images (not to mention a safety hazard). Gaynor Minden is one company manufacturing shoes that do not contain nails in their soles; these were selected for use in the studies described herein.

To mitigate the problems associated with open MRI units, we developed a supine "en pointe" protocol.[15] Replicating as true an en pointe position as possible requires a dancer to wear a pointe shoe and stand en pointe while her foot, ankle, and leg are splinted with wood rods wrapped with Velcro straps (or other nonferromagnetic materials). Once affixed this way, the dancer is placed on her back in a standard high-field strength (3 Tesla [3T]) MR scanner with her ankle inside a knee coil, which helps focus the radiofrequency signals to optimize the resulting images (Figure 5). A similar protocol, with the coil repositioned and the MRI parameters adjusted, could be used to visualize the foot in an en pointe position.

In one study[15] we used this MRI protocol to review uninjured ankles in six university-level dancers who had been dancing for an average of 13 years and dancing en pointe for an average of seven years. The dancers typically reported minor amounts of dancing-related pain in their ankles and feet. All exhibited several traits in their ankle MRIs: the posterior portion of the articular surface of the tibia rested on a nonarticular surface of the posterior talus; the synovial sheaths of the flexor and fibularis tendons collected fluid; Kager's fat pad was impinged by the posterior tibial plafond; and small ganglion cysts were apparent in one or more spots around the ankle and proximal foot.

The images obtained with high-field strength MRI (Figure 3) are of substantially higher quality than those obtained with the low-field strength standing open MR procedure. It appears from the images taken with this adapted method that the en pointe position is

Figure 4: A dancer standing in an open MR scanner. The right image shows of her lower extremity with the ankle in a knee coil.

Continued on page 24

Felts, Foams, Moleskin, Gels, Cork, Rubber Cork, PPT, Poron and much more!

Dr. Jill's foot pads

Dr. Jill's Orthotics

Dr. Jill's GELS

Made in USA

BEST PRICES AND 100% GUARANTEE!

Everything you need to keep your Patients and Athletes going!
Used by Doctors and Hospitals Worldwide along
with NFL, NBA, NHL, MLB and NCAA.
No Minimum Order and FREE Shipping on all domestic orders $80 or more.

Re-usable Gel Pads

Premier Gel

Ecogel

Felt

Foam

Moleskin

866-366-8723
www.drjillsfootpads.com
Dr. Jill's Foot Pads, Inc.

Foot Pads • Padding Supplies
Lifts • Wedges • Insoles
Semi – Custom Orthotics

Continued from page 22

essentially preserved even though the dancers are back-lying rather than weightbearing. There are no qualitative differences in the positions of the bones when evaluated on the images from both techniques, and the finding that the tibia, talus, and calcaneus converge in every case holds true when the dancers are imaged supine[15] as it has in previous studies when they have been imaged while standing en pointe in an open MR device.[14]

Ongoing research

X-ray and MR imaging are useful for evaluating the extreme position of the ankle and foot required to attain the en pointe position in ballet. The observation that the talocrural joint exhibits incongruence when a dancer is en pointe leads to a logical next question: Does the fact that the articular surface of the talus rests on the nonarticular posterior talus increase the likelihood of ballet dancers developing early ankle osteochondritis or osteoarthritis?

Although limited research on these in ballet dancers is published, available reports are equivocal about the presence of degeneration in the ankle.[24-26] Thus, an important development in MR imaging may be helpful for more accurately discerning whether ankle osteoarthritis occurs in dancers' ankles. Mapping of T2/T1 MRI signals[27,28] allows closer investigation of hyaline cartilage quality than is possible with traditional MR imaging; it analyzes the relative presence of proteoglycans and other important molecules in the cartilage's extracellular matrix. Hopefully, future research using this technique will shed additional light on the extent to which pointe dancing affects the ankle's joint surfaces.

The supine method of high-field strength MR imaging of ballet dancers' ankles in the en pointe position is helpful clinically: Because the ankle's structures can be viewed in the relative positions in which they interact during pointe dancing it identifies structures and pathologies that can hinder this type of dancing. Although routine MR imaging of all young dancers wanting to dance en pointe is neither feasible nor advised, possible further applications of this method in select dancers could include pre-emptively evaluating positions of the bones or soft tissues that could lead to injury, with the goal of initiating preventive conditioning or retraining. Additionally, the technique may allow surgeons contemplating surgical intervention in pointe dancers (eg, for os trigonum removal) to better visualize both the pathology and the intended operative results.

Conclusion

Dancing en pointe is a beautiful and essential aspect of ballet that has been entrenched since Marie Taglioni's progressive foray in *La Sylphide* during the 1830s. It is the dream of young girls who take ballet lessons to obtain their first pointe shoes and begin training in this type of dance. However, such training is not without a physical cost that must be understood and ameliorated to the greatest possible degree within the context of the aesthetics of ballet.

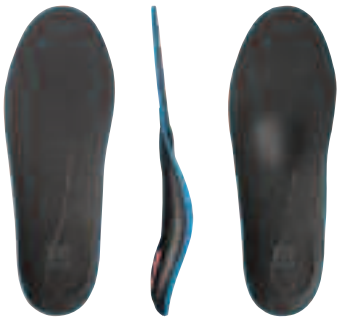
Figure 5: A dancer positioned supine, with her foot, ankle, and leg splinted, for entry into a Philips 3T MR scanner.

The use of orthopedic imaging to examine pointe dancers' ankles in detail offers insight into the demands placed on the ankle by dancing en pointe, as these radiographic methods allow assessment of the bones' alignment. In short, this most unnatural of ankle positions causes incongruence of the proximal (on the tibia) and distal (on the talus) articular surfaces of the ankle joint such that a section of the hyaline cartilage of the tibia rests on a nonarticular portion of the talus.

With pointe dancing here to stay in ballet, these research findings suggest that dance teachers, dance medicine clinicians, and others responsible for the healthy practice of dance must help dancers achieve their performance goals in a safe way. This includes moderating young dancers' commencement of pointe work until they are maturationally and physically (and emotionally, for that matter) ready to take up this high-level training, a worthy goal suggested by leading clinicians and dance medicine organizations. ler

Jeffrey A. Russell, PhD, AT, FIADMS, is assistant professor of athletic training and director of Science and Health in Artistic Performance at Ohio University in Athens. He is a fellow of the International Association for Dance Medicine & Science.

References are available at lermagazine.com.



Heel Spur Heel Spur pro

cushion

support

pain-relief

Introducing medi's new prefabricated insoles for active people suffering from plantar fascia-related conditions.

The new medi Heel Spur and Heel Spur Pro insoles reduce heel and plantar fascia pain in Plantar Fasciitis & Plantar Fasciosis-related conditions

Golf swing biomechanics: Footwear considerations

By Patricia Pande, MClScPT, CSCS, CPed

With the rise of a new crop of young stars and the anticipation of its Olympic debut this year, golf continues to be immensely popular for players and spectators alike. Golfing is a highly coordinated sport that, by its nature, is associated with risk of repetitive motion injuries.[1] Its broad appeal, however, makes it a cross-generational activity, attracting players with varying levels of ability and talent.

Golf-related injuries of the spine and upper extremities have been documented in the literature,[2] but there is a lack of information about its impact on the foot and ankle. Blistering is the most commonly reported lower extremity injury, but there are reported cases of plantar fasciitis and ankle sprain in the clinic.[3] Further, until quite recently, little attention had been paid to the role of the foot and ankle in golf's biomechanics, particularly during the swing.[4,5] An understanding of these mechanics will enhance clinicians' ability to help improve performance and prevent injury in golfers, particularly with the use of foot orthoses.

Understanding the golf swing

In a survey of golfers, 46.2% reported sustaining an injury during the golf swing.[2] The swing accounts for nearly 60% of the golfer's game,[6] and puts significant stress on the lower body.

To better understand the demands on the body, this analysis will discuss the swing motion in terms of four phases: ball set up and foot stance, backswing, downswing (acceleration and ball impact), and follow through (early and late).

Foot stance. To align the body with the target—the golf ball—the golfer's weight must be fairly equally distributed between the feet, with slightly more weight on the back foot.[7] In the optimal golf swing, the golfer rotates around a fixed back foot, then transfers the force to the front foot. Initial foot placement is critical, as a firmly planted foot improves shot accuracy and distance; conversely, foot slippage may negatively impact performance.[8]

Backswing. Golf involves large amplitude movements of the lead hip—away from the ball on the backswing and toward the left on the downswing in a right-handed player (opposite for a left-handed player).[9] The backswing positions the club head for a powerful downward motion toward the ball.[10] During the backswing, the lead leg undergoes external rotation secondary to the right pelvic internal rotation. This results in 60% to 80% weight transfer to the trailing side[10] and concomitant flexion, adduction, and hip internal rotation on the same side.[11] The trunk rotation required to increase the club head speed puts stress on the lumbar spine and may harm overall spine health.[9]

If the range of motion on the lead side hip is restricted, the spine may be negatively affected. However, allowing the lead heel to rise from the ground during the backswing may allow more pelvic rotation and decrease stress on the spine.[9]

Downswing. The goal of the downswing is to return the club head to the ball with maximum velocity and accuracy.[10] In the modern golf swing, the lead hip initiates and accelerates the left backward pelvic motion (in a right-handed golfer) by activating the left vastus lateralis and adductor magnus, which are active through weight transfer, and the right gluteus medius, which drives the rotation.[11] Similar to the backswing, reducing the fixation of the foot during rotation toward the ball may also decrease the compressive, rotational, and side-bending forces experienced by the spine.[9]

Because club head velocity is associated with weight transfer to the lateral target forefoot in amateur golfers, footwear or orthoses that shift weight anteriorly and laterally could help increase club head speed in this group.[12] Specifically, elevating the heel and providing medial arch support may increase club head speed in golfers at this skill level.

The downswing is associated with high peak loads on both the lead and trail knee.[13] In a study of healthy collegiate golfers,[14] the magnitude of the knee varus/adduction moment on the target side (just after ball contact) is higher than values reported in the literature for gait and stair ascent. These findings may be relevant for golfers with medial tibiofemoral compartment arthritis and must be considered in return to golf after knee surgery.[14]

Changing the initial foot position from straight to externally rotated has not been shown to reduce valgus stress at ball impact[14] but may be effective in reducing the varus force. Interestingly, footwear design (spiked vs spikeless) does not affect these forces.[8,13] Lateral wedging of orthoses may significantly reduce varus force at the knee in the golfer with degeneration of the medial compartment.[15] However, a comprehensive full-body approach may be a more effective way to minimize the stresses associated with hip, knee, and foot rotation. According to Wadsworth, treatment must always "address assessment of deficiencies in the kinetic chain."[16]

Follow through. The purpose of follow through is to decelerate the body and club head.[10] As the trunk rotates to the left and hips

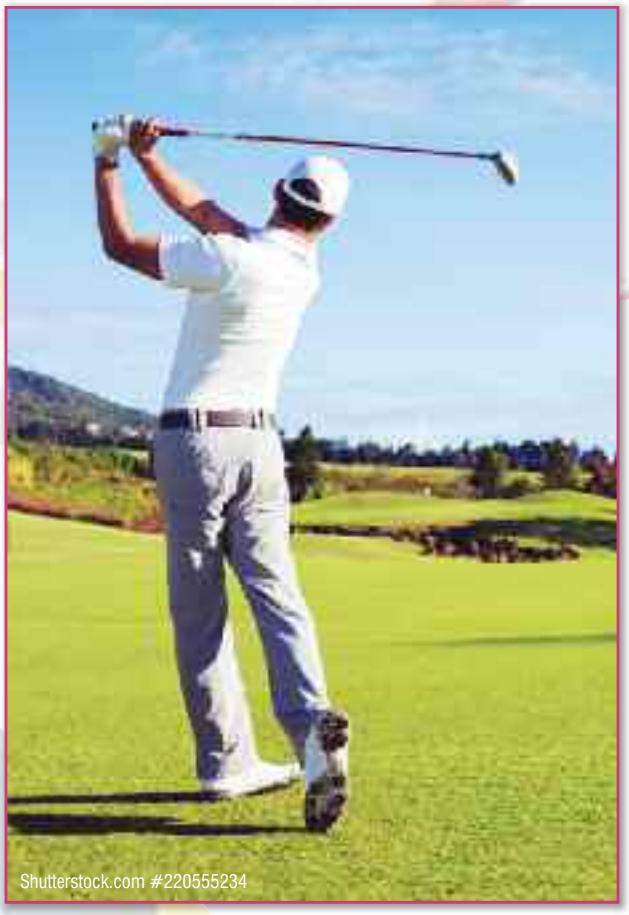
Sponsored by an educational grant from medi USA.

externally rotate, the lead ankle simultaneously internally rotates and supinates.[10] Fradkin et al found that most foot and ankle injuries in golfers were related to inversion (supination) of the ankle during follow through.[2] The rotational motions may also result in increased stress to the ligaments and meniscus of the knee.[17]

Footwear and injury reduction

Golf shoes with traction are almost as old as the sport; they first appeared in 1857.[18] During the 1900s, golf shoes were basic wingtip Oxfords with spikes. Because spikes damaged the golf course turf, however, design changes followed. Footwear is now specialized for golf biomechanics, but sole shape and spike configuration is much the same as in the past.[8] Williams and Cavanagh identified shear and vertical force as the most important elements influencing golf shoes' resistance to slippage, force generation, and stability.[19] Counterintuitively, modern golf shoes have not proven to impact drive accuracy or distance.[8] However, flexible custom orthoses have been associated with increased club head velocity, as discussed below.[5]

There has been little study of how golf shoe design parameters and comfort influence injury prevention. Shoes do need to provide stability, support, and traction while allowing divergent use of both feet and minimizing the discomfort and fatigue associated with negotiating a golf course's variable topography. It is a formidable challenge for a single shoe design to meet the complex biomechanical demands of the golf swing while providing enough comfort to traverse uneven ground. Addressing the variety of demands on the foot by switching footwear at differing times in the game could be a strategy in recreational golfers with disabling foot and ankle pain.


Shutterstock.com #220555234

Foot orthoses

The biomechanics of golf demand foot orthoses that can address a multitude of foot positions. Although prefabricated orthoses can help improve posture in the back foot, the effect may be limited by the devices' inability to fully address the differences between the lead and trail feet.[20] Semicustomizable carbon fiber orthoses that can accommodate posts or pods as needed merit individual study in the clinic or on the golf course. The asymmetrical mechanics of the golf swing are similar to the cutting motions in other cleated sports. Therefore, transferring stress with carbon fiber while maintaining flexibility may positively affect the forefoot during the golf swing, as it has been shown to do during cutting.[21]

Flexible customized foot orthoses have been associated with a positive influence on pain and fatigue in golfers.[4,5] The researchers noted the results cannot necessarily be extrapolated to all golfers, as the study participants were drawn from a specific population and the orthoses were of a specific design. Nonetheless, the positive findings are worth considering in the clinical management of any golfer.

Dynamic postural control is a key component of the backswing and follow through.[22] A recent study suggests that flexible orthoses may positively influence golfers' balance and proprioception,[4] which suggests such devices may have benefits for those aspects of the golf swing. This study had several limitations—it lacked a control group, the potential effect of the learning curve was not assessed, and the sample size was too small for full extrapolation—however, the findings suggest the need for further research.[4]

Ensuring comfort without disrupting balance will continue to be of paramount importance for a long and healthy golf habit, in spite of the variable research findings. As such, orthotic management in golf should consider:

1. Flexibility to allow the foot's dynamic function, including pronation/ supination, mediolateral movement, heel lift, and foot rotation;[9,10]
2. Appropriate fit within the shoe to reduce slippage during downswing and ball impact;[8]
3. Full-length insert to reduce the translation of the foot within the shoe and potentially enhance accuracy and speed;[8]
4. Inserts with a textured topcover to improve the coefficient of friction at the foot–orthosis interface and potentially enhance proprioceptive input and balance;[8,22,23]
5. Modifiable or semimodifiable devices to address the variable demands on the foot during the golf swing and while ambulating on the course;[10]
6. Modifiable to allow wedging laterally to reduce varus force at the knee in golfers with medial knee pathology;[15]
7. Inserts composed of lightweight carbon fiber to allow redistribution of force in the forefoot;[21] and
8. Lightweight and flexible materials to reduce fatigue associated with long periods of repetitive weightbearing and load shifting.[23]

The effects of orthoses on foot and ankle mechanics, as well as knee valgus and hip torque in golfers—among other sports—merit further study. The growing number of mature golfers who wish to pursue the sport in spite of "failing joints" must be met by advancements in orthotic science. Addressing deficiencies in the kinetic chain will have an impact on both injury prevention and performance enhancement and forge the way to a better, healthier game. ler

Patricia Pande, MClScPT, CSCS, CPed, is a physical therapist, pedorthist, and strength and conditioning specialist based in Durham, NC. She is the founder of FootCentric, an online continuing education company dedicated to comprehensive, multidisciplinary foot treatment.

References are available at lermagazine.com.

Sponsored by an educational grant from medi USA.

Megan's a blade runner

After her accident and amputation, Megan wondered if she'd ever run again. Her prosthetist knew that once she had healed, there was a way to give her a far better outcome.

The technicians at Spinal Technology are experts in fabricating the latest prosthesis technology to help patients like Megan lead full, rich lives. In fact, we have years of experience in fabricating lower limb prosthetics, using the most advanced materials and technology available.

Megan's new blade prosthesis is custom-crafted of lightweight carbon fiber, which helps her put smiles in her miles as she trains for her next half-marathon.

Find out for yourself. Call to place an order, and we'll show you how Spinal Technology can help you achieve better prosthetic results for your patients.

Spinal
Technology, Inc.

191 Mid Tech Drive West Yarmouth, MA 02673 | **800 253 7868** | **spinaltech.com**

Istockphoto.com #36758488

When knee OA research becomes legal testimony

In worker's compensation cases, including those involving knee osteoarthritis, an expert witness often will be asked to use his or her knowledge of biomechanics to provide an opinion supporting or refuting a causal relationship between work conditions and an overuse injury.

By Steven T. McCaw, PhD

Litigation following personal injury is widespread in today's society. Determining cause and allocating responsibility are at the heart of financial settlements in both criminal and civil cases. The social and economic consequences of the assigned liability can be enormous. In such cases, particularly those involving workplace injuries, lower extremity biomechanics often plays a key role.

The worker's compensation (WC) program provides coverage for medical and economic costs, such as lost wages, resulting from a workplace injury. WC programs began in the US in the early 1900s, and since 1949 all states have provided programs.[1] Under WC, employees forfeit the right to sue an employer for negligence in exchange for assured, but limited, compensation. WC provides a form of disability, health, and life insurance, with disputed claims adjudicated by a state administrative board overseen by an administrative judge instead of through a trial court. The board resolves contested claims by determining if an injury is work related. Appeals are generally limited, as one purpose of establishing WC was to reduce court adjudication of claims.

Establishing that workplace conditions or events were responsible for an injury can be a contentious issue in WC. In cases of traumatic injury, it's typically easy to isolate a single causative incident, such as a trip, fall, or crushing event. Overuse injuries are problematic because they develop from repetitive loading and not a single, isolated trauma. The task of separating possible work-related causes from possible away-from-work causes can be contentious in cases involving overuse injury. If the injury did not occur at work, any benefits must be covered through private insurance and not by WC. Claims for overuse injury are frequently challenged by employers, particularly in the manufacturing sector, where WC expenses represent 3% of overall employee costs per hour.[2]

Unlike the prosecution in a criminal case having to prove an accused individual's guilt "beyond a reasonable doubt," in a WC claim, showing causation requires support from a preponderance of the evidence, as carefully woven into a case by an attorney.[3]

Separating possible work-related causes from possible away-from-work causes can be contentious in worker's compensation cases involving overuse injury.

Continued from page 29

Often, a witness will be asked to use his or her knowledge of biomechanics to provide an expert opinion supporting or refuting a causal relationship between work conditions (identifying a source of the loading) and an overuse injury (developing from a known loading pattern). The opinion must be supported by evidence to a reasonable degree of scientific certainty, with the presiding judge determining the case outcome based on which side best demonstrated that standard.

The Occupational Safety and Health Administration (OSHA) guidelines[4] mandate that an employer "shall furnish to each of his employees employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical harm." Many WC disputes on overuse injury arise from the nebulous statements "recognized hazards that are causing or are likely to cause" and "serious harm."

The biomechanics of osteoarthritis

Osteoarthritis (OA) is a widely prevalent degenerative joint condition, affecting about 12% of the adult population in the US. OA is a "whole joint" disease because every anatomical structure within and around a joint is affected.[5] Patterns of OA have been linked with certain occupations,[6] and the job-related costs for medical treatment and lost productivity related to OA are in the billions of dollars.[7] OA is a form of "serious harm."

Structurally, knee OA is characterized by the thinning and eventual disappearance of articular cartilage. Damaged cartilage cannot heal because it is nonvascularized. Progressively, the articulating bone surfaces become denser, osteophytes project into the joint space, ligaments loosen, the joint capsule thickens, and surrounding muscles weaken through atrophy and changes in neural drive.[8-11] Importantly, the area of the cartilage that provides contact between the bones of the joint becomes smaller as it degenerates, altering the distribution of stress over the joint surfaces.[12] In advanced knee OA, the cartilage wears away completely and the surfaces of the now-contacting bones become severely deformed.

Cartilage changes associated with knee OA are typically evident on x-rays or magnetic resonance imaging before symptoms are reported. As mentioned, cartilage is not easily, if at all, repairable. This is important because the joint has typically reached a significant level of deterioration before interventions are started to treat the symptoms and slow progression of disease.

Knee OA interferes with kinesthetic sense, the ability to detect joint position and change of position. Kinesthetic sense is necessary to control the joint and to prevent excessive movement. Loss of position sense leads to additional knee instability,[13] and higher joint stress beyond that is caused by mechanical damage to the joint structures. This exacerbates the progression of knee OA and interferes with activities such as walking and stair use.

Clinically, knee OA includes symptoms specific to the joint (pain, perceived weakness, instability, and joint buckling) and symptoms specific to activity (impaired locomotion, ability to work, and recreation). Joint stiffness, swelling, inflammation, tenderness, crepitus, and limited range of motion are typical. Symptoms are aggravated by, and continue following, joint use.

The initiating factors for knee OA remain controversial, and this controversy underlies some companies' reluctance to pay knee OA-related WC claims. Two hypotheses dominate the discussion of knee

OA initiation. The inflammatory hypothesis[14] posits that inflammation within the joint capsule initiates the cartilage degeneration. The mechanical hypothesis[15] states that joint malalignment or injury alters the stress distribution over the cartilage within the joint to initiate the degenerative process.

What is not controversial is that, regardless of the initiating source, both mechanical loading and inflammation are present as joint failure progresses.[14,15] Treatment of the inflammation and other clinical symptoms will not reverse OA, or even slow progression, unless the source of mechanical loading is reduced or eliminated. Continued loading of a degenerating joint makes it inevitable that the degeneration process will continue. The problem is a conundrum in the workplace when repetitive loading is imposed by the design of or the requirements of a task performed at a workstation. For this reason, repetitive loading is a recognized hazard likely to cause serious physical harm in the form of OA.

A case in point

In a disputed WC claim, I was retained as an expert witness for a 57-year-old man following denial of coverage for knee joint replacement. He was morbidly obese with tricompartmental OA in his left knee, and had been employed by a manufacturing company for 36 years. The employer contended that his task, which included stepping up and down a 7-inch step four times per hour, had not caused the OA, and claimed the degeneration resulted from regular activity. The worker countered that several work incidents, including a slip on a bolt four years prior and a severe twisting of his knee when it gave out while he was stepping down from his platform two years earlier, caused knee joint damage that was aggravated by his continued use of the workstation step.

Clinical notes and medical records from physicians are needed to provide a critical foundation for any disability claim related to an overuse injury. Documented symptoms, and the diagnoses, prognoses, treatment plans, and prescriptions, supplemented with notes from physical or occupational therapists, create a timeline for the onset and progression of a condition. In the disputed case, records over the previous five years from the claimant's personal physician, the company medical team, and an independent orthopedist documented the progression of his OA. This included degeneration of the joint capsule, atrophy of the neuromuscular system, and symptoms including pain, inflammation, perception of instability, impaired movement, and sleep disturbances. The records also summarized the medical interventions that had been used, including diagnostic imaging, arthroscopic surgery (meniscectomy and chondroplasty three years earlier), oral medication, and anti-inflammatory injections. These provided only temporary pain relief and did not slow progression of OA to its advanced stage. There was general consensus that a joint replacement was necessary because conservative treatments had failed.

One aspect of the employer's liability in the claim was attributed to the design of the workstation, specifically repetitive use of the 7-inch step. The claimant's lawyer retained my services to provide an opinion on whether the workstation step exacerbated the progression of his OA.

Stair negotiation and knee OA

The three primary functions of the lower extremity during locomotion are energy absorption, energy generation, and support.[16] Compared

Continued on page 32

Continued from page 31

with level walking, each function is more demanding during stair negotiation. During lead foot contact in descent, the knee joint first flexes to absorb the downward momentum, then extends briefly to stabilize the body, and finally flexes again to lower to the next step. The loading of the lower extremity joints is increased by the need for a greater range of motion and higher muscle joint torques when navigating a step.[20,21]

Difficulty with stair use is a common complaint in patients with knee OA because of increased pain, muscle weakness, and the perception of the knee "giving out."[17] Individuals with knee OA compensate by using a strategy different from healthy individuals during stair use. They use steps more slowly than healthy individuals, which is most evident during stair descent, when controlling the body's downward momentum is critical.

Ground reaction forces (GRF), the external forces produced at the foot-ground interface to control locomotion, are higher during stair use than during level or sloped walking. The initial impulsive load magnitude at stair contact is about 33% higher and the loading rate is about 68% higher compared with initial contact during walking.[18,19] Coordinated joint flexion, controlled by eccentric muscle activity, is important to attenuate these forces as they propagate toward the head. Because they encounter greater absorption and stabilization demands while perceiving joint instability, patients with knee OA typically use a slightly wider step width,[18] a more extended knee position at stair contact,[18] and less joint flexion during absorption and body lowering than healthy individuals.[20] Reconciling the conflict between energy absorption and stability, individuals with knee OA accept higher joint loading to achieve greater joint stability.

Greater joint torques are required to control individual joint flexion and extension in patients with knee OA than in controls, and these joint torques result from higher levels of muscle activity. The activation level of both the quadriceps and hamstring muscles are slightly higher for individuals with knee OA than for those with healthy knees. This is of great importance because the increased muscle forces around the joint raise the bone-on-bone force within the joint more than can be attributed solely to the fluctuating GRFs. Greater activation of weaker muscles suggests individuals with knee OA use a higher percentage of their functional capacity than healthy individuals.[19,21] Thus, individuals with knee OA are more likely than those with healthy knees to fatigue with repetitive step use, further impairing energy absorption and creating a greater risk of falls.[21]

By descending more slowly and using less knee flexion, individuals with knee OA can reduce their net loading at the knee joint. Because knee OA reduces the joint contact area, however, stress on the remaining cartilage remains high in spite of the reduced loading.[22] Even with adaptations, continued step use contributes to the degenerative process.

Criteria for causation

The medical literature is typically based on studies of large samples. But injuries happen to individuals, not populations, and individuals vary in measured response across a sample. To present a convincing expert opinion implicating step use as a contributor to knee OA, it was important to meet three criteria[23,24] for causation:

1) Show the OA followed the loading in an appropriate temporal sequence;

2) Present objective evidence of both the loading exposure and the OA development; and

3) Demonstrate the biomechanical plausibility that the loading exposure exceeded the tolerance known to increase risk for knee OA.

These criteria of causation were met by combining the medical records and work history with the literature on the biomechanics of step use. The documented history of reported symptoms, physical evaluations, and medical treatments established the timeline of OA development following the employee's slip on the bolt. His work history of continued step use without significant modification, other than temporary restrictions immediately following his surgery, constituted repetitive loading that occurred during the period of OA progression. Synthesizing the published literature on knee loading during step use and on knee OA pathogenesis demonstrated the biomechanical plausibility of step use at work being a primary contributor to onset and progression of the employee's knee OA.

The decision

With these criteria covered, it was not difficult to confidently provide and defend an opinion that the step use at work was a probable causative factor in the onset and progression of OA necessitating knee joint replacement. The administrative board accepted this as a convincing opinion and ruled that the employee's OA was work-related. However, because of the possible precedent-setting nature of the decision as it applies to the widespread prevalence of OA in workers, the case is under appeal.

Steven T. McCaw, PhD, is a professor emeritus in exercise science from Illinois State University in Normal and now consults on personal injury cases through McCaw Biomechanics Consulting in Charleston, IL.

References are available at lermagazine.com.

STILL LOOKING FOR A FIT?

ComfortFit is Unmatched in Quality, Price and Service


Night Splints and Walkers


Stabilizer Brace


Richie Brace Products


Medicare-Approved Diabetic Shoes and Inserts


iTOM-CAT Scanning Technology


Comprehensive Line of Custom Foot Orthotics


Prefabricated Orthotics for All Ages

FLAT-RATE PRICING on all custom foot orthotics, including all additions/modifications and free shipping

7- TO 10-DAY TURNAROUND time on all orthotic orders

COMFORTFIT'S STUDENT MENTORING PROGRAM with our Medical Director, Dr. Barbara Campbell

APMSA COMPANY OF THE YEAR

E-SERVICE ON OUR WEBSITE with three years of order status information, online ordering capability, and product information, including coding, tutorials, and instructional videos

COMFORTFIT OFFERS custom foot orthotics for all activities and foot conditions, prefabs for adults and children, the full line of Richie Brace products, night splints and walkers, ComfortFit Stabilizer Brace, Medicare-approved diabetic shoes and inserts, ComfortFit's New Deluxe Pneumatic Walker and our new iTOM-CAT in-office iPad Air 2 based scanning system.

ComfortFit Orthotics

EMAIL contact@comfortfitlabs.com

VISIT www.comfortfitlabs.com

CALL 1-888-523-1600

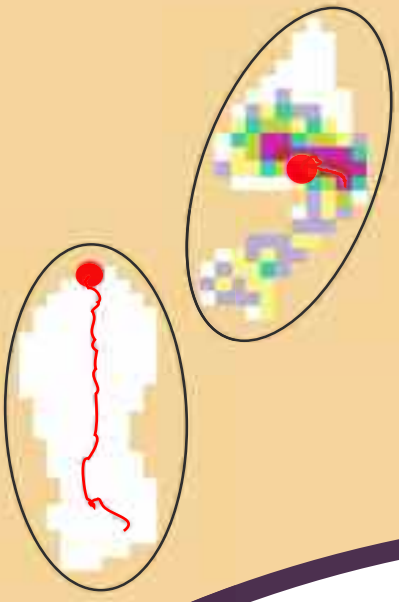
PROTOKINETICS

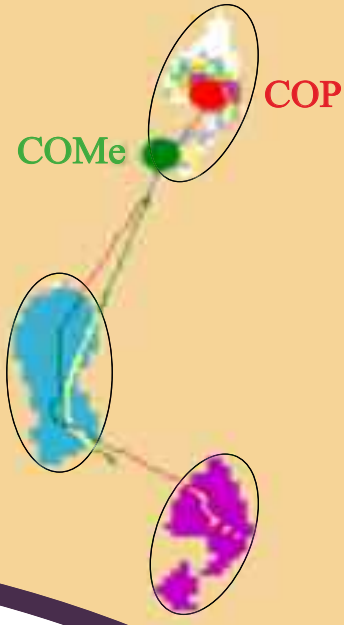
Leading Innovation in Gait & Balance Measurement

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


Istockphoto.com #37230558

Stroke rehab: Strategies to improve gait velocity

Multiple techniques can help improve gait speed after stroke, from therapeutic exercise to task-specific training to orthotic devices. Despite a growing body of research in this area, however, it is still not clear which intervention is most appropriate for which patients.

By Hank Black

When driving a car, speed can kill. But gait speed, in many patient populations, is an indicator of survival. It's been called "the sixth vital sign."[1] Famously, Stanaway et al, in studying a large group of community-walking older men, determined a speed (1.36 m/s) at which an individual might "outwalk the Grim Reaper."[2]

Walking velocity can also track progression through rehabilitation for individuals who have experienced a hemiplegic stroke. Walking speed, or changes in it, can help predict hospital discharge location and the need for rehabilitation.[3] In people with stroke, gait speed also has been found to be significantly correlated with function and level of disability.[4,5]

In the first week after experiencing a stroke, 63% of patients are unable to walk without assistance, and 50% cannot walk even with help,[6] so it's no surprise that a return to walking is a primary goal of rehabilitation.[7]

Once patients are medically stable, the goal of the acute care team is to get them up and taking steps if the insult to the central nervous system will allow it. Most patients ambulate more slowly poststroke than they did prior to the stroke due to reduced strength,[8] balance,[9] and cardiovascular fitness;[10] impaired cognition,[11] as well as prestroke function, also contribute to ambulatory status.

If ambulation is a plausible goal for an individual poststroke, a multitude of techniques are on the table, from therapeutic exercise to task-specific training to orthotic devices, or a combination of some or all of these.[12] Despite a growing body of research in this area, however, it is not clear which intervention is best and when it's best to apply it—at least in part because stroke is highly individualized.

"Truly, if you've seen one stroke, you've seen only one stroke, so an initial evaluation that can define the specific deficits from stroke is critical to developing the rehab plan," said Steven R. Flanagan, MD, chair of the Department of Rehabilitation Medicine at New York University Langone Medical Center in New York City. "The

Ankle foot orthoses and other orthotic devices for poststroke patients need to provide stability even as they allow for increasing mobility and gait speed.

Continued from page 35

amount of time a patient spends in the acute rehabilitation facility has decreased over the past several years, so our primary focus is to tailor a program to get folks to where they can at least negotiate within the home environment and realize that most near-term and long-term goals will mostly be attained in the home or outpatient setting."

Regardless of the rehab approach used, gait speed is an important outcome measure. Perry et al[4] developed three categories of gait speed that correlate with increasing levels of function. Someone who walks slower than .4 m/s is classified as a household ambulator, one whose gait speed is between .4 m/s and .8 m/s is a limited community ambulator, and one who walks faster than .8 m/s is considered able to walk in the community without substantial limitation. The minimum speed for unlimited community ambulation allows someone to cross a street before the traffic light changes. Those people who recover walking velocity and progress from one category to another experience increasingly better function and quality of life.[5]

The window of opportunity for increased function after stroke has widened over the years, Flanagan noted, but the most consistent and dramatic return of function occurs in the first few months following a stroke when the brain is most capable of remodeling, or neuroplasticity.

Although it can be a useful outcome measure, gait speed itself may not be the first concern of a clinical stroke rehabilitation team, experts say.

"We initially try to improve the manner with which patients walk, making sure their mechanics are right, and as that improves we may want to pick up their speed," said Flanagan, a member of the Board of Governors of the American Academy of Physical Medicine and Rehabilitation.

Other therapists may emphasize intensity of training, and the number of repetitions of steps, over biomechanics. Trisha Kesar, PhD, PT, assistant professor of rehabilitation medicine at Emory University School of Medicine in Atlanta, GA, said each method has pros and cons, and using only one global outcome measure such as walking speed for all interventions would be unfair.

Although her background is in biomechanics, in which quality of gait is paramount, Kesar said she sees an advantage of increasing speed and number of steps in the limited period of time available in a therapy session. A conventional outpatient rehabilitation session, she said, might be divided between several types of training, including balance, strength, walking over ground with assistance, and a few minutes on the treadmill.

"The problem is that, in forty-five minutes of therapy, which is what insurance pays for, you can't focus on any one aspect long enough to effect long-lasting changes in function and take advantage of the brain's neuroplasticity. That's the disadvantage of circuit training," she said. "Spending more time on treadmill training, in contrast, provides the ability to practice thousands of steps in a relatively short period of time, even if every step is not biomechanically beautiful. Intensity and repetition should be good for changing brain function after stroke."

Because stroke patients' walking ability can vary even among those with anatomically similar brain lesions, Kesar would like to see more research focusing on tailoring rehabilitation to a patient's baseline impairments and goals.

"This would help provide the basis for guidelines and criteria for decision-making about the best approach. But in general, gait speed and long-distance walking are the focus for function and return to work after stroke," she said.

Most interventions will improve speed, Kesar said, though the literature offers little help in determining which is best for a given patient. Task-specific training includes both circuit training, functional task practice, and treadmill training (with or without body weight support). Therapeutic exercise includes strength and resistance training, along with balance and cardiovascular/aerobic training. Orthoses, either conventional devices or those that provide nerve stimulation, are a third type of intervention frequently used early in the rehabilitation process to complement other therapies.[12]

AFOs and gait speed

Conventional ankle foot orthoses (AFOs) and sometimes knee ankle foot orthoses (KAFOs) are by far the most common devices used in poststroke rehabilitation, though training with neural stimulation devices is receiving increasing attention. Orthotic devices can help combat foot drop,[13] which is common to individuals poststroke, and allow gait training to start early on in the process. They are not, however, a substitute for functional exercise if the prognosis for motor recovery is good, experts say.[14]

Keith M. Smith, CO, LO, FAAOP, of Webster Groves, MO, past president of the American Academy of Orthotists and Prosthetists, described a bracing program for a poststroke patient as like a ladder.

"The particular deficits to be addressed determine which rung the patient is on in the climb back to independent ambulation," said Smith, who is in private practice at Orthotic and Prosthetic Lab in St. Louis. "The orthosis must be set up to be able to adapt to increasing strengths and ranges of motion, such as having the device's joints vacuumed in a solid design so it can later be converted to an articulating device as strength increases."

Orthotic devices for this population need to provide stability even as they allow for increasing mobility and gait speed, said Hilary Englehardt, LCPO, MBA, area clinic manager at Hanger Clinic in Seattle, WA.

"We like to allow as much range of motion as possible while maintaining proper alignment and ensuring that the patient is stable," Englehardt said. "Patients must be stable while standing before they can progress to working on their gait. If an evaluation of muscle strength reveals flaccidity and little muscle strength below the knee, we will increase the patient's stability by providing a more rigid orthosis."

The stability an AFO provides on the affected side allows a hemiplegic patient to advance the unaffected leg more quickly, she said.

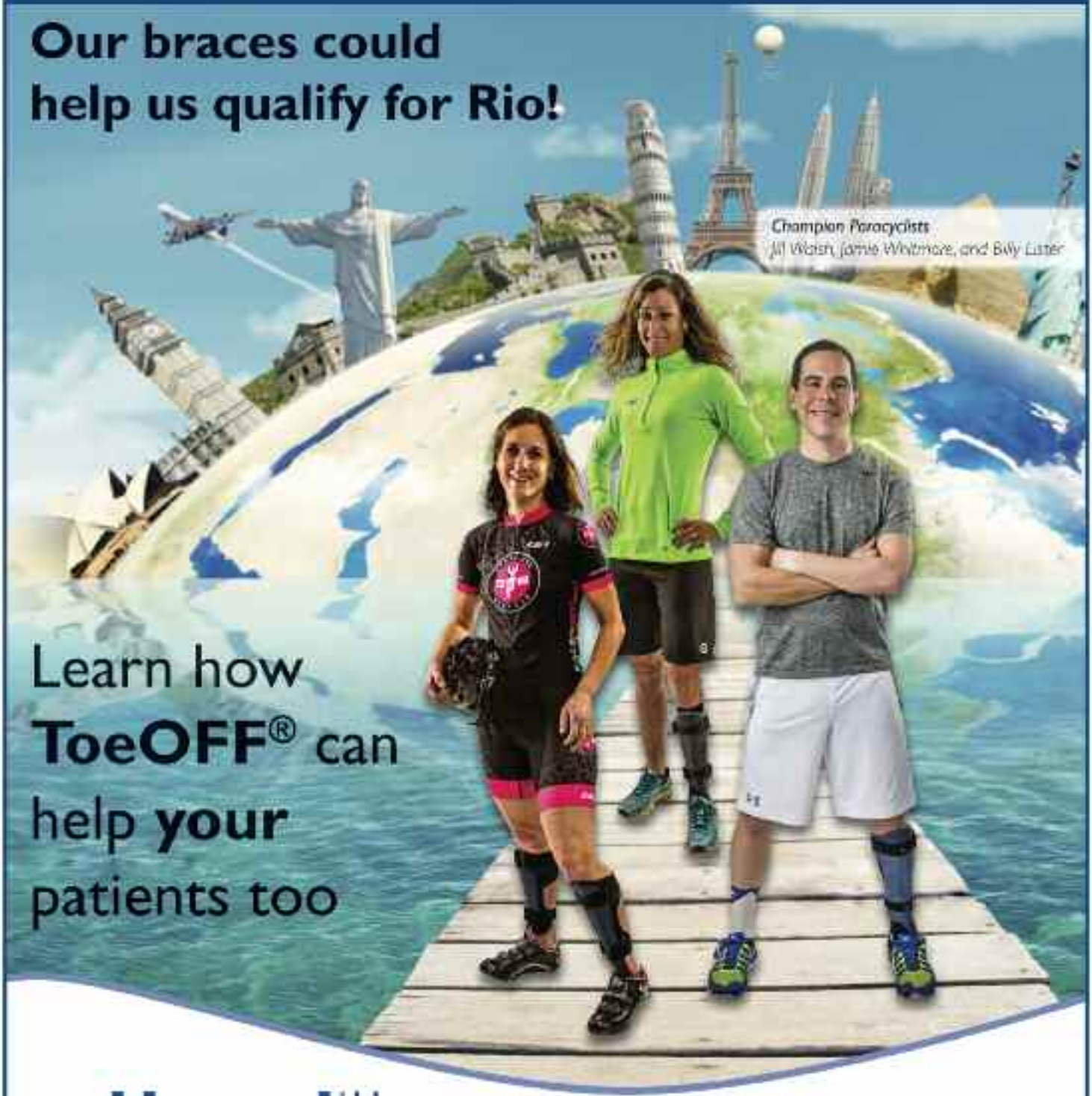
"We look at how the design of the orthosis helps the patient progress through stance phase while the affected foot is on the ground. We observe what happens at heel contact, how the tibia progresses through stance, and then how the patient rolls up on their toes, because that whole motion should be smooth and controlled," Englehardt said. "In the case of weak dorsiflexors or drop foot, providing assistance in picking up the foot increases ground clearance and allows them to swing that limb faster and clear the ground without lifting from the hip."

Timing of orthotic therapy is crucial for maximizing ambulation, Smith said, with early intervention most likely to prevent compensatory pathological gait patterns from developing and persisting. For example, he said, a patient with increased gastrocsoleus spasticity tends to quickly develop secondary knee hyperextension; if left

Continued on page 40

allard USA

Our braces could help us qualify for Rio!



Champion Paracyclists
Jill Walsh, Jamie Whitmore, and Billy Lister

Learn how **ToeOFF®** can help **your** patients too

allard USA www.allardusa.com

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

info@allardusa.com
Toll Free 888-678-6548
Fax 800-289-0809

DROP FOOT?

Just when you thought that there was nothing else to do for your customers.... Well think again!

FRANÇOIS CÔTÉ
President
Turbomed Orthotics
drop foot patient.

NO SKIN CONTACT

COME VISIT US AT AOPA
IN BOSTON, SEPTEMBER 2016

Patented in USA and Canada /Patent pending in all european countries

Turbomed is introducing the revolutionary **foot drop AFO FS3000**. A clever **alternative** to many existing carbon fiber AFOs that fit into the shoe!

See the stunning 3 minute video on our web site at: **turbomedorthotics**.com

- Running shoes
- Working shoes and boots
- Dress shoes
- Even sandals....
- 100% Transferable
- 100% External
- Lightweight as a carbon fiber AFO

- **No skin contact** what so ever with the foot or the ankle
- Amazing **energy return** due to the patented design
- Best warranty on the market*

Turbo Med ORTHOTICS

For more information call:
001 418 563-8675

or email us at
info@turbomedorthotics.com

turbomedorthotics.com

100% TRANSFERABLE

* Try the FS3000 for 2 months and if you are not satisfied, you will get a full refund.

Continued from page 36

untreated, this could cause a full loss of passive range of motion in the muscle, potentially leading to a strong pattern of knee hyperextension that in some cases may require trading a simple AFO for a device that extends more proximally.

"The goal is always to do the least amount of bracing necessary to provide most function," Smith said. "Typically the issue poststroke is what limits, assistance, or resistance do we need when choosing the AFO design. For example, will we need a dorsiflexion assist or plantar flexion or dorsiflexion stops? What motions can we allow? And should we rocker the shoes that will be used with the AFO?"

AFOs can induce an increase in gait speed by overcoming excessive plantar flexion and allowing the heel of the affected limb to contact the ground first. Karen J. Nolan, PhD, senior research scientist at Kessler Foundation in West Orange, NJ, found that AFO preservation of the first rocker provided the rollover effect that preserves momentum and increases gait speed.[15] Her research group also looked at changes in propulsion force at third rocker, or toe-off, but the results were inconsistent, Nolan said.

The AFOs used in that study were of a rigid design. As for energy-returning AFO designs, she said, "We've seen some very positive outcomes with those devices in the movement at the hip and at the ankle,[16] but we did not investigate the propulsive act."

Researchers have yet to examine whether newer joint technology systems that provide controlled or resisted motion will further impact gait velocity.

"These systems provide a controlled resistance into plantar flexion ensuring a heel strike at initial contact but also a true first rocker to accept weight in early stance," Smith said. "The determining factor is the extent of knee hyperextension and whether a plantar flexion stop would be necessary to ensure that the tibia would advance over the foot rather than into knee hyperextension as the patient progresses into the second rocker."

Rocker shoes, which also help propel patients through the gait cycle, are another option for stroke rehab, especially for those who need the additional stability a solid AFO provides. In a recent study, Farmani et al concluded that, when patients using AFOs also wore rocker shoes, their functional mobility improved and oxygen cost diminished.[17]

"If we lock down the patient's ankle with a solid orthosis, we need to consider putting a rocker type sole on the shoe so they have a smooth progression through stance," Englehardt said. "The degree of rocker depends on the patient's stability. Those who have better balance, proprioception, and strength can maintain control with a greater rocker, and a minimal rocker is better for those not quite ready for that much motion."

Rocker shoes may not be right for all patients, however.

"The advantages of a rockered shoe to replace the rockers lost with a solid AFO are great, but getting the patient to wear shoes with extra sole height can be challenging as they can be heavy, expensive, and cosmetically unappealing," Smith said.

Functional electrical stimulation

A recent review of six randomized controlled trials found functional electrical stimulation (FES) of the peroneal nerve for foot drop after stroke was as effective as conventional AFO use for increasing gait speed.[18]

"FES actually does more than mechanically reduce foot drop," Nolan said. "We looked more in depth at use of the device in community ambulation over a one-month period and found it can retrain the activation of the tibialis anterior muscle so when it's removed the effect continued.[19,20] So the FES resulted in a therapeutic effect."

Kesar said recent studies[21,22] from the University of Delaware in Newark showed a combination of fast treadmill walking and FES increased energy efficiency, as well as performance in distance tests. Her lab is studying whether the improvements in endurance after such a program are due to cardiovascular benefits of the faster exercise or to a neuroplastic effect strengthening brain-muscle connections.

"We are using transcranial magnetic stimulation and peripheral electrical stimulation to study if there are changes in spinal or brain circuity with gait rehabilitation," she said. "But, in parallel with that, we are monitoring biomechanics of the gait in an attempt to tease apart when the quality of walking function changes and when speed or endurance changes. That will tell us whether the time course of change in gait quality, neuroplasticity, and speed or endurance are similar. We also want to know whether we're improving both legs simultaneously or preferentially changing function in the leg affected by the stroke versus the other."

The neuroplastic abilities of the brain are also the focus of still other areas of stroke rehabilitation, including constraint-induced therapy.[23] More widely used for upper limb impairment because of the obvious difficulty of constraining the unaffected lower limb poststroke, the therapy forces the affected limb to be used repetitively over several weeks, theoretically inducing the development of appropriate neural connections.

Kesar said a similar effect can be seen by preferentially training

the stroke-impaired leg instead of constraining the unaffected leg.

"FES can achieve a similar preferential activation of the muscles of the affected leg. We are also looking at split-treadmill walking, differentially speeding up the affected leg's treadmill belt, but haven't yet defined the biomechanical effects of this treatment," she said. "It's tricky, because preferentially speeding up the affected leg may help with some mechanics, but slowing it down may help with others, such as the asymmetry of a limp. Again, the intervention has to be customized according to an individual's impairment instead of a one-size-fits-all strategy."

Asymmetries after stroke are related to slow gait speed.[24] Reisman et al found step-length asymmetry could be improved post-stroke with repeated split-belt treadmill training.[25] She also led a group that reported the effect of step-length symmetry continues after the training, when walking on same-speed belts.[26,27] The compelled body-weight shift approach[28] proposed by Aruin et al (see "Inserts improve symmetry, velocity in stroke patients," June 2013, page 23) also calls on the brain's neuroplasticity in forcing increased weightbearing on the weaker leg to improve symmetry and gait speed, Kesar noted.

"You place a lift under the unaffected foot, so in a way it's similar to using the split-belt treadmill," she said. "If you put in a little elevation preferentially on one leg, you bias the system to force the other leg to bear more weight."

Measuring gait speed

Measuring gait speed is easy, cost effective, and takes very little time. A stopwatch is the only equipment required. Setting up the test is as simple as marking off a straight line 20 meters long and subtly marking the middle 10 meters, which is the only distance timed. The patient walks at a self-selected (safe and comfortable) speed. In confined spaces, an even shorter distance may be measured.[1]

Defining clinically meaningful improvement in gait speed is more difficult. In a 2006 study of a diverse group of older adults with varying diagnoses, .05 m/s was cited as the necessary change for a meaningful improvement in walking speed.[29] But, for patients with subacute stroke, Tilson et al used data from the LEAPS (locomotor experience applied poststroke) multisite randomized clinical trial to develop a reference value of .16 m/s as a minimal clinically important difference that can be used to develop target goals and interpret progress.[30]

Experts interviewed for this article agreed that gait speed is an important sign of progress in stroke rehabilitation while acknowledging that no research has defined the best intervention to target it. But NYU Langone's Flanagan is optimistic.

"One of the problems in doing research in rehabilitation medicine is the tremendous heterogeneity of stroke; the phenotype is so variable. And you can't do a placebo trial because that means you don't provide rehab to some patients," he said. "But we recognize these challenges, and I believe the increasing volume and quality of research in stroke rehabilitation will be able to provide the answers we need." ler

Hank Black is a freelance writer in Birmingham, AL.

References are available at lermagazine.com.

BAUERFEIND®
MOTION IS LIFE.

"I ONLY WANT THE BEST."

Dirk Nowitzki
13-time NBA All-Star
Bauerfeind Ambassador

TRY OUT
GenuTrain® S Pro
L1832/L1833

GenuTrain®
The Original Knee Support.

For a sample request, please email:
sample@bauerfeindusa.com

BAUERFEIND.COM


Shutterstock.com #393622249

Posture-specific strength and landing mechanics

Recent research suggests that training designed to maximize strength at deeper knee flexion angles during landing may be warranted, especially in female athletes, to help reduce the risk of anterior cruciate ligament injury without inadvertently compromising jump height.

By Boyi Dai, PhD; Jacob S. Layer; and Taylour J. Hinshaw

Landing is a type of fall in which the person falling is able to strike the surface with controlled movement patterns. During landing activities, the musculoskeletal system responds to the landing surface by generating forces and moments that progressively decelerate the body's downward velocity.[1,2] Inappropriate landing patterns are associated with increased risks of lower extremity injuries, such as anterior cruciate ligament (ACL) injury and patellofemoral pain syndrome.

Video analysis has shown that individuals who suffer ACL injuries typically demonstrate decreased knee flexion angles and increased knee valgus–varus angles during landing near the time point at which the injury occurs.[3-7] Prospective studies have suggested that athletes who land with relatively large knee valgus angles and moments, high-impact ground reaction forces, small knee flexion angles,[8] and small sagittal plane joint displacements[9] during baseline assessments are more likely to suffer ACL injuries. Another prospective study has identified relatively small knee flexion angles and ground reaction forces during landing, as well as relatively weak quadriceps and hamstring muscles, as risk factors for patellofemoral pain syndrome.[10]

Based on these identified landing-specific risk factors for ACL injuries, one strategy for at-risk individuals to decrease that risk is to land with more knee flexion, less knee valgus, and lower ground reaction forces. Using different feedback modalities, including verbal, visual, and tactile feedback, investigators have developed many training strategies to modify jump-landing patterns.[11-14] Research has shown immediate improvements in both knee flexion angles and ground reaction forces following a short period of feedback training. However, these changes in landing mechanics may not represent a true learning effect because they can result in decreased performance, as indicated by an accompanying decline in jump height and increase in stance time.[11,14,15] It is questionable whether competitive athletes will be willing to modify their landing patterns if decreased performance is a possible result, especially during competitions. The ultimate goal of jump-landing training should be for individuals to perform the modified landing pattern automatically and efficiently, without sacrificing performance.[14]

In addition to isometric squat training, transitional front and back squats could also be performed with greater knee flexion angles to achieve training goals.

Continued from page 43

Strength assessment

Strength is an essential component of sports performance and injury prevention. Previous investigators have hypothesized that lower extremity strength and landing mechanics, in particular, may be related.[10,16-19] The lower extremity musculature contracts, primarily eccentrically, to absorb impact ground reaction forces during landing. However, studies designed to identify clinically relevant associations between strength and landing mechanics may be limited by the techniques used to assess strength.

Although strength is typically measured in terms of the maximum torque or force a group of muscles can produce, several factors need to be considered during strength assessments. During a strength assessment, a group of muscles activate to generate internal torques around a single joint or multiple joints. The internal torques may be counterbalanced by external torques generated by external forces. Therefore, strength may be quantified in terms of external forces, external torques, internal torques, or internal forces. External forces and torques are the most commonly used measurements of strength.

For example, when isometric quadriceps strength is assessed using a dynamometer, the force measured by the dynamometer is an external force.[10,16] If the dynamometer is applied perpendicular to the shank, the external torque can be quantified by multiplying the external force by the distance between the dynamometer's point of contact and the knee joint.[20] Once the external torques generated by the weights of the shank and foot have been quantified, internal knee extension torques can be calculated using an inverse dynamic approach. Assuming no muscle co-activation, knee extension torque can be divided by the patellar tendon moment arm to estimate the quadriceps force. Internal torques can also be determined using a computerized dynamometer after adjusting for the external torques caused by segment weights and angular accelerations.[21]

Another factor is the muscle force-length-velocity relationship.[22] During concentric, isometric, and eccentric contractions, the length of muscles is shortened, kept the same, or elongated when forces are generated. The muscle force-velocity relationship describes that the maximum force muscle can generate decreases when the velocity of contraction increases during concentric contractions. The maximum force that can be generated is the greatest during eccentric contraction, second greatest during isometric contraction, and lowest during concentric contractions. As such, it is important to control the speed of muscle contraction when measuring strength.

Because the speed of muscle contraction is affected by the speed of joint motion, investigators commonly control joint motion speed during strength assessment; for example, controlling speed of knee flexion and extension when assessing quadriceps and hamstring strength.[18] The muscle force-length relationship indicates there is an optimal length for a muscle to generate maximum force. Therefore, the magnitudes of joint angles, which directly affect muscle length, also need to be considered during strength testing.[10]

Two other important factors are task modalities and body posture. During an open-chain exercise, such as kicking a soccer ball, the distal joints are typically free to move. However, distal joints have little motion during closed-chain movements, such as jumping from the ground. Previously, investigators have found different knee joint contact forces, shear forces, and thigh muscle activations between two closed-chain exercises (squat vs leg press) and between the closed-chain exercises and an open-chain exercise (knee extension).[23] In another study, participants performed squat exercises to train for lower extremity strength. Although squat training was associated with gains of more than 20% for both vertical jump height and load in maximal squat, no change was found in isokinetic knee extension torques assessed during an open-chain task.[24] A recent study found squat training was more effective than leg press training for improving jump performance.[25]

These studies highlight the importance of task modality and body posture in strength training and assessments. The greatest strength gain is likely to be associated with the exercises used for training. One should also keep in mind that, in addition to the muscle force-length-velocity relationship, neural adaptation and multijoint coordination also contribute to the specificity of strength training.[25]

Strength and landing mechanics

Previous studies on the relationship between strength and landing mechanics are not consistent. Although some findings have suggested a correlation between lower extremity strength and knee flexion angles during landing, other findings have indicated a lack of correlation. These inconsistent findings may be related to the use of different strength assessments in the various studies.

The aforementioned prospective study on landing mechanics and risks of patellofemoral pain syndrome found quadriceps and hamstring weakness was associated with risk of injury. In this study quadriceps and hamstring strength were assessed isometrically in sitting or prone positions.[10] In a different study, Lephart et al assessed the association between landing mechanics and isokinetic quadriceps and hamstring strength, and found women demonstrated smaller knee flexion angles during landing and less strength than men.[18] On the other hand, another study using the same military data set as the patellofemoral pain syndrome study found weak correlations between Land Error Scoring System scores (a visual assessment of landing mechanics to assess injury risk) and lower extremity muscle isometric strength.[16] Shultz et al found that isometric quadriceps and hamstring strength were poor predictors of knee and hip flexion angles during landing.[19]

In these studies, quadriceps and hamstring strength was mainly assessed isometrically or isokinetically during an open-chain exercise in a seated or prone position. However, landing is a closed-chain task in which the body is in a relatively upright position. The advantage of isometric or isokinetic strength assessment is the ability to isolate different muscle groups, such as knee and hip extensors and flexors. The disadvantage, however, is the inability to accurately simulate the body postures associated with landing.

Our research

To better assess the dynamic strength utilized during landing, we recently completed a study to quantify the relationship between the peak force production during isometric squats at different knee flexion angles and the knee flexion angles during landing.[26] Eighteen male and 18 female recreational and collegiate athletes participated. They did a jump-landing-jump task while knee flexion angles were recorded

Continued on page 46

HAPPY**MEDIUM**

the arizonamezzo

800.288.7027 | WWW.AZAFO.NET

The OHI Family of Brands

APEX AZafo Langer PedAlign safeStep The Orthotic Group

Continued from page 44

during the landing phase. Four isometric squats at different knee flexion angles were also performed, and the bilateral ground reaction forces were recorded during the squats to assess strength.

Interestingly, we found significant correlations only for women. In our female participants, we found significant and strong correlations between knee flexion angle at initial contact during landing and peak force production during isometric squats at knee flexion angles of 55° and 70°, and between the peak knee flexion angle during landing and the peak force production during isometric squats at knee flexion angles of 55°, 70°, and 90°. These correlations tended to be stronger for the isometric squats performed with greater knee flexion angles.

Based on the findings, we concluded that posture-specific strength may play a role in determining the self-selected knee flexion angles during landing in women, and therefore may contribute to ACL injury risk.

In previous studies in which participants did a landing task from a jump or a drop, the landing could be the end of the task or followed by another jump.[10,16-19] Investigators have quantified the differences in kinematics and kinetics between a landing with or without a subsequent jump, and shown that landing with a jump is associated with greater peak anterior tibial shear force, internal knee extension moment, and internal knee varus moment. Landing without a jump results in decreased knee and hip flexion and increased side-to-side asymmetry in vertical ground reaction force and height of center of mass.[27,28]

Although ACL injuries have been observed during different landing types, different landing tasks may load the ACL differently and are associated with different ACL injury risk factors.[3-7] Findings from studies using different landing protocols should also be compared with caution; doing so may have contributed to some inconsistencies in previous studies.

During the landing phase, the knee and hip joint angles are relatively small at initial contact and increase during the landing phase. Knee and hip joint angles typically vary between 10° and 100° throughout the landing phase.[29,30] During a jump-landing-jump task, the landing is followed by a jump for maximum height. Therefore, the goal is to dissipate impact ground reaction forces during the landing phase and then generate ground reaction force during the jumping phase. From an injury prevention perspective, lower impact ground reaction forces are associated with decreased injury risks. From a performance perspective, greater ground reaction forces during the jumping phase are associated with increased jump height. As such, the relationship between posture and the ability to produce force needs to be considered during a jump-landing-jump task, especially during the jumping phase.

Increasing knee and hip angles typically increases the moment arms of the vertical ground reaction force about the knee and hip, and results in decreased magnitude of vertical ground reaction forces relative to internal joint torques. Therefore, increased knee and hip joint angles place the lower extremity in a position of mechanical disadvantage for producing vertical ground reaction force for the jump. It is reasonable to observe that individuals who are stronger at increased hip and knee flexion angles will tend to utilize these deeper flexion angles because they may benefit from the additional range of motion to produce force for the jump. Conversely,

individuals who are weaker at deeper hip and knee joint angles may avoid these positions, from which they are unable to produce sufficient force to use the additional range of motion effectively.

Gender considerations

Our study's observation of significant correlations between strength and landing mechanics only in women is consistent with the findings of two previous studies[31,32] that found significant correlations between strength and energy adoption patterns during landing in female participants, but not in their male counterparts. Other factors, such as balance, range of motion, and motor learning of landing techniques,[33] may explain the lack of correlation between posture-specific strength and knee flexion angles during landing in men.

Men are generally stronger than women in terms of both raw strength and strength relative to body weight. In the current study, we postulated the lower force production in female participants suggests a more important role in women compared with men of strength as a determinant of landing mechanics. In men, other factors, such as motor learning of landing techniques, may play more important roles in landing mechanics.

Based on our findings, women may benefit from training designed to increase strength at greater degrees of knee flexion from both an injury prevention and performance training perspective. Literature has shown isometric squat training at greater knee flexion can increase force production during squats and joint moments during a jump.[34,35] In addition, isometric squat training at certain knee flexion could shift the optimal angle for torque production toward the training angle.[36] In addition to isometric squat training, transitional front and back squats could also be performed with greater knee flexion to achieve training goals.[37] Future intervention studies are needed to quantify the training effect on landing mechanics in women.

Summary

Impaired landing mechanics are associated with increased risks of lower extremity injury. Strength may play an important role in self-selected landing patterns, particularly in women. The findings of our study suggest posture-specific strength training may be considered a component of intervention to increase knee flexion angles during landing in women.

A jump landing is a closed-chain task that involves muscle eccentric and concentric contractions while the body is in a relatively upright posture; therefore, effective evaluation of the dynamic strength used in landing tasks requires development of assessment techniques superior to those involving the isometric squat. Additional studies on the effects of different posture-specific strength-training interventions on landing mechanics are needed to further quantify the cause-effect relationship between strength and landing mechanics. (ler)

Boyi Dai, PhD, is an assistant professor of biomechanics in the Division of Kinesiology and Health at the University of Wyoming in Laramie. Jacob S. Layer and Taylour J. Hinshaw are graduate students in the Division of Kinesiology and Health at the University of Wyoming.

References are available at lermagazine.com.

Levy® Diabetic Econ

Levy Diabetic Econ custom foot orthoses are manufactured using plaster cast, foam impressions or 3D scan. Levy Diabetic Econ I and Econ II are a cost-effective diabetic custom orthoses solution with a 3-5 day in house turn-around.

ECON I

A bi-laminate custom orthoses featuring 35 Tan EVA Base and Blue plastazote top cover

3 pair for $65

ECON II

A tri-laminate custom orthoses featuring 35 Tan EVA base, 1/16" PPT mid-layer and Blue plastazote top cover

3 pair for $75

Levy Rappel

800/564-LEVY (5389)
www.levyandrappel.com

Treatment of distal toe calluses and ulcerations

When calluses or ulcers develop on the distal aspect of the lesser toes, offloading pressure from the distal end of the digit is essential for healing to occur. Research suggests that toe crest pads offer an inexpensive but effective means of offloading and healing these distal wounds.

By Monica Melo, DNP, RN, ACNS-BC, CWOCN, CFCN

Treatment of distal toe calluses and ulcerations can be particularly challenging. The presence of multiple comorbidities, combined with toe deformity and the minimal amount of bone-covering tissue at the distal toe, can lead to the need for invasive treatments to achieve healing. These treatments can include revascularization through angioplasty, stenting, bypass, or a combination of procedures. Surgical correction of toe deformities can also be attempted to reduce pressure on the distal end of the affected digit(s). Toe amputation is another treatment option. Unfortunately, amputation of the digit can often precipitate the need for a more proximal amputation if the original surgical incision fails to heal.

The most common cause of preventable amputations in the neuropathic diabetic population is repetitive painless trauma leading to ulceration.[1] Lesser-toe deformities—including hammertoes, claw-toes, and mallet-toes—are common findings in patients with peripheral neuropathy, with or without associated diabetes mellitus.[2,3] Coughlin[2] noted these deformities also can occur with any inflammatory arthropathies, such as gout or arthritis; repetitive trauma, such as ill-fitting shoes; or neuromuscular diseases, including lumbar disc disease or polio. Toe deformities that are initially flexible become rigid over time. This rigidity leads to increased pressures and skin shear over the distal digits and bony prominences. McGuire[4] has written that joint stiffness caused by rigid deformities decreases the digit's ability to absorb excess pressure.

Lesser-toe deformities can be precursors to the development of callus or ulceration on the distal aspect of the affected digits. Cavanaugh and Bus[5] noted that claw-toe deformities are one of the most common causes of ulceration in neuropathic patients. Peripheral vascular disease also contributes to the risk of ulcer formation, and is present in 90% of patients with diabetes who undergo major amputations.[6]

Chronic repetitive stress on the distal end of the toe, especially in neuropathic patients, leads to callus formation. A callus is an area of thickened hyperkeratotic skin cells that are compacted by pressure

A crest pad made of rolled gauze covered in moleskin offers an alternative approach that minimizes the risks associated with tight bands or rings in at-risk patients.

Continued from page 49

or friction.[7] If the pressure continues, hemorrhage within the callus layers will become evident. Boulton[8] described this presentation as a preulcerative lesion that needs aggressive management to avoid ulcer development. Simple callus removal through debridement may reduce pressures up to 30%, but, without intervention to relieve the pressure, the callus will return and can lead to limb-threatening problems.[4,5]

Figure 1. Photos show an example of hemorrhagic callus with underlying ulcer (top), the same digit after debridement of the callus (center), and after 12 days of crest pad use (bottom). Reprinted with permission from reference 17.

Treatment

When treating any wound, the principles of wound management, as outlined by Doughty,[9] should be used to guide decision making. First, the underlying cause of the wound needs to be determined. Reduction or elimination of causative factors is one of the basic tenets of wound care.[9,10] Secondly, systemic support should be provided. This includes adequate nutrition and fluids, appropriate oxygenation, and control of systemic variables such as blood glucose levels. Finally, appropriate topical therapy should be applied.

The first goal of topical therapy is to remove necrotic tissue. This can occur through sharp debridement or the use of dressings, such as enzymatic debriding agents. Of note, stable eschars in patients with arterial insufficiency should not be debrided until circulation has been optimized. Neuropathic ulcers should be routinely debrided of devitalized tissue and surrounding callus at one- to four-week intervals.[11]

The second goal of topical therapy is the identification and elimination of infection. During wound assessment, a positive probe-to-bone test has a high positive predictive value for osteomyelitis.[11,12] The chosen topical therapy has to fill any dead space in the wound to decrease the likelihood of abscess formation.

Another goal of topical therapy is selecting a dressing that will absorb exudate, protecting the periwound area, while maintaining a moist wound surface. Finally, the chosen therapy should provide thermal insulation and protect the healing wound.

Rothman's model of causation[13] describes two types of causes for the occurrence of a given disease or problem. Sufficient causes invariably produce a particular effect. Component causes work together to produce a given effect. Blocking the causal role of one component will therefore block the effect.[13]

Distal toe callus most often occurs with a triad of component causes—neuropathy, pressure, and deformity. Per the Rothman model of causation,[13] removing pressure will prevent the development of callus. This aligns with the principle of wound management addressing identification and elimination of the underlying wound cause(s).

Reducing distal toe pressure can be accomplished through surgical intervention, often involving flexor tenotomy.[14] Schade[15] noted that flexor tenotomy can be employed as a treatment for current ulceration as well as for the prevention of future callus formation. Surgical repair options for fixed deformities include decompression of the affected joints, along with tendon repairs.[2] Boffeli, Abben, and Hyllengren[14] describe performing in-office distal toe Symes amputations to excise distal lesser toe ulcers; this procedure removes the distal phalanx rather than the entire foot as is done with a conventional Symes amputation.

In-office distal toe Symes amputation offloads the tip of the toe, prevents ulcer recurrence, removes infected bone, and is most effective in treating affected digits that have rigid deformities, excessive length, and associated nail pathology.[14] Unfortunately, many patients are at high risk for complications related to any surgical intervention, and require more conservative approaches.

Offloading the distal toe also can be accomplished through the use of a crest pad. Crest pads are commercially available in several styles. The first is constructed entirely of silicone, and is held in place by a silicone ring around a toe. A second style is a foam crest pad, which is secured with an adjustable elastic band that wraps around a toe. Caution must be used to avoid producing an ischemic toe or

Continued on page 53

NEW!

shark-o™

Charcot Orthosis

OWLS™

KNOW BETTER ORTHOSES™

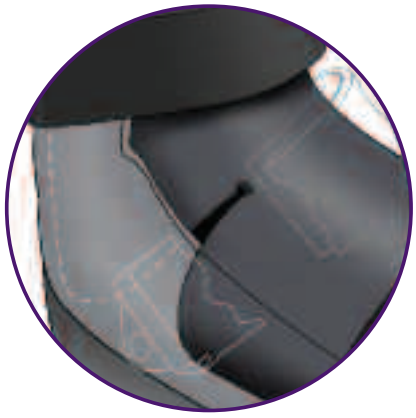
Custom to Cast or Scan from all industry standard file formats. Features: Liner made from ¼" aliplast foam. Outer shell constructed of polypropylene for maximum control of the foot and ankle complex. Molded copolymer anterior internal shell to limit shear forces and lock the leg in securely. Tri-laminated foot bed consisting of two densities EVA and one layer of P-Cell® to help protect the foot during treatment.

INDICATIONS

Used for the prevention and management of pressure ulcers caused by ischemia, direct trauma and/or repetitive stress often found in persons with:

- Diabetes Mellitus
- Charcot deformity
- Decreased sensation and/or paralysis
- Foot fractures

The "shark-o style" CROW Orthosis is a viable design that makes fitting and follow-up of the Charcot foot easier and more effective. Its design features reduce orthosis weight and pressure to the plantar foot surface as compared to the traditional CROW.



Patent pending design allows adjustable volume changes of the calf while leaving the foot at a set volume. This is achieved by ***overlapping*** the foot section, locking it in place while at the same time smoothly ***underlapping*** the calf area allowing the anterior shell to slide easily under the posterior.

This transition is made possible by the notched wedge shaped trim cutout at the ankle/instep. The patient can easily adjust for daily calf volume (edema) changes with simple strap adjustments.

Look for this mark on genuine shark-o®

ORTHOMERICA®

877-737-8444 | www.orthomerica.com

With PolyMem®, finger and toe injuries don't have to slow you down.

Save time with PolyMem Finger/Toe dressings, which are easy to apply – even for patients themselves – and often require fewer dressing changes thanks to their unique design. Simply roll the dressing onto the injured digit and let PolyMem do the work. PolyMem dressings help reduce edema, bruising, pain and inflammation when applied to open or closed injuries.

THE IDEAL CHOICE FOR MANAGING:

- Sprains
- Strains
- Contusions
- Abrasions
- Lacerations
- Burns
- Ulcers
- Matricectomies

NEW, BIGGER sizes available – ideal for large toes!

CLEANSES
MOISTENS
PolyMem
FILLS
ABSORBS
more healing • less pain®

Ferris Mfg. Corp. 5133 Northeast Parkway, Fort Worth, TX 76106 USA • +1 817-900-1301 • www.polymem.eu

MKL-619, REV-1, 0913

Continued from page 50

Figure 2. A toe crest pad in place.

a pressure ulcer from the band. Patients with neuropathy are particularly at risk.

Huppin[16] has described adding a crest pad directly to an orthotic insert; a temporary crest pad of adhesive felt is used to assess comfort prior to making it a permanent addition to the insert. Incorporating the crest pad into the insert assures that it is always being utilized; however, the patient has to be using both the prescribed shoes and inserts. Moving the insert with the molded crest pad into another pair of shoes could result in pressure over the dorsal aspect of the toes if the toe box is not of sufficient depth.

A crest pad made of rolled gauze covered in moleskin offers an alternative approach that minimizes the risks associated with tight bands or rings in at-risk patients. This design allows the affected toes to slide through an opening in the moleskin and rest on top of the rolled gauze pad. Over the course of several days, the pad will mold to the plantar surface to accommodate any deformities more comfortably.

This author and colleagues conducted a pre–post intervention retrospective chart review of the use of moleskin and gauze crest pads.[17] The purpose of the study was to examine the use of crest pads in the treatment of toe callus, hemorrhagic callus, and ulceration in individuals with lesser toe deformities. All crest pads were made by the primary researcher at the time of the patient's visit. A retrospective chart review was performed for patients seen between August 1, 2011 and December 31, 2014 who were treated with a gauze and moleskin crest pad. Callus and ulcer characteristics were compared pre- and postintervention.

Twenty-eight patients were identified as receiving a crest pad as part of their treatment, which consisted of nail or callus debridement or both as part of routine foot care. Of these, three patients were treated with a crest pad as a preventive measure and were thus excluded. Two were excluded based on the lack of a follow-up visit, and one patient was excluded due to early identification of

Continued on page 55

Trust DARCO to Assist in the Healing Process.


WCS™ Closed-Toe


MedSurg™ with PTQ series PegAssist™


PegAssist™ Walker

Off-load wounds and ulcerations of the foot with our footwear and off-loading insoles.

DARCO Wound Care products are:

DARCO has worked with the global wound care community for over 30 years. Our collaboration with surgeons and care providers has helped us with the research and development of a wound care product line that is effective, efficient and economical. Our goal is to meet the special requirements of patients, prevent wounds and ulcerations around the foot as well as healing existing wounds. In doing this we can create an improved quality of life for your patients.

www.darcointernational.com/off-loading-wound-care

WOUNDCARE-CIRCLE
Get pressure ulcers under control

DARCO

Continued from page 53

osteomyelitis. The total sample size for the study was 22 patients, evenly divided between men and women. Two patients were aged between 50 and 59 years, five were aged between 60 and 69 years, eight were aged between 70 and 79 years, and seven were 80 years or older.[17]

Patients were divided into callus, hemorrhagic callus, and ulcer groups. At up to four follow-up visits, patients were recorded as either improved/resolved or unchanged/worsened. New crest pads were made for each patient at follow-up visits. The first callus follow-up group (at a mean of 45 days) had 20 resolved/improved patients and one unchanged/worsened patient, which represented a statistically significant improvement from baseline ($p < .001$).[17] The second callus follow-up group (at a mean of 97.4 days) had 13 patients in the resolved/improved group and one in the unchanged/worsened group; this also represented a statistically significant improvement from baseline ($p = .0002$).[17] The 21 patients in the third follow-up group (at a mean of 112 days) and the 11 patients in the fourth follow-up group (at a mean of 236 days) were all deemed resolved/improved. Patients returned for follow-up to receive routine nail care even after healing of the ulcer or resolution of the callus. This allowed us to document the maintenance of healed ulceration or lack of callus.[17]

Patients reported the moleskin crest pads were comfortable, especially after several days of use, which allowed the pads to mold to the shape of the toes. There were no reported adverse effects from the use of the pads, such as transfer ulcers or skin reactions. No patients developed dorsal toe ulcers, as the crest pad fits into the space under the toes. Discussion of proper footwear is standard during routine foot care visits, including an emphasis on a roomy toe box in shoes.

Discussion

Treatment of lesser toe callus and ulceration consists of eliminating infection, debriding callus, and offloading pressure. Patients with osteomyelitis will often require amputation of at least the distal end of the affected digit. Optimization of arterial circulation with angioplasty, stenting, or bypass may be required for healing for some patients. Offloading pressure from the distal end of the digit is essential in all cases if healing is to occur. This can be accomplished through the use of offloading devices such as crest pads.

While our study[17] did not address prevention of callus or ulceration through the use of crest pads, it is worth noting that, in those patients having multiple follow-ups for foot care, none developed a recurrent ulcer on the distal toes once the crest pad was applied.

Commercially available silicone crest pads may be a good offloading option for patients, providing that patients are educated in proper use of the device. Crest pads can also be incorporated into an orthotic insert. Moleskin and rolled gauze crest pads may also be a good alternative, and can be custom-made by providers during foot care visits. A video demonstrating how to make a moleskin crest pad can be viewed at http://youtu.be/AMguRDlbd98.

Monica Melo, DNP, RN, ACNS-BC, CWOCN, CFCN, is a clinical nurse specialist at LVPG Vascular Surgery in Allentown, PA, treating patients with vascular wounds and performing preventive foot and nail care services.

References are available at lermagazine.com.

MISSION POSSIBLE:

Flip-Flops for Mike Kinney

Mike Kinney, Footmaxx Territory Manager, is more than just a great guy - he's a great case study in what Footmaxx custom milled orthotic flip-flops can do. With every pair, our certified pedorthists work with our highly-trained lab technicians to design a pair of custom milled orthotic flip-flops just for your patient. For Mike, **Footmaxx custom milled orthotic flip-flops are the first and only flip-flops he can wear comfortably and safely.**

BAJA
By Footmaxx

2 Different Sized Feet

Left: Size 13 / Right: Size 12

Leg Length Inequality

1.5 cm Lift

Without Custom Milled Orthotic Flip-Flops

With Custom Milled Orthotic Flip-Flops

Footmaxx

Footmaxx.com

ad index

Please Support our Advertisers.

ler new p

Prefabricated DynaFlange

Apex introduces a prefabricated version of its custom DynaFlange orthotic support. This over-the-counter device features a rearfoot flange, which flexes at three points during heel strike to minimize the deforming effects of impact. DynaFlange orthotic supports are designed to provide superior shock absorption, then release the stored energy with each step to dynamically reposition the foot for optimal propulsion. DynaFlange orthotic supports also help to improve center of pressure and stability through all phases of the gait cycle, which in turn helps to improve posture while standing, walking, or running.

Apex
800/252-2739
apexfoot.com

Sheer Ease Hosiery

Therafirm is releasing an addition to its new brand, Ease by Therafirm. Sheer Ease styles include open- and closed-toe knee highs, thigh highs, and pantyhose in three compression levels—mild (15-20 mm Hg), moderate (20-30 mm Hg) and firm (30-40 mm Hg). The Sheer Ease line is made of soft, breathable, and moisture-wicking materials. Soft, knit-in bands on the knee highs and pantyhose, as well as silicone bands on the thigh highs, keep the hosiery comfortably in place. All styles are available in black, natural, and sand; mild- and moderate-compression closed-toe styles are also available in bronze, coal, cocoa, and navy.

Therafirm, a Knit-Rite company
866/842-0984
therafirm.com

Swede-O Patella Tracker

Swede-O introduces the Patella Tracker, a thermal support designed to help reduce swelling and associated pain while providing gentle counter "traction" to help prevent the patella from shifting out of position. Patellar positioning is accomplished with dynamic traction straps and a crescent-shaped foam internal buttress that can be positioned medially or laterally. The brace features a low-profile, open wrap design for easy application and adjustable straps for a comfortable fit. The contoured shape facilitates knee flexion and extension movement. The universal design fits either the right or left knee.

Swede-O
800/525-9339
swedeo.com

Orpyx LogR Analysis System

Orpyx LogR is a technology solution designed for accurate, efficient, and real-time foot and plantar pressure measurement and analysis. Featuring comfortable sensor-embedded shoe inserts, a simple but powerful iOS application, and cloud-based software for data storage and management, this wireless system can be used by researchers to assess foot and ankle health and performance. Potential applications include footwear and orthotic device design, biomechanics, sports performance, gait and balance assessments, posture research, rehabilitation, injury prevention, fall prevention, and more.

Orpyx Medical Technologies
855/996-7799
orpyx.com

roducts

Allied OSI Foot Gym Pro

Allied OSI Labs now offers the Foot Gym Pro, an all-in-one tool for performing eight different foot and ankle strengthening and rehabilitation exercises including toe curl, toe extension, dorsiflexion, plantar fascia stretch, arch massage, calf raise, calf stretch, and ankle inversion. The Foot Gym Pro can be used for the treatment of plantar fasciitis, Achilles tendinitis, and foot pain; it can also be used during rehabilitation after injury or surgery. The Foot Gym Pro also provides therapeutic and massage features, including a massage roller that can be filled with warm water or frozen for thermal therapeutic benefits.

Allied OSI Labs
800/444-3632
alliedosilabs.com

Acor AFO Gauntlets

For 2016, Acor has updated its custom AFO Gauntlets, which are handmade in the company's Cleveland, OH, facility. Also known as a "Leather Lacer," the company's most popular AFO (ankle foot orthosis) gauntlet is the G9210. This particular design comes with a choice of 18 colors of leather, polypropylene reinforcement, and a lining of leather or NeoSponge, a synthetic rubber cushioning material covered with silver-impregnated X-Static. The footbed area is now seamless, and Mini-Check antiskid soling is an option. The company has reduced turnaround time to five business days in-house.

Acor
800/237-2267
acor.com

PediFix ToeBuddy Long

Foot specialists since 1885, PediFix now offers a new version of its popular Visco-Gel ToeBuddy for dividing crooked toes, including overlapping, hammer, claw, and mallet toes. The ToeBuddy Long joins PediFix's wide variety of Visco-Gel products, all of which are constructed of SmartGel, which soothes and softens skin while it gently divides crooked toes, relieving irritation associated with rubbing. ToeBuddy products feature two loops to keep the spacer in position. The new ToeBuddy Long design features a longer, extended toe spacer, which is suited for more severe deformities of the first and second toes.

PediFix
800/424-5561
pedifix.com

Perforated Memory Foam Top Cover

ComfortFit Labs has expanded its topcover choices to seven with its purple perforated Memory Foam Top Cover. The 1/8" topcover forms to the contour of the foot based on heat. With perforations for improved air flow, it is designed to be both comfortable and durable. The line of topcovers, available with any ComfortFit custom foot orthoses at no extra charge, also includes antimicrobial, antifungal vinyl; Spenco (or equivalent); antifungal, odor-free bamboo/Neolon; perforated leather (now higher quality); diabetic; and Blue Cloud ethylene vinyl acetate. Topcovers can be cut to any length.

ComfortFit Labs
888/523-1600
comfortfitlabs.com

Visit lermagazine.com/products for more products and to submit your new product listing.

Complete Multi Axial Brace Ready to Fit

NEW Carbon Fiber AFO's - Same Great Quality - In Four Sizes

PDAC approved for Medicare reimbursement - L1971, L2210, L2820

Removable Liner

Carbon Fiber Construction

Made from Prepreg Carbon Fiber.

Multi Axial Joint

This design allows free plantar, dorsi flexion assist and 10 degrees varus and valgus motion of the ankle joint.

Urethane Band Technology

CustomComposite

Custom Composite Manufacturing, Inc.

www.cc-mfg.com | 866-273-2230

market mechanics

By Emily Delzell

EULAR-presented ArthritisPower data detail patient research, education priorities

Investigators involved in the CreakyJoints patient education initiative on June 10 presented preliminary results stemming from the ArthritisPower research registry at the 2016 Annual European Congress of Rheumatology (EULAR) in London, UK.

In an oral presentation at the People with Arthritis and Rheumatism in Europe (PARE) submeeting, investigators from the Global Healthy Living Foundation in Upper Nyack, NY, and the University of Alabama at Birmingham reported the top 10 topics a majority of 400 survey respondents with various arthritides and rheumatologic conditions rated "extremely important."

These were: How arthritis affects more than just joints (86%); signs a medication is not working (84%); importance of knowing how disease will progress, even if the news is bad (83%); side effects of available drugs, and how these drugs interact (82%); the available medications and treatments for your case (80%); how to understand results of monitoring tests (79%); finding the right rheumatologist (76%); how to take an active role in decisions about your care (76%); how your life will change as your disease progresses (74%); and how to speak up and help manage your care when your perspective is different from your doctor's (73%).

The same investigators also presented a poster showing 47 patients' top-ranked rheumatic disease educational concerns. These included knowledge about disease and medication, coping, communication, and physician selection.

The researchers concluded that patient-centered education and research should maximally address these questions.

Go to arthritispower.org to learn more about the Arthritis Power Research Network. ler

Arcopédico notes 50 years, study results

Sparks, NV-based Arcopédico USA, the only US distributor of Portuguese-made comfort and travel footwear, celebrated its 50th anniversary on May 4 by announcing results of its shoe comfort research.

Arcopédico designed the 18-month Star Shoes Project to identify the sole comfort of a diverse, international population. More than 2400 customers from 19 countries received boxes of phenolic foam and provided their footprint to researchers at the Institute of Science and Innovation in Mechanical Engineering at the University of Porto in Portugal. The researchers analyzed the prints in several simulated walking situations, and through their observations, developed new plantar topography for Arcopédico shoes.

Arcopédico is scheduled to bring the Star Sole to the US market in 2017. Italian scientist Elio Parodi founded Arcopédico in 1966 with his invention of an arch-supporting sole, which became the company's twin arch support sole. ler

ACFAS offers summer footcare help

The American College of Foot and Ankle Surgeons (ACFAS) in May released two new infographics for patients on summer foot issues.

Focused on keeping feet safe while barefoot and on sunny days, the educational tools are available for ACFAS members to download at http://ht.ly/iAfT300Mp8Q; nonmembers can get them at ACFAS's patient website, foothealthfacts.org. ler

Ottobock study, RCT support use of its C-Brace in paresis, Patella Pro in PFPS

Ottobock in May reported results of studies involving two of the Duderstadt, Germany-based company's devices.

Ottobock investigators on May 4 epublished in *Prosthetics and Orthotics International* results of a study that evaluated the potential benefits of the C-Brace Orthotronic Mobility System, a microprocessor stance and swing control orthosis, compared with a stance control orthosis and locked knee ankle foot orthosis in activities of daily living (ADL).

According to the Orthosis Evaluation Questionnaire filled out by the 13 patients with various lower limb pareses, the C-Brace significantly improved ambulation, paretic limb health, sounds, well-being, and ADL scores with regard to perceived safety and difficulty.

A second group of investigators, which also included Ottobock employees and consultants, on May 5 epublished in the *Archives of Orthopaedic and Trauma Surgery* results of a randomized controlled trial looking at the effects of the company's Patella Pro brace on patellofemoral pain syndrome (PFPS).

The researchers compared device wear plus supervised physical therapy with physical therapy alone in 156 people with PFPS.

After six and 12 weeks, patients wearing the medially directed patellar realignment brace had significantly better Knee Injury and Osteoarthritis Outcome Score (KOOS) subscales than the unbraced group, along with a higher mean Kujala score and less pain while climbing stairs or playing sports. After 54 weeks, the groups differed only for the KOOS activities of daily living subscale. ler

AOPA announces Thranhardt nominees

The Alexandria, VA-based American Orthotic & Prosthetic Association (AOPA) on May 23 announced the contenders for its 2016 Thranhardt Award. They are Beatrice Janka, MPO, CPO; Gordon Stevens, CPO, LPO; Kenton Kaufman, PhD, PE; and Lauren White, PT, DPT, PCS. The nominees will present their research at the 2016 AOPA National Assembly in September in Boston.

Janka, a clinical prosthetist-orthotist in Becker Orthopedic's Patient Care Division and a product development engineer for Becker's R&D team in Detroit, will present "The Effects of AFO Stiffness and Alignment on Lower Extremity Kinematics in Stroke and Multiple Sclerosis."

Stevens, president of Baker O&P in Dallas and a previous Thranhardt winner, will present "Increasing Functional Independence through Prosthetic Rehabilitation."

Kaufman, the W. Hall Wendel Jr. Musculoskeletal Research Professor, biomedical engineering professor and director of the Biomechanics-Motion Analysis Laboratory at the Mayo Clinic in Rochester, MN, will present "Functional Assessment and Satisfaction in K2 Transfemoral Amputees Receiving MPK Knees–Initial Findings."

White, a physical therapist with at Kennedy Krieger Institute's International Center for Spinal Cord Injury (ICSCI) who manages the Interdisciplinary Orthotic Clinic in Baltimore, will present "Development and Implementation of a Clinical Decision Making Algorithm for Aiding Orthotic Prescription for Patients with Neurological Impairments."

The Thranhardt award was launched by a gift from J.E. Hanger in memory of Howard R. Thranhardt, CP, in 1996. ler

Continued on page 62

Continued from page 61

ACSM, AMSSM award $20K research grant

The American College of Sports Medicine (ACSM) and American Medical Society for Sports Medicine (AMSSM) on May 26 awarded the $20,000 2016 ACSM-AMSSM Clinical Research Grant to Alison Brooks, MD, MPH, and her coinvestigator David Bell, PhD, ATC.

The ACSM-AMSSM Foundation awarded Brooks for her proposed research titled, "Parent-Athlete Knowledge of Sport Volume Recommendations, Attitudes and Beliefs Towards Sport Specialization." Brooks is assistant professor of orthopedics in the Division of Sports Medicine at the University of Wisconsin (UW)-Madison School of Medicine and Public Health and a team physician for UW Athletics.

The joint organization review committee that selected Brooks' research called it "ambitious," noting the investigation aims to survey 1000 parents and 1000 youth athletes.

In its fourth year, this collaborative project between the ACSM and AMSSM funds a single award to foster original scientific investigations with a strong clinical focus among physician members of ACSM and AMSSM. ler

AAOS releases patient education apps

The Rosemont, IL-based American Academy of Orthopaedic Surgeons (AAOS) in June introduced apps that help physicians explain musculoskeletal problems and procedures to patients.

The Guide to Orthopaedic Surgery apps feature easy-to-use visual tools to help patients understand their diagnosis and treatment options. Currently, the apps, codeveloped by the AAOS and Fort Collins, CO-based Visual Health Solutions, cover total knee replacement, total hip replacement, and anterior cruciate ligament reconstruction and can be loaded onto exam room desktops or iPads.

Practitioners can also add customized content to practice websites. AAOS is trialing the apps for free until June 30.

Go to aaos.org/patientapps to learn more. ler

Cryos Tech unveils new 3D foot scanner

Joliette, Canada-based Cryos Technologies on May 26 premiered a new 3D foot scanning system for podiatrists at the FIP (Federation Internationale des Podologues) World Congress of Podiatry in Montreal.

The CryoScan3D captures high-resolution, full-color 3D scans of the foot accurate to 250 microns (.25 mm) in less than .1 seconds, meaning patient movement can't distort the scan, according to a Cryos release. The compact device (38.5 x 68.5 cm/ 15 x 27 inches) can scan the foot in full-, semi- and nonweightbearing positions.

The company plans to make the system commercially available in September. ler

Spenco backs ultra-distance run for cancer

Waco, TX-based Spenco Medical reported on June 4 that ultra-distance runner Roy Weigand completed a 131-mile trek in Burbank, CA, in about 27 hours to raise funds to help support families of children with cancer.

Weigand, who runs in honor of Christopher Wilke, his son's friend who died from cancer, raised more than $12,000 for the Michael Hoefflin Foundation for Children's Cancer in Santa Clarita, CA. This is the third year Spenco has supported "Roy's Run for Christopher" by providing him with supportive insoles, recovery shoes, and other products.

Support Roy's Run for Chris topher at mhf.org. ler

Hanger reports internal audit results to SEC

Birmingham, AL-based Hanger on June 7 filed an 8-K form with the Securities and Exchange Commission (SEC) reporting the results of an internal investigation. The form, which companies must file to announce major events that shareholders should know about, details the recent findings of Hanger's internal audit committee.

The committee concluded it is "more likely than not" that certain former employees and officers, including its former CFO and chief accounting officer, engaged in inappropriate accounting practices. It also found certain former senior managers created an inappropriate "tone at the top" that led to weakness in Hanger's overall environment, though the committee reported Vinit K. Asar, Hanger's current CEO, was not involved in the inappropriate practices.

According to Asar, Hanger has taken steps to address issues the investigation uncovered, including hiring a new CFO, principal accounting officer, and corporate controller; strengthening accounting processes and controls; hiring additional, "highly qualified" employees and consultants; completing compliance training; and investing in infrastructure and systems "to reduce reliance on manual processes." ler

Steampunk offers 3D printing classes

Catoosa, OK-based Steampunk Bionics Academy in May announced four new class offerings on 3D printing: an introductory course called 3D Printing in Healthcare, as well as three practice-specific courses in Orthotics, Prosthetics, and Foot Orthotics, which cover scanning, design, and 3D printing of devices.

The academy classes teach students to use a mix of freeware, open-source software, and low-cost commercial scanning and design software, along with inexpensive 3D printing hardware, to put together a full scanning, design, and printing solution for a fraction of the cost of commercial systems.

The academy, a division of Tulsa, OK-based CFS Allied Health Education, is a self-funded, family owned provider of ABC/BOC pre- and postcertification level educational resources to the O&P, pedorthic, podiatric, pharmacy, and general healthcare community.

Visit steampunkbionics .com for more information. ler

AOSSM warns on early sport specialization

The American Orthopaedic Society for Sports Medicine (AOSSM) in April epublished a consensus statement concluding there is no evidence that young children will benefit from early sport specialization in the majority of sports, and that they are subject to overuse injury and burnout from concentrated activity.

Read the full statement on the *Orthopaedic Journal of Sports Medicine* website at http://ojs.sagepub.com/content/4/4/2325967116644241.full. ler

Sigvaris buys BiaCare to build product line

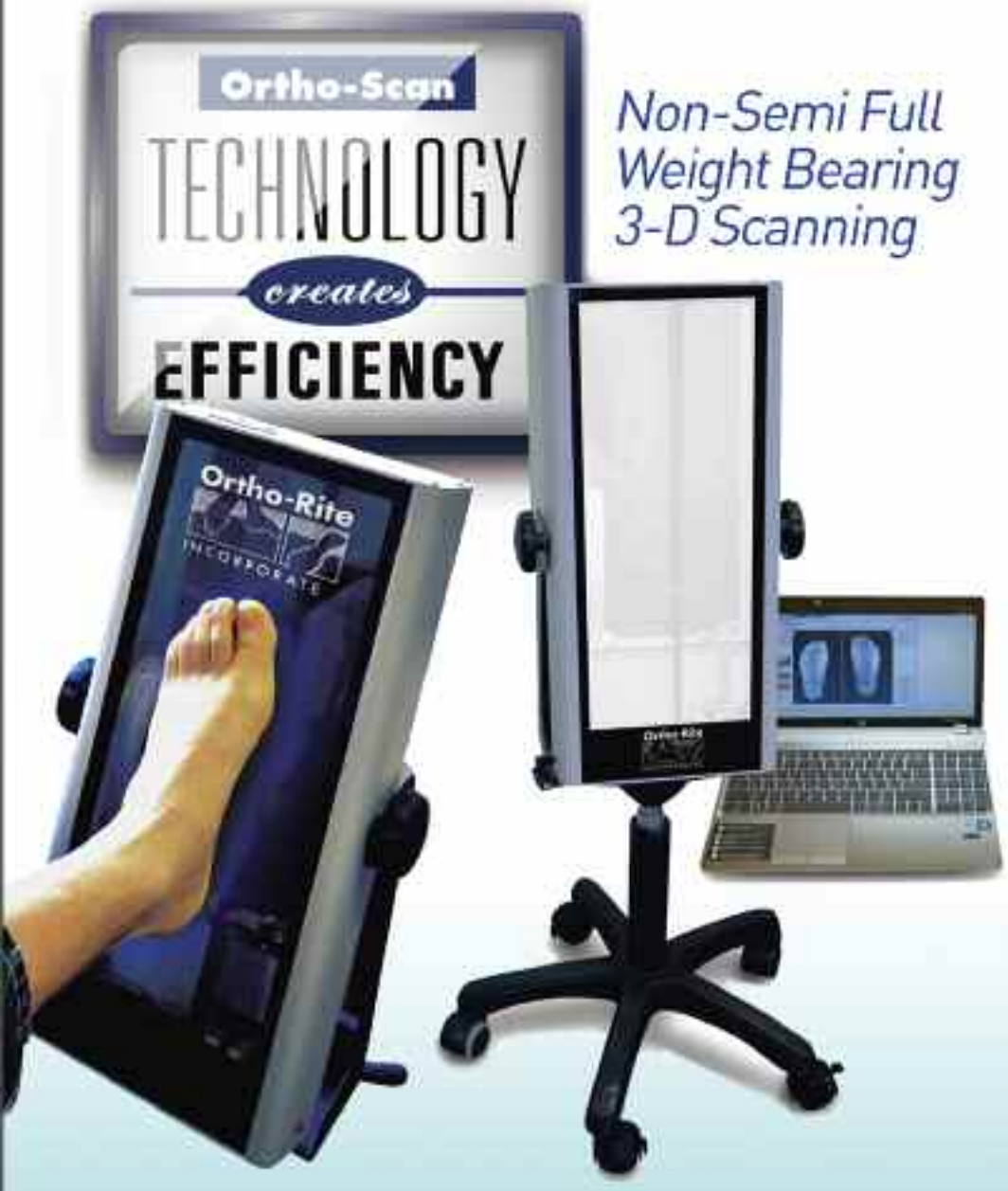
Winterthur, Switzerland-based Sigvaris announced April 29 that it has completed a definitive agreement to purchase BiaCare, located in Zeeland, MI. BiaCare designs and produces short stretch wraps, compression garments, and other products designed to treat patients with venolymphatic disorders.

Through this acquisition, the Sigvaris Group, which distributes in more than 70 countries, will continue its international growth strategy of expanding its product offerings for patients who need medically complex compression therapy options, according to a Sigvaris release. ler

Stop wasting time and money with plaster.

New Technology, Same Product

Get the same result from a 3-D scan



Non-Semi Full Weight Bearing 3-D Scanning

We will always accept traditional orthotic casting methods as well.

Call Us

Never hang up unhappy

800-473-6682

www.ortho-rite.com

Here are some of our orthotic products:

Ortho-Rite
INCORPORATED

65 Plain Ave.
New Rochelle, NY 10801
Fax: (914) 235-9697
info@ortho-rite.com

APEX
An OHI Company

EMBRACE INNOVATION

-1877-
Thomas Edison
Invents the phonograph

Patent # 9,179,736

dynaFLANGE®
ORTHOTIC SUPPORTS

State-of-the-art prefabricated orthotics

Did you know that the earliest foot orthotics date back at least 2,000 years when layers of wool were placed inside sandals to relieve foot fatigue? Or that the first recorded use of an arch support dates to 1865?

Since then, there have been many advances in over-the-counter foot orthotics, but innovation is now defined by the revolutionary Apex dynaFLANGE®.

The patented rearfoot flange flexes at three points during heel strike to minimize the deforming effects of impact. dynaFLANGE® provides exceptional shock absorption then releases that stored energy with each step and stride to dynamically reposition the foot for optimal propulsion.

Feel the Science™. Feel the Power. dynaFlange®.

To order, or for a free sample: 800-252-2739 • apexfoot.com
Orders begin shipping June 1

The OHI Family of Brands

APEX · AZafo ARIZONA · Langer Biomechanics · PedAlign · safestep PREVENTION PAYS · The Orthotic Group