• REHABILITATION • TRAUMA • DIABETES • BIOMECHANICS • SPORTS MEDICINE

ler

LOWER EXTREMITY REVIEW
October 15 / volume 7 / number 10

The mechanistic mysteries of FOAM ROLLING

+

O&P
FROM AMPUTEE TO CLINICAL PROSTHETIST: FOUR JOURNEYS

SPORTS MEDICINE
INCLUDING INJURY HISTORY ADDS VALUE TO FMS SCORE

REHABILITATION
POST-POLIO SYNDROME: IT TAKES A TEAM APPROACH

GAIT ANALYSIS
RUNNING IN AN EXERTED STATE: MECHANICAL EFFECTS

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

DATE 10.2015

MODEL	COLOR	STITCHING
No.52	Whiskey	Tan

SPECS

ANODYNE

PREMIUM QUALITY

DEFINITION

ANODYNE

[an-uh-dahyn]

noun

1. A medicine that alleviates or allays pain
2. Something that soothes and comforts:
   "The shoes were an anodyne for his feet"

adjective

3. Serving to relieve pain
4. Soothing to the mind or feelings

IMAGE

DEALER DETAILS

PDAC A5500, A5512, A5513, L5000 Reviewed
Full Custom Laboratory
iPad Scanner for Custom Accommodative Inserts

DEALER NAME AND INFORMATION

ANODYNE
www.anodyneshoes.com
phone: 1-844-637-4637
email: info@anodyneshoes.com

EST. 2015 SHOE MFG

ANODYNE

PREMIUM QUALITY

It seems everywhere we go, no matter the occasion, we're yearning for a sense of relief. A comfort in where we stand. And for many of us, it's not just where we stand. It's how we stand and what's keeping us going. It's easy to forget (and neglect) what allows us to stay active and on to our next venture. After all, the root of what keeps us stable, upright, and moving, is our feet.

An anodyne, by definition, is something that brings you a sense of soothing and comfort. The comfort we desire (and in some cases need) is unique to each of us. We believe that you deserve shoes that will meet your comfort and style needs, and allow you to maintain an active, healthy and productive lifestyle.

In a far too stagnant market of comfort-based footwear, we're bringing you an unparalleled collection of therapeutic and, at the very same time, refined footwear. At Anodyne, we've avoided the commercial vision of quick and easy comfort. Instead, we've returned to the fundamental roots of footwear – meticulous design, quality craftsmanship, and rigorous attention to detail. We're re-inventing the paradigm in comfort, and we want you to experience it firsthand.

1-844-637-4637

www.anodyneshoes.com

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!

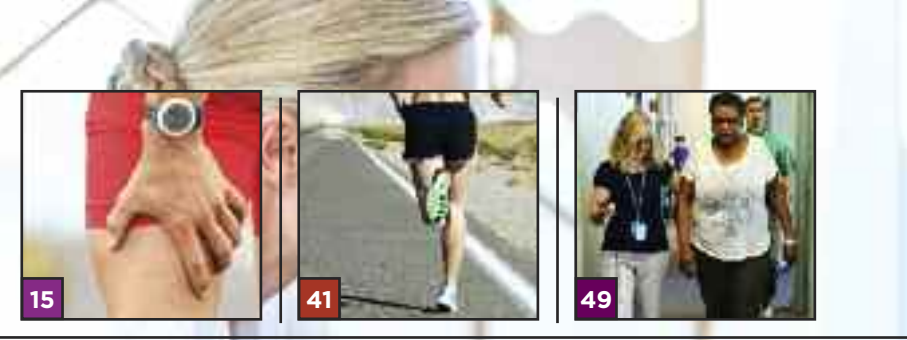
For more information visit:
richiebrace.com

THE Richie BRACE
RESTORING MOBILITY®

Lower Extremity Review

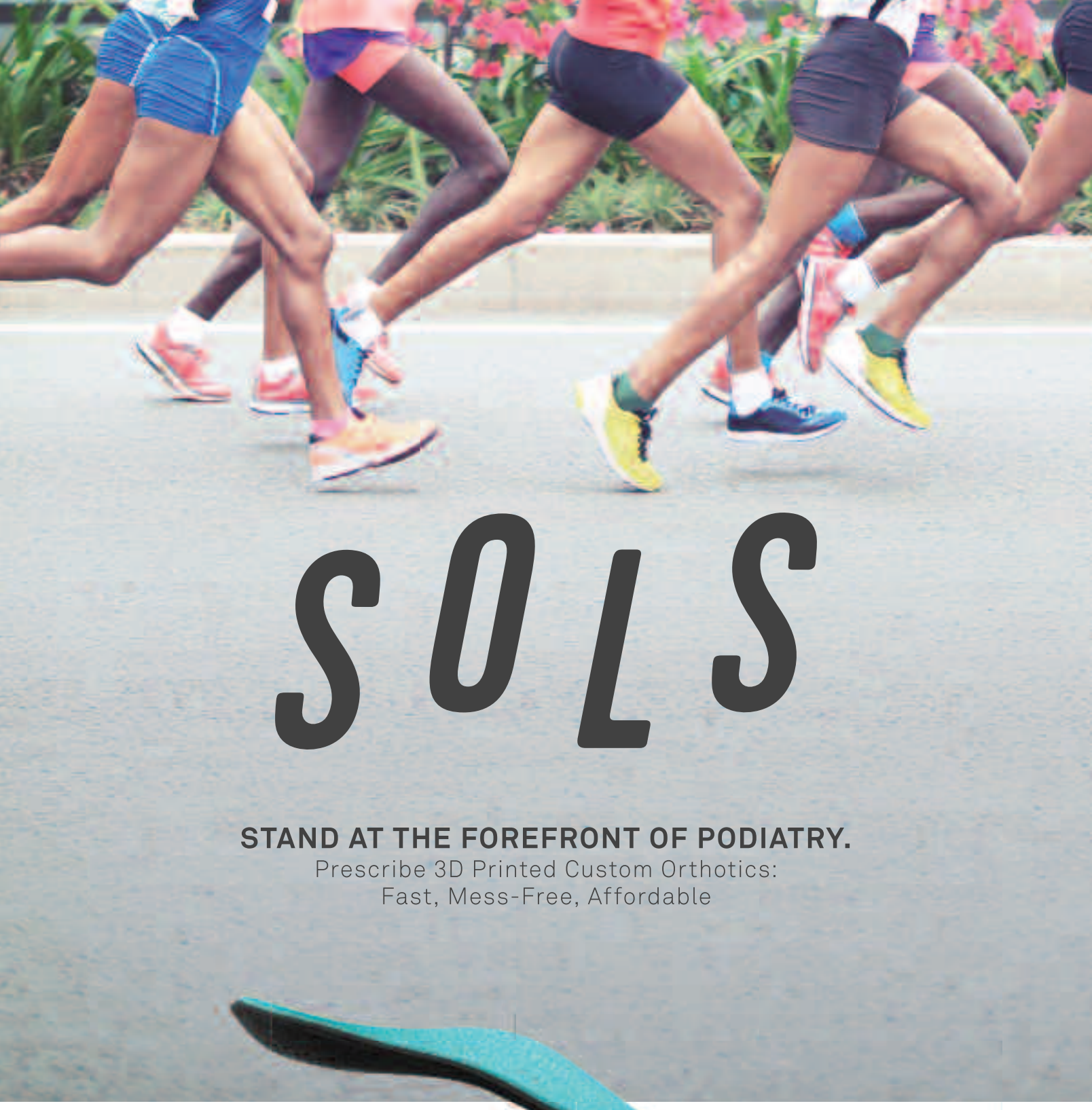
ler

October 2015



VOLUME 7 NUMBER 10 LERMAGAZINE.COM

features



SOLS

STAND AT THE FOREFRONT OF PODIATRY.

Prescribe 3D Printed Custom Orthotics:
Fast, Mess-Free, Affordable

SIGN UP OR LEARN MORE AT WWW.SOLS.COM/LER

Get 15% Off with Promo Code: **15SOLS**

Lower Extremity Review
ler

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
64,000 post views per month

twitter.com/LowerExtremity
2,616 Followers

youtube.com/user/LowerExtremityReview
122,000 video views

instagram.com/lowerextremity/
180 followers

pinterest.com/lowerextremity/
279 followers

ACOR® PRESENTS:

Sole Defense® EZ-Fit Orthotics

MULTI-LAYER PREMIUM ORTHOTICS

- Advanced Materials
- Increased Support
- Improved Cushioning
- 40% thinner in forefoot area than our conventional orthotics
- Easier to fit most shoes
- Ideal for retail!

Sole Defense® EZ-Fit Premium Orthotics SD-4001L	
Materials	Storm Puff + XRD® foam + Copoly + Dura Suede

PROTECTED BY Xrd TECHNOLOGY

Utilizes XRD® Extreme Impact Protection in the cushioning layer!

Sole Defense® EZ-Fit Premium Orthotics SD-4002L	
Materials	Leather + XRD® foam + Copoly + Dura Suede

Sole Defense® EZ-Fit Premium Orthotics SD-4003L	
Materials	X-Static®/Recoil + XRD® foam + Copoly + Dura Suede

Lower Extremity Review
ler

out on a limb:
Smoke signals

My grandmother smoked for decades, and although she did eventually succeed in quitting, she still spent the last few years of her life linked to an oxygen tank. And as a medical journalist, I'm very familiar with the long list of health-related disadvantages of smoking. So you can't blame me for being skeptical when I learned that smoking might actually have a protective effect against osteoarthritis (OA).

As counterintuitive as it may seem, a 2011 meta-analysis of 48 studies found an inverse relationship between smoking and OA of the knee and hip, and more research suggesting this protective effect has been published since then. Research has also found smoking to be protective against ulcerative colitis and Parkinson disease, possibly due to stimulatory effects of nicotine on neuronal acetylcholine receptors.

But, as we all know, study findings are not always as they seem. And the most recent publications on this topic suggest the relationship between smoking and OA is actually quite complicated.

As clinicians familiar with the biomechanics of OA in weightbearing joints, you might rightly point out that lower body mass index (BMI) in smokers than nonsmokers would naturally be associated with a lower risk of OA. But, although the aforementioned meta-analysis found the apparent protective effect of smoking was greater when the authors did not control for BMI, the positive effect still persisted after BMI was accounted for.

And the association between thinness and an apparent protective effect of smoking on OA risk may actually be important. In a March 2015 editorial, OA researchers from Boston University noted that variables other than smoking status (genetics, for example) can contribute to thinness, and the interaction between smoking and one or more of those other variables may underlie any protective effect.

It should also be noted that multiple OA studies have not found a protective effect of smoking. That includes a University of Massachusetts study epublished in late September in which smoking status was not associated with longitudinal changes in OA symptoms or joint space width.

Even more interesting from a clinical perspective is that, while the 2011 meta-analysis did find that smokers had less severe radiographic OA than nonsmokers, smokers had more severe OA pain than nonsmokers. That's the finding that really hits home for me.

> Research suggests smoking may have a protective effect against OA of the knee and hip. But it may not be that simple.

For my brother's most recent birthday, he asked for a vapor-based electronic cigarette system to help him give up smoking as part of an ongoing commitment to a healthier lifestyle. Interestingly, he's also had significant knee OA pain for most of his adult life.

It would take a lot for me to discourage my brother—or anyone—from quitting smoking. Nobody in our family wants to see my brother go through what our grandmother went through at the end of her life, and, even if giving up cigarettes ultimately increases the progression of radiographic knee OA, that's a trade I would always be willing to make. But, if giving up cigarettes can also help to alleviate my brother's knee pain, that's yet another good reason to do it.

Jordana Bieze Foster, *Editor*

Take Comfort in this…

The Apex 'Never Out' Program!

'Never Out' from Apex eliminates **Back Orders** and guarantees your patients' 18 favorite styles will always be in stock.

- Free wall display featuring a primary pack of 18 top selling Apex footwear styles*
- Guaranteed 72 hour shipping
- 25% discount on items that don't ship, plus free freight

Call for details: **800-252-2739**

APEX®
An OHI Company

414 Alfred Avenue
Teaneck, NJ 07666
www.apexfoot.com

** We bill your account $199 for the wall display but credit back the charge if you send us a photo of your mounted wall display within 60 days.*

The OHI Family of Brands

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

By Robyn Parets and Jordana Bieze Foster

Joint-friendly floors

Novel surface softens ballet landings

It's no surprise that ballet dancers, who spend hours rehearsing high impact jumps, experience a high incidence of lower extremity injuries. A new study, however, shows that dancers can reduce loading on lower extremity joints and help reduce injury risk by performing ballet jumps, also called sautés, on a reduced-stiffness floor.

Istockphoto.com #28219960

The study, published in September 2015 in the *Journal of Dance Medicine & Science* by a team of researchers from the Department of Physical Therapy at Missouri State University in Springfield, included 15 female dancers aged 18 to 28 years. All the dancers had at least five years of dance experience and no history of lower extremity injuries, surgeries, or recent pain. They performed sauté jumps on both a reduced-stiffness floor (also called a sprung floor) and a vinyl-covered concrete floor. Investigators measured maximum joint flexion and negative velocities of the ankles, knees, and hips on both types of floors.

The results: Jumping on the reduced-stiffness floor led to decreased maximum joint flexion angles and angular negative velocity in the lower extremity joints compared with performing the same jumps on the concrete floor.

"If a dancer lands a grande jeté, the joints bend, and the lower

Continued on page 14

Hip hop study finds excessive joint angles that could affect injury risk

Excessive peak angles in weightbearing joints during hip hop dance may contribute to lower extremity injuries in this population, according to a September 2015 study published in *Medical Problems of Performing Artists*.

Researchers from the Analysis of Dance and Movement Center and the Alvin Ailey American Dance Theater, both in New York City, analyzed the hip, knee, and ankle kinematics of six expert female hip hop dancers as they performed three choreographed sequences representative of top rock, breaking (breakdance), and house dance styles.

The investigators found the maximal joint angles associated with hip hop dance exceeded previously published values associated with activities of daily living and gymnastics. Peak angles during the breaking sequence were higher than the other two sequences for the majority of planes and joints analyzed.

The finding that much of hip hop dance occurs at the end ranges of weightbearing joints, where muscles are at a functional disadvantage, may help explain the incidence of lower extremity injuries in these dancers, the authors hypothesized. – *JBF*

Source:

Bronner S, Ojofeitimi S, Woo H. Extreme kinematics in selected hip hop dance sequences. Med Probl Perform Art 2015;30(3):126-134.

Textured insoles worn outside of dance class may improve ankle proprioception

Wearing textured insoles during nonclass time is associated with improved ankle proprioception in ballet dancers, according to research from the University of Canberra in Australia.

Investigators assessed the effects of textured insoles in 26 students from the Australian Ballet School in Melbourne (14 women), aged between 14 and 19 years. One group wore textured insoles in their athletic shoes during nonclass periods for four weeks while a second group followed standard practice, then the groups switched conditions for another four weeks.

Dancers in both groups demonstrated improved inversion and eversion ankle discrimination after wearing the insoles compared with baseline. The findings were epublished in September by the *International Journal of Sports Medicine*.

In a study epublished in April by *Physical Therapy in Sport*, the same researchers found wearing textured ballet shoe insoles was associated with improved inversion ankle discrimination in dancers with the lowest quartile of baseline scores. – *JBF*

Sources:

Steinberg N, Tirosh O, Adams R, et al. Does wearing textured insoles during non-class time improve proprioception in professional dancers? Int J Sports Med 2015 Sep 2. [Epub ahead of print]

Steinberg N, Waddington G, Adams R, et al. The effect of textured ballet shoe insoles on ankle proprioception in dancers. Phys Ther Sport 2015 Apr 29. [Epub ahead of print]

Continued from page 13

extremities compress, store energy, and then recoil," said James Hackney, PhD, PT, associate professor of physical therapy at the university and the study's lead author. A grand jeté is a type of sauté commonly known as a split jump, where one of the dancer's legs is stretched out in front of the body and the other is behind.

Jumping on a sprung floor reduces tension on lower extremity muscles and joints, as the reduced-stiffness surface absorbs some of the shock that is experienced by the lower extremities when a dancer jumps on a concrete floor, Hackney said. The findings suggest that dancers rehearsing on a sprung floor might experience a reduction in knee overuse injuries and Achilles tendon injuries.

Only female dancers participated in the study simply because it was easier to recruit women than men, Hackney said.

"I have no reason to think the results would not be the same with men," he said.

In fact, all ballet dancers have a lifetime injury rate as high as 84%, according to estimates from a study published in the September 2008 issue of *Archives of Physical Medicine & Rehabilitation*.

Hackney recommends that, to better prepare and train the body for the rigors of ballet jumps, dancers should rehearse mainly on a sprung surface, but also on a harder type of floor. This way the lower extremities are better prepared for either type of surface and less prone to injury, he said.

Training solely on a sprung floor, however, may not help reduce injury risk in dancers who then have to perform on concrete floors, said Jeff Russell, PhD, ATC, assistant professor of athletic training and director of Science and Health in Artistic Performance at Ohio University in Athens. If dancers train on a sprung floor and then spend a week or two performing on a concrete floor, there is a higher chance of an injury while performing, as they aren't accustomed to the force on the extremities associated with the harder floor, he said.

"These dancers get anxious when they realize they have to dance on a hard surface," Russell said.

Reduced-stiffness floors are installed at many major ballet companies, but they are expensive and this prohibits many mom-and-pop dance studios and even universities from putting in the flooring systems. It can cost upwards of $50,000, for example, to install a 50-foot by 50-foot reduced-stiffness floor system, Hackney said.

Research backing manufacturer claims that sprung floors can help reduce the risk of injuries could entice dance studios to spend the money on these surfaces.

"Dance is similar to [other] sports in terms of the physical demands on the body," Hackney said. – *RP*

Source:

Hackney J, Brummel S, Newman M, et al. Effect of reduced stiffness dance flooring on lower extremity joint angular trajectories during a ballet jump. J Dance Med Sci 2015;19(3):110-117.

Hincapie CA, Morton EJ, Cassidy JD. Musculoskeletal injuries and pain in dancers: A systematic review. Arch Phys Med Rehabil 2008;89(9):1819-1829.

By Chris Klingenberg and Jordana Bieze Foster

Eccentric and effective

Protocol lowers hamstring reinjury risk

Research epublished in September by the *Journal of Sport Rehabilitation* supports the use of eccentric strengthening at long muscle lengths for preventing recurrent hamstring injuries.


Istockphoto.com #21308308

The study, conducted at the Nicholas Institute of Sports Medicine & Athletic Training (NISMAT) in New York City, also underscores the importance of completing all phases of the hamstring rehabilitation protocol for preventing reinjury.

"Some athletes want to return to play before completing the proper rehabilitation," said Tim Tyler, MS, PT, ATC, a clinical research associate at NISMAT and lead author of the study. "External pressure from owners and coaches pushes some players back into competition against our wishes. We tell our athletes to do it right the first time or take a serious chance at having to start over with a worse injury and missing even more competition."

The study group comprised 50 athletes (20 women) diagnosed with a unilateral hamstring strain that occurred during sports performance or recreational exercise. All athletes followed the same three-phase rehabilitation protocol; an individual could not move on to the next phase without being pain free in the previous phase.

Continued on page 16

Supervised exercise for claudication may benefit men more than women

Supervised exercise therapy for intermittent claudication is more effective in men than in women, according to research from the Netherlands that suggests gender-specific interventions may be appropriate in this population.

Investigators from Catharina Hospital in Eindhoven performed a follow-up analysis on 169 patients (56 women) with peripheral arterial disease and intermittent claudication who received 12 months of supervised exercise therapy as part of an earlier randomized controlled trial.

Absolute claudication distance (ACD), defined as the distance a participant could walk before experiencing intolerable pain, was similar for men and women at baseline. The exercise intervention was associated with ACD improvement compared with baseline in both men and women, but the improvement at three months was significantly greater in men than in women. Men also significantly outperformed women at one year in absolute walking distance and several domains of the Walking Impairment Questionnaire.

The findings, published in the September issue of the *Journal of Vascular Surgery*, suggest that men and women with intermittent claudication may require different approaches to supervised exercise intervention. – *JBF*

Source:

Gommans LN, Scheltinga MR, van Sambeek MR, et al. Gender differences following supervised exercise therapy in patients with intermittent claudication. J Vasc Surg 2015;62(3):681-688.

Addition of pain coping skills training improves knee OA therapy outcomes

A combined intervention of exercise therapy plus training in pain coping skills is associated with better function than either intervention alone in patients with knee osteoarthritis (OA), according to an Australian randomized controlled trial.

Investigators from the University of Melbourne randomized 222 patients with knee OA who were aged 50 years or older to receive one of the three interventions. Each intervention involved 10 supervised sessions over 12 weeks, plus a home therapy program. The exercise protocols focused on strengthening; the pain coping protocols focused on pain education and cognitive and behavioral skills for dealing with pain.

The combined-intervention group demonstrated significantly greater improvement in functional scores (assessed using the Western Ontario and McMaster Universities Osteoarthritis Index) compared with baseline than either of the other groups at 12 and 32 weeks. Reductions in pain compared with baseline, as measured on a visual analog scale, for the combined-intervention group were not significantly greater than in the exercise-only group or the group that was trained only in pain coping skills. The findings were epublished in late September by *Arthritis Care & Research*. – *JBF*

Source:

Bennell KL, Ahamed Y, Jull G, et al. Physical therapist-delivered pain coping skills training and exercise for knee osteoarthritis: Randomized controlled trial. Arthritis Care Res 2015 Sep 28. [Epub ahead of print]

Continued from page 15

The goal of phase one was to protect the healing tissue, prevent motion loss, and minimize atrophy and strength loss. Phase two was designed to restore pain-free maximal hamstring contractions throughout the range of motion and improve neuromuscular control of the trunk and pelvis. Increasing hamstring strength at long muscle lengths was the goal of phase three.

On average, athletes required 11 weeks and 17 sessions to complete the three phases. Eight athletes did not complete the rehab protocol, returning to sports after the same number of weeks, but after just 11 sessions, on average. At follow-up, an average of two years after the initial injury, four reinjuries had occurred, all in noncompliant athletes.

"We are trying to get away from time and base our decisions on clinical milestones instead," Tyler said. "Anecdotally, to get the athlete pain-free in stage three took the longest. Compliant athletes average more treatments than noncompliant athletes—the difference was not statistically significant, but that could be because the number of noncompliant athletes was so small."

James Smuda, ATC, LAT, an athletic trainer in the UC San Diego Health System, weighed in on steps clinicians can take to increase compliance in athletes rehabbing from hamstring injuries.

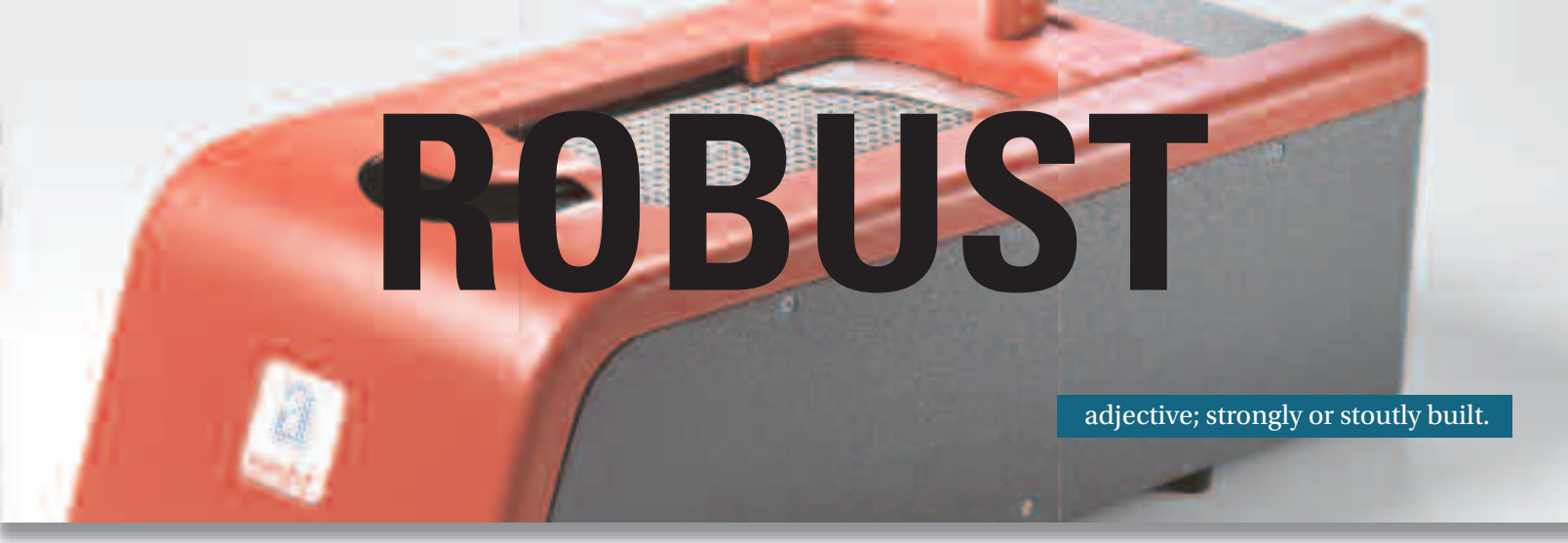
"From a clinical perspective, it's very important to first educate the patient on their injury—help them understand the etiology of their injury," Smuda said. "Once they understand what exactly is going on with their hamstring, I like to explain the findings from my evaluation, from both an injury perspective and a biomechanical perspective. Next, we go over the steps needed to return to play and what to expect. From there we establish both-short and long-term goals based on their individual injury and make a 'soft' projection of when they will return to full activity."

Kevin Cross, PhD, PT, ATC, a physical therapist, athletic trainer, and research coordinator at the University of Virginia-Healthsouth Rehabilitation Hospital in Charlottesville, agreed that developing a good rapport with the patient and providing education and feedback about expectations and goals are important.

"The patient needs to understand the healing process of the injured tissue with timelines for introducing stresses to maximize the tissue health," Cross said. "This education may reduce the patient's frustration with the 'slow' progress, and it will justify the rationale for the current program goals. Getting the patient's feedback and having the patient participate in planning their rehabilitation will increase the patient's ownership of the program and responsibility for the outcome." – *CK*

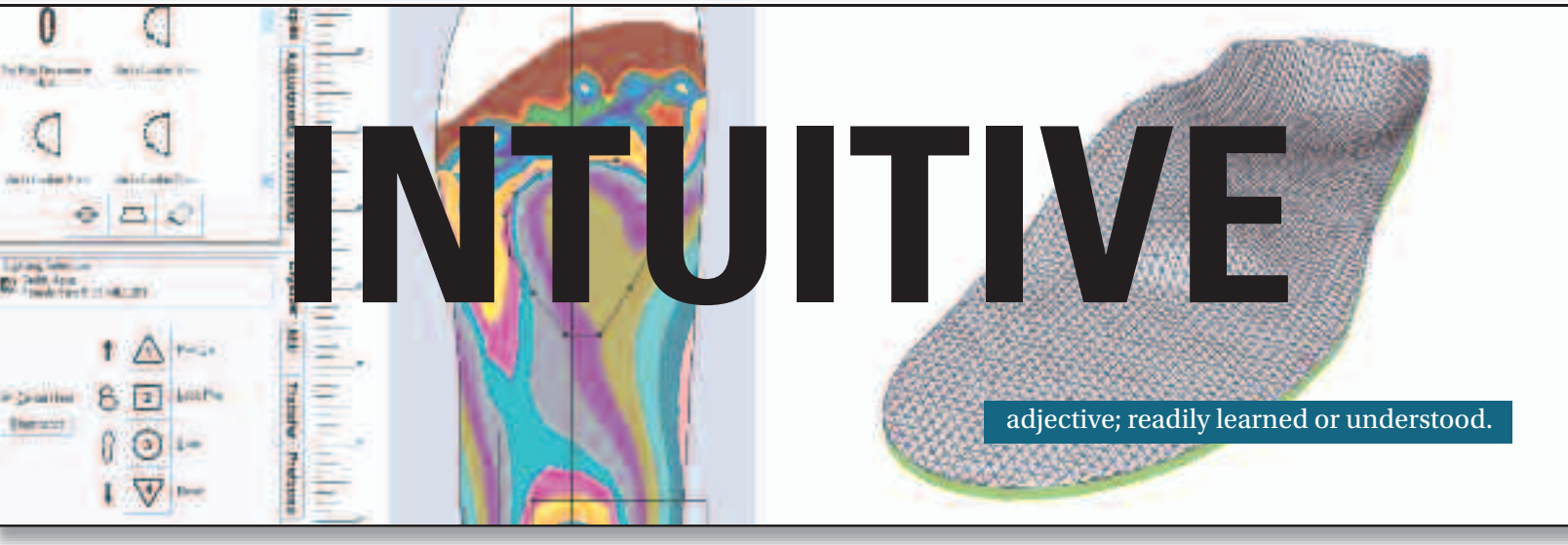
Source:

Tyler TF, Schmitt BM, Nicholas SJ, McHugh M. Rehabilitation after hamstring strain injury emphasizing eccentric strengthening at long muscle lengths: Results of long term follow up. J Sport Rehabil 2015 Sep 9. [Epub ahead of print]



ROBUST

adjective; strongly or stoutly built.



INTUITIVE

adjective; readily learned or understood.

TRUSTED

United States of America - Canada - Mexico - Guatemala
Chile - Ecuador - England - Scotland - Spain - France
Italy - Norway - Austria - Greece - South Africa - Slovakia
Azerbaijan - Turkey - Egypt - United Arab Emirates
Saudi Arabia - Qatar - Pakistan - India - Russia - China
Taiwan - Hong Kong - Australia - New Zealand - Lebanon

verb; a belief that something is reliable, good, honest, effective.

Does this describe YOUR orthotic system?

Available NOW - Lab Services & Equipment Programs
to fit your clinic needs.

Included with every Amfit system: 2 year warranty; training; lifetime support.

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

amfit

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

Managing Finger and Toe Wounds

The closing and healing of all wounds involves establishing and maintaining optimal wound healing conditions. Managing wounds on fingers and toes can be difficult due to the need to reduce edema without a good way to accomplish the goal. Additionally, a caregiver is often required to apply dressings in a way that limits the digit's range of motion, further interfering with the healing process. Dressings applied to the finger or toe often need to be changed frequently because they slip off due to movement. In patients with vascular or diabetic co-morbidities, digit wounds can be especially slow to heal and often require multiple medical interventions.

A recent poster,[1] highlighting four patients with digit wounds on either the hand or foot, demonstrated the use of Ferris Mfg. Corp.'s latest product, the PolyMem® Finger/Toe dressing. The dressing was developed to be easily applied and removed and contains the same formulation of all PolyMem dressings, helping ensure less pain and more healing.

Patient 1 was a 78-year-old diabetic male with a below-the-knee right leg amputation. He bumped his left foot during a transfer from his wheelchair to the toilet. The trauma resulted in three blood-filled blisters on the second toe of the left foot and swelling of his left lower extremity became a healing obstacle. Due to increased susceptibility to infection, the silver version of the PolyMem Finger/Toe dressing was applied to the blisters. His wife performed the dressing changes and his blisters dried under the dressings in less than two weeks, using only two dressings.

The Silver Finger/Toe dressing was easily applied.

Patient 2 was a 71-year-old diabetic male with a history of poor vascular perfusion, below-the-knee amputation of the right leg, and venous stasis ulcers. The hook-and-loop fastener of a post-operative shoe created a friction wound on the top of the toe on his remaining foot. The periwound skin became edematous and macerated. Using the PolyMem Finger/Toe dressing, he was able to do his own dressing changes and the periwound maceration, swelling and weeping decreased. The wound, which originally measured 0.5 cm x 0.7 cm x 0.1 cm, was closed in 14 days. Only two PolyMem dressings were used to close this wound.

Patient 3 was a 56-year-old paraplegic female whose shoe came off when her foot fell from the wheelchair footrest, resulting in an avulsion of the second toenail of the left foot. The periwound skin became slightly erythemic and edematous. Her dressing changes were performed by home health and the wound closed in only three days.

Patient 4 was a 56-year-old male who suffered an amputation at the proximal joint of the first finger of his right hand while operating a hydraulic log-splitter. A surgical flap was attempted, but it was unsuccessful. The periwound skin was swollen, macerated and warm to the touch. He received whirlpool baths to the wound twice weekly by physical therapy. He changed his own dressings when required and when no whirlpool treatments were scheduled. The macerated periwound skin resulting from the whirlpools was managed with a barrier cream. The pain during the whirlpool treatments was managed with oral analgesia. All these wounds healed rapidly using PolyMem Finger/Toe dressings.

PolyMem is a multifunctional polymeric membrane dressing and contains components that draw and concentrate the body's natural healing substances into the wound bed to promote rapid healing. PolyMem Silver has all the unique properties of the standard pink PolyMem dressings with the additional antimicrobial properties provided by elemental silver.

The Finger/Toe dressings, like all PolyMem products, help to reduce edema, bruising, pain and inflammation when applied to either open or closed injuries. The dressings help relieve both persistent and procedural pain that is associated with injury and are effective throughout all stages of the healing process. The dressings fit securely over the finger or toe while allowing freedom of movement; encouraging range of motion; helping reduce pain, swelling, bruising and inflammation; and providing cushioning protection.

After application of PolyMem dressings, all these patients experienced significant swelling reduction in the affected digits and saw rapid resolution of any previously present periwound skin complications. Nurses, patients and caregivers found the dressings easy and convenient to use. Finger/Toe dressings were shown to be cost effective when compared to other approaches as the number of dressings used was significantly decreased, the time needed for dressing changes was minimal and the home health nurses made fewer visits. PolyMem dressings provided optimal healing environments, which resulted in rapid wound resolutions.

The entire dressing was applied to cover the the knuckle as well as the wound in order to help reduce the swelling faster.

Reference:

1. Harrison J. Successful Healing of Digit Wounds with One Dressing. Poster 6130. Wound Ostomy and Continence Nurses Association (WOCN). June 9-13, 2012. Charlotte, NC, USA.

The mechanistic mysteries of FOAM ROLLING

By Cary Groner

As the popularity of foam rollers escalates, researchers are scrambling to document the therapy's effects and tease out the possible underlying mechanisms, which now appear to be more complicated than the earliest investigators had hypothesized.

Shutterstock.com #273991493

Foam rollers are beginning to seem a bit like Star Trek's tribbles: inert and nonthreatening, but extremely successful at reproduction. In gyms and on athletic fields everywhere, people are half-lying on the colorful, worm-like cylinders and rolling slowly forward and back. Given how ubiquitous foam rollers have become, however, a surprising number of questions remain about what they do for us and how.

"In our research, we've found that foam rolling tends to offer similar increases in range of motion as static stretching, but without the typical impairment associated with stretching," said David Behm, PhD, a research professor in the School of Human Kinetics and Recreation at the Memorial University of Newfoundland (MUN) in St. John's, Canada. In one of those quirks of scientific curiosity, where investigators with similar interests tend to congregate at certain institutions, MUN has become a hotbed of research into foam rolling and its sister therapy, roller massage.

Some claims about foam rolling may not hold up, as it turns out, and Behm and his colleagues have published a number of studies in an attempt to winnow wheat from chaff. Other researchers are getting on board, and the recent American College of Sports Medicine (ACSM) conference offered a slew of papers on the subject. For that matter, a new article from Behm's team, accepted for publication in *BMC Musculoskeletal Disorders*, offers insights into the approach's mechanism of action that may upend much of what clinicians and trainers thought they knew.

The basics

Essentially, people use their own weight on the rollers to exert both direct and sweeping pressure on soft tissue, typically the calves, hamstrings, iliotibial band, quadriceps, or gluteals.[1] Researchers and trainers are interested in foam rolling's effects in two primary conditions: athletic performance (particularly range of motion [ROM]), and recovery from intense athletic activities that create sore muscles. Much of the current research into both of these has come from the labs at MUN.

"How does it work?" asked Behm. "Some people describe it as self-myofascial release, but that suggests that it's actually breaking up adhesions, having an effect on trigger points."

Behm said that whereas foam rolling may exert enough pressure to help release fascial tissue due to the body weight involved, using a roller massager—typically a smaller, handheld device with an undulant surface—probably doesn't generate adequate forces, given how tough fascia is.

Such issues are critical in sports medicine because, when fascia becomes restricted—typically due to injury, disease, inactivity, or inflammation—it can lose its elasticity and bind around injured areas, causing fibrous adhesions. These, in turn, often lead to pain and abnormal muscle mechanics that affect joint range of motion, strength, endurance, coordination, and other factors.[2] While massage and stretching sometimes help address such matters, they have recognized downsides; massage requires a therapist or trainer, while stretching runs the risk of weakening muscle tissue.[3]

A brief look at current research into foam rolling helps clarify where things stand and provides context for the new sheaf of papers.

Existing research

In a 2013 paper in the *Journal of Strength and Conditioning Research (JSCR)*, for example, MUN investigators had participants perform two one-minute trials of foam rolling on their quadriceps; they measured parameters including knee joint ROM and muscle force beforehand, then at two and 10 minutes afterward.[2] Despite the brevity of the foam rolling, knee joint ROM increased by 12.7% and 10.3% (10° and 8°) at two and 10 minutes, respectively, without negative effects on voluntary muscle activation, force, or evoked contractile properties.

Another 2013 study from MUN had participants do a sit-and-reach ROM test before and after using a handheld roller massager on their hamstrings in four variations (one set for five seconds, one for 10 seconds, two sets for five seconds, two for 10 seconds).[4] The authors reported a 4.3% ROM increase and noted the longer rolling durations tended to increase ROM more than the shorter ones.

Continued from page 21

A paper from Iowa researchers published in *the Journal of Sport Rehabilitation* last year looked at passive hip-flexion ROM before and immediately after static stretching, foam rolling plus static stretching, foam rolling alone, or no intervention (control) over the course of six daily sessions.[5] They found that, although all approaches were associated with a significant change in ROM, participants who did the combined intervention improved more than those in any other group.

Then, in a paper published earlier this year, the MUN team had individuals perform two randomized applications of a handheld roller massager to their quadriceps; as a control condition, the participants sat quietly for the average time it took to complete the two roller-massage applications.[6] Participants did five repetitions of 20 or 60 seconds per repetition, separated by 24 to 48 hours, then performed a lunge. Knee joint ROM was 10% and 16% greater in the 20- and 60-second conditions, respectively, than in controls; the roller massage was also associated with increased neuromuscular efficiency during the lunge.

As noted, one of foam rolling's attractions is that it seems to increase ROM without introducing the performance deficits sometimes associated with static stretching. For example, a paper presented at the 2014 ACSM meeting in Orlando compared the effects of foam rolling and static stretching on the recovery of quadriceps and hamstring force production after intensive exercise.[7] The authors found that foam rolling helped preserve muscle force versus stretching, particularly in knee extension (94% vs 84% of baseline) and knee flexion (98% vs 88%, respectively). Another study reported an increase in maximal

voluntary contraction (MVC) of the plantar flexors at 10 minutes following roller massage versus static stretching, which decreased maximal force.[8]

Although researchers aren't sure why foam rolling might preserve or increase muscle force, theories include elevated muscle temperature due to friction from the roller, myofascial release, and other factors, possibly in combination. It's also conceivable that foam rolling may pressure tissue into a more gel-like state, improving the fascia's viscoelastic properties without affecting muscles.[1]

"So is foam rolling better than stretching?" asked Behm. "Magnusson says that you get an increase in range of motion because you have an increased tolerance to stretch.[9] There's definitely a neural component to this, and I think foam rolling taps into that increased stretch tolerance and the associated decrease in pain."

As noted, research has also shed light on the use of foam rolling to help athletes recover from muscle damage and the associated soreness and swelling. For example, a 2014 study reported that individuals who did 20 minutes of foam rolling had less muscle soreness after a fatiguing squat protocol than controls, and also demonstrated improved vertical jump height, muscle activation, and both passive and dynamic ROM.[10] And MUN research published earlier this year found that foam rolling after a similar squat protocol was associated with reduced delayed-onset muscle soreness (DOMS) and improved power, sprint time, and dynamic strength for one to three days after application.[11]

"In that study, using the foam roller increased neuromuscular efficiency," Behm said. "Once they were damaged—they had DOMS—they had to use more EMG activity to do those things. But if they used the foam roller, the increased effort was brought back to almost normal. I can't say it's equivalent to massage, because there are no studies directly comparing massage to foam rolling. But I would point out that you're going to pay for your massage, so after an injury or a heavy workout, foam rollers would be helpful and similar to massage without the expense."

New findings

As noted earlier, 2015 has been a big year for research into foam rolling.

In one study out of Austria, for example, researchers compared foam rolling to proprioceptive neuromuscular facilitation (PNF stretching, done with a partner to contract and relax muscles in a stretch) and found both methods about equally effective for increasing hamstring flexibility.[13] Another paper reported that foam rolling plus stretching was superior to foam rolling alone for increasing ROM.[14]

Several papers presented at this year's ACSM conference in San Diego addressed questions around foam rolling, as well. In one case, researchers reported that after foam rolling, participants showed significantly increased joint flexion in the hips and knees during the landing phase of a maximum vertical jump; jump height wasn't affected.[15] They noted that because such increased flexion is associated with lower injury risk, foam rolling could decrease injury rates without affecting performance.

In another paper, presented in poster form, researchers from the University of Minnesota in Minneapolis studied the effect of foam rolling on soreness and running performance compared with sham tights (placebo) in eight runners (four women).[16] They found

Continued on page 24

Continued from page 23

that foam rolling decreased leg muscle soreness compared with the placebo condition but did not affect running performance.

The lead author, Emma Lee, MS, a doctoral student in exercise physiology at the university, told *LER* she's been a competitive distance runner for many years and wanted to study the rollers in a mixed-gender cohort of trained runners, given that most studies have been conducted in people who were only recreationally active or in strength-trained men.

"We had them do pre- and post-testing that included a running economy test—two stages of submaximal running, then a three-kilometer time trial, with economy measured by the volume of oxygen consumed per kilogram of body weight per minute," she explained. "In the middle they did a downhill run on a treadmill for thirty minutes, which introduced muscle soreness. Immediately after the downhill run, they either foam rolled for eight minutes on each leg—quads, IT band, hamstrings, and glutes—or received the placebo treatment; we told them they were compression tights, though they weren't."

Lee found that in the placebo (sham tights) condition, time trials were significantly slower after the downhill run, whereas participants who'd done foam rolling had no drop-off in times. Soreness was much worse in those who didn't foam roll, too.

"I'd recommend foam rolling after a workout that is potentially soreness-inducing," she said. "In a trail run, or a race with a large downhill component, it could be beneficial to attenuate muscle soreness and possible declines in performance. I would especially urge people to foam roll if they have a competitive situation coming up soon after muscle-damaging exercise."

In another ACSM poster, researchers studied the effects of six weeks of foam rolling on functional movement, which they described as an indirect way to assess fascial health.[17] They found the treatment was associated with significant improvements in a variety of measures, including deep squats, hurdle steps, leg raises, and trunk and rotary stability.

"We did six different foam rolling exercises—calves, hamstrings, gluteals, IT band, quadriceps, then lower and upper back," said lead author Briana Felton, BA, who will begin a doctoral program in exercise science at St. Catherine University in Minneapolis this fall. "I think this shows that you can have your athletes and clients use foam rolling rather than having to come in and have someone else do myofascial release on them."

In a paper published this year in *JSCR*, investigators at the University of Oregon in Eugene examined the duration of effectiveness of foam rolling on hip extension angles in a dynamic lunge, done twice in each of three sessions a week apart.[18] The intervention group performed foam rolling on their quadriceps between each of two lunges in sessions one and two, and five times in the week between those two sessions. They didn't use the rollers between sessions two and three, or during session three.

The researchers reported that foam rolling was associated with increased hip extension during the lunge in the intervention group, but noted that these were within-group differences only; the change in hip extension angle did not differ significantly between the control and intervention groups. They speculated that this may have been due to individual variability within the study population, and to the testing of extension angles in a dynamic position. Moreover, extension angles in session three did not differ significantly from baseline in either group, suggesting that any effect wore off after a week without rolling.

Lead author Jenn Bushell, MS, ATC, who is now an athletic therapist at the University of Ottawa and works with the Canadian National Women's Basketball Team, told *LER* that she was looking for alternatives to stretching, given the associated risk of strength reduction in highly trained athletes.

"The whole reason we're doing foam rolling is for some kind of functional activity, but do we want it as a warm-up or as a cool-down?" she said. "I wanted to see what effect it might have if done consistently."

Bushell noted that she and her colleagues did, in fact, find differences in hip extension angles between the groups, but that these hadn't reached statistical significance. She added that although she's more comfortable recommending foam rolling to her athletes than static stretching, there are still issues to be addressed.

"If people foam roll too much, they can get sore and end up feeling like they can't do their workout," she said. "I don't think it actually gets deep enough into the muscle to damage it, but if you do it too long you can cause pain, and that poses an injury risk because it changes how your muscle fires when you're active."

In another study published this year, researchers at Oklahoma State University in Stillwater used a crossover study design to compare a single bout of foam rolling to a dynamic stretching protocol in college football linemen.[19] Analysis revealed no pre- to post-test differences in the groups for a number of strength and power variables; however, hip ROM improved significantly in both groups. The authors concluded that the modalities were essentially equivalent.

"We looked at power, velocity, maximum torque, and range of motion in the hip flexors," said coauthor Bert Jacobson, EdD, FACSM, a regents' professor and Seretean Professor in Wellness at

the university. "We used a roller with a knobby surface, and in men that weigh between two hundred eighty and three hundred twenty pounds, that's a lot of pressure; we thought it might detract from power and velocity, but it didn't."

As a former football player himself, Jacobson was particularly interested in the results in this study population.

"These guys are so well trained, but many of them don't have a lot of range of motion," he said. "The fascia, the tendons, the connective tissue can begin to shrink. That's why athletes like a massage after a hard workout; it relaxes the muscle, loosens up the fascia, and helps prevent the formation of trigger points. The problem with having trainers do those massages is that you've got up to ninety athletes—twenty six starters—and there aren't enough people on the training staff to handle that. I see foam rolling as complementary to a postpractice regime. All of the players agreed that it hurt like hell when they did it, but when they were done, they felt much better."

New frontiers

Back at the Memorial University of Newfoundland, David Behm describes the startling results of his team's new study (accepted for publication). Researchers treated individuals with exercise-induced sore calves (n=75, in 15-person groups) using one of five interventions. Once they'd identified which calf was more painful, they used foam rolling (to 7 on a 10-point visual analog pain scale) on both the tender calf and the contralateral calf. They also used a sham treatment (foam rolling, but so softly it was unlikely to have therapeutic benefit), tender calf massage, and a control (no massage). Foam rolling on the contralateral calf had a similar effect on pain threshold as rolling the tender calf, unlike sham treatment.

"It turned out that it didn't matter whether you treated the leg that was sore or the other leg; you had the same decrease in the pain-pressure threshold," Behm said. "That tells us that even though there may be a myofascial release of some kind, there's obviously a neural component to this."

The researchers are still sorting out the implications of this, but Behm said it's within current neurological thinking. One possible explanation is the "diffuse noxious inhibitory control theory," which notes that, for example, if you stub your toe, you can stick your hand in very cold water and decrease the pain in your toe.

"The nociceptors in your hands send signals up to neurons in the central nervous system that take in all the information and inhibit afferent information from other parts of the body," he said. "So if we cause some pain in the opposite calf, and both signals are going up to the brain, one signal may selectively inhibit the other."

Behm noted, however, that such intriguing results don't negate the obvious practical advantages of foam rolling, regardless of how well or poorly we understand them.

"One way roller massagers might be really effective is on second-string players," he noted. "You've done a nice warm-up, then you go and sit on the bench, and you don't know when the coach is going to call you. You could use a roller during that time and maintain your range of motion while you're waiting to get into the game."

However they're used—and however they work—it seems apparent that foam rollers' advantages far outweigh their minimal drawbacks. Athletes and their trainers can expect to see more of those tribbles as time goes on.

Cary Groner is a freelance writer in the San Francisco Bay Area.

References are available at lermagazine.com.

Mt. Emey

Toll Free 1-888-937-2747

9226-Women Surgical Opening

502-X -Men Edema Accommodator

9301-X-Women Edema Accommodator

738 Men Post-Op Shoes

728-E Edema Bunion (Men)

618-Women Edema Bunion

502-C Men Charcot

708-Men Edema Bunion

801-Men Supra Depth Casual

7021-Men Supra Depth Dress

Medical Shoe Collection is specially designed to accommodate various foot deformities, offering a variety of widths, closures and depths, or even shapes for charcot foot. This collection focuses on ease of fit adjustability, foot protection and wound prevention. Our goal is to provide multitude of shoe options to accommodate all mild to severe foot deformities without ever sacrificing Apis comfort and quality promises.

Available Depths, Sizes & Widths:

Widths: Women: B, D, 3E, 5E, 7E,10E and 14E Men : D, 2E, 4E, 6E, 9E,10E & 14E
Sizes: Women: 4.5-11.5,12-5 Men: 5-11.5, 12-20
Depths: Added Depth; Duo-Depth; Supra-Depth

Medical & Hard-to-Fit Collection

Call for product catalog & free samples

Apis Footwear Company, 2239 Tyler Ave., South El Monte, CA 91733 www.apisfootwear.com

From amputee to clinical prosthetist: four journeys

A number of amputees, many inspired by the expert care they received after losing a limb, have been motivated to pursue careers in prosthetics, where they can provide patients with a unique and personal perspective. Four of these practitioners shared their stories with *LER*.

By P.K. Daniel

Losing a limb—be it to cancer, traumatic injury, diabetes, or something else—is a life-altering experience. But having a proper-fitting prosthesis can help make the transition smoother. And an experienced prosthetist, who through fittings, adjustments, and fixes, forms a long-term relationship with the patient, is an integral part of the process. Who better to understand the process, and the challenges, than a fellow amputee?

It's widely known that many amputees enter this field because of their personal journeys. Four such prosthetists shared their stories with *LER*. Their journeys are unique, but all have a common thread—the ability to empathize with patients and the gratification they feel when seeing the positive impact they've had.

Their journeys are unique, but all have a common thread—the ability to empathize with patients and the gratification they feel when seeing the impact they've had.

STEVE MILLER, CPO

Sharing the 'limitless' benefits of a good-fitting prosthetic device

Steve Miller, CPO, has a love for athletics and the outdoors that began as a youth. He played baseball, basketball, and football. He hunted and fished. He rode horses, motorcycles, and kneeboards. It was while he was on the water riding a kneeboard behind a ski boat that the 11-year-old noticed a painful lump on the back of his knee that prevented him from completely sitting back on his heels.

Miller was diagnosed with an osteosarcoma. His parents opted for rotationplasty to help him maintain his active lifestyle. This alternative procedure to limb-sparing surgery is regularly performed on young patients with bone cancer of the distal femur to preserve knee function by rotating and reattaching the ankle joint at the distal end of the femur after removing a portion of the limb.

Miller had to travel from his home in Savannah, GA, to Shands Hospital in Gainesville, FL, a four-hour trip, to undergo the surgery. He was fitted with a prosthesis that turned out to be ill-fitting and problematic. For a year, Miller's family would endure frequent treks

Lower Limb
Technology

A Division of
Spinal Technology, Inc.

Prosthetics that meet your exacting standards

Experts in advanced prosthetic fabrication

- Modifications
- Elevated Vacuum Systems
- Check Sockets
- Definitive Sockets
- Powered Ankles

Lower Limb Technology manufactures superior custom orthotics and prosthetics. We provide the highest quality products in the industry, as well as unparalleled customer service.

Call us today to place your order at 800 253 7868.

Spinal
Technology, Inc.

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

Continued from page 27

to Gainesville for repeated adjustments.

"We ended up going back and forth for every irritation that I had," Miller said. "It was pretty tough, not just for me but for my parents. I was playing sports and at night I would take off my prosthetic socks and just have blisters and a lot of pain. It wasn't good. I felt a little depressed."

Running would cause more than just blistering. Miller's prosthesis would break down.

"It was just not well-made," he said.

Steve Miller, CPO. (Photo courtesy of Hanger.)

Miller needed a properly designed and fitted prosthesis to restore complete function, and he needed a local solution. His family was introduced to Alfred Kritter, CPO, FAAOP, and vice president of Clinical Services for Hanger in Savannah.

"Kritter was very familiar with rotationplasty surgery," Miller said. "He made me a prosthesis and it was like night and day. At an early age I knew what it meant to have a really good-fitting prosthesis. I was limitless. I could run, play, and do sports, and I wasn't in pain all the time. That's what triggered in my mind to go into prosthetics, knowing how a prosthetist can really affect someone's life."

After being fitted with his new prosthesis, Miller was able to play sports, including high school football and baseball. It was during high school that Miller started working with Kritter, cleaning up his shop.

"I started learning about prosthetics," he said. "[Kritter] took me under his wing. I knew right then that that was what I wanted to do for the rest of my life."

After getting his undergraduate degree in kinesiology at Georgia Southern University in Statesboro, Miller studied prosthetics at the University of Texas Southwestern in Dallas. He then went to work for Hanger Clinic in Savannah. He has been there for 16 years designing prosthetics. He enjoys working with all patients, but he's partial to kids.

"Working with kids who've had the same type of amputation I have had I truly, truly love, because I know I can help them. And because I've had years of experience walking on this type of prosthesis," Miller said.

JOHN "MO" KENNEY, CPO

Traumatic childhood accident became 'a blessing in disguise'

John "Mo" Kenney, CPO, owns 10 O&P practices in the Kentucky-Indiana area that specialize in taking care of amputees. Kenney Orthopedics also provides international humanitarian care on an annual basis, including operating a clinic in Queretaro, Mexico.

Kenney is the past president of the American Board for Certifi-

Continued on page 30

Continued from page 29

John "Mo" Kenney, CPO, (far right) takes a walk with his youngest patient and the patient's father. (Photo courtesy of Kenney Orthopedics.)

cation in Orthotics, Prosthetics & Pedorthics (ABC), as well as the Kentucky Orthotics and Prosthetics Association. He is the current ABC examiner in orthotics and prosthetics and has served on the board of directors of the Amputee Coalition, which helps empower amputees to achieve their full potential.

While he has been a decorated and well-established member of the orthotics and prosthetics community, Kenney's story began in a residential community on the island of Guam when he was just 7 years old. He was outside when a teenage driver lost control of his vehicle and ran into Kenney. The resulting trauma led to a below-knee amputation on his right leg.

The experience was devastating, Kenney said.

"I still to this day very vividly remember the emotions of when I realized I lost my leg," he said. "The despair, even as a child, was so overwhelming that I will never forget the grief."

Kenney (left) has a strong commitment to humanitarian work. (Photo courtesy of Kenney Orthopedics.)

But Kenney called the accident "a blessing in disguise. It gave me direction in life at a young age to pursue exactly what I wanted to do," he said.

Kenney's father is from Georgia, where his elderly and widowed mother resided. When Kenney was 16 his family moved from Guam back to the US to be closer to his grandmother. He earned his undergraduate degree in psychology from Emory University in Atlanta,

GA, and went to graduate school at the Northwestern University Prosthetics-Orthotics Center in Chicago.

Kenney doesn't view himself as more qualified than a prosthetist without a prosthesis; however, he recognizes he offers a different perspective.

"I'm not so foolish as to think I'm a better prosthetist than others, however, due to my past personal experience, I will always be sympathetic to an amputee's initial start in life," he said.

Kenney is interested in inspiring other amputees to pursue careers in the prosthetics industry. He's currently treating an amputee who wants to become a board-certified prosthetic assistant. The patient also works part time for Kenney.

"He told me I planted the seed a few years ago and put him on a track to change his life," he said.

Kenney also has a young patient whom he thinks would be a good candidate.

"[He] lost his leg at about the same age as I was," he said. "This kid reminds me so much of myself it's uncanny. I want to see if one day I can have him find interest in this field. He would be good medicine for someone one day."

What drives Kenney is seeing an amputee walking for the first time.

"The hope that returns to an amputee's face after that first step is always a heart tug for me," he said. "I still enjoy going to work every day because of this."

NICK ACKERMAN, CP

Phone call makes wrestling champ rethink career goals

Meningitis was what led to bilateral below-knee amputations for Nick Ackerman, CP, in 1981, when he was just 18 months old. Ackerman, who became a patient of American Prosthetics and Orthotics in Davenport, IA, went on to become a prosthetist for the same company.

Ackerman didn't let his disability stop him from taking on challenges. He won the National Collegiate Athletic Association Division III wrestling championship in the 174-pound weight class in 2001 for Simpson College in Indianola, IA. He did it by beating the defending national champ and stopping his opponent's 60-match

Nick Ackerman, CP, won the NCAA Division III wrestling championship in 2001. (Photo courtesy of Simpson College.)

Continued on page 32

Continued from page 31

winning streak. There was a lot of publicity surrounding Ackerman's victory, which was lauded by the sports world.

"Shortly after a newspaper article ran that featured my story, I received a phone call," Ackerman said. "It was a young man from Texas who had just lost his leg in a car accident. We talked for a long time that night about everything—from showering, to driving, to what girls think. I remember getting off the phone and looking at my college roommate and saying, 'I need to make his leg.'"

While Ackerman knew he wouldn't actually make that leg, he knew then that making prosthetic devices would become his life's work. He also wanted to share with others, including the young man from Texas, his experience using them.

"I felt that he needed to see that it really is not a big deal," Ackerman said.

But, as Ackerman noted, being an amputee is "not a requirement to be good at our job. What I can offer them is maybe a vision of what they can and should be able to do," he said. "No excuses, and more showing and less telling."

In fact, Ackerman said the best prosthetist he knows—Gary Cheney, CPO, with American Prosthetics and Orthotics in Clive, IA—has both of his legs. Cheney has been Ackerman's prosthetist since he was 2 years old.

"Growing up, I never felt as if, 'You don't know what it is like,'" Ackerman said.

While Ackerman's parents and his own prosthetist had encouraged him early on to pursue this career path, Ackerman wasn't sold on the idea of working indoors every day. His bachelor's degree was in environmental science, and he had planned on working for the Department of Natural Resources.

But, after receiving that phone call, he decided to make one of his own. He called American Prosthetics and Orthotics, the company that has made Ackerman's legs for 20 years. The graduate of the prosthetics program at the Northwestern University Prosthetics-Orthotics Center in Chicago recently began his 15th year there.

"Gary is still working there," Ackerman said. "The really cool thing is I get to work in the same office with him. He has been a great mentor my entire life, and now continues to mentor me in my professional life."

JAIME SIEG, CPA

Clinician's advice opened her eyes to career change

Jamie Sieg, CPA. (Photo courtesy of Hanger.)

Twenty years ago, Jamie Sieg, CPA, was a 16-year-old, three-sport high school athlete. Then, while driving, she experienced a tire blowout, lost control of her car, and hit a tree.

Complications from the accident resulted in the amputation of her left toes and a portion of her left foot; part of the tibialis anterior muscle was also removed. She underwent several surgeries, including rerouting tendons to allow her some movement.

"Most of high school was just trying to get back what I could," Sieg said. "I had bad days, but I made it through pretty well. It was hard, but I was just so happy after everything that had happened that I could walk."

While Sieg went on to participate in intramural and recreational sports in college, she was no longer competitively active. She often experienced pain in the distal end of her foot and could only participate in physical activity for a limited time.

"I could do most things, but for only short periods of time," she said. "I would have a lot of pain."

Eight-plus years after the initial surgery, when Sieg was 24 years old, she started to experience less movement and more breakdowns. She had repeated infections. It was necessary to undergo an amputation below the knee.

But, despite some initial healing issues related to the original accident, Sieg was playing beach volleyball four months after her amputation.

"I was able to become a lot more active than I had been in years," she said.

Sieg graduated from the University of Missouri in Columbia with a degree in recreational therapy in 2001. But jobs were scarce post-9/11. She settled for a position at a nursing home in Kansas City, MO, running the activities department. But that's not what she saw herself doing long term. Eventually, she had a chat with her

prosthetist, Robert Kuenzi, MS, CP, about her future. Kuenzi, who worked for Hanger at the time, suggested she return to school to become a prosthetist.

"I had worked with prosthetists since I was sixteen but never really thought about doing it," she said. "He's the one that really opened my eyes."

Currently a certified prosthetic assistant, Sieg is finishing the process of becoming fully certified in both orthotics and prosthetics. The most rewarding part of Sieg's eight-year career at Hanger's Florissant, MO, location has been seeing her patients walk back into her office for the first time after receiving their prostheses. In fact, just recently, the staff cheered the return of a patient.

"It was the first time I had seen him standing up. It was awesome," said Sieg, who has used a wheelchair off and on. "Being able to stand up and look into people's eyes—it's a great feeling to see people get back to that point."

One of Sieg's first patients was a man in his early 50s who had just had an amputation as a result of diabetes. Sieg recalls him being down and unsure of what his future held. He thought his career working for a major manufacturing company was over. Sieg reassured him that in time he would return to work. And, after nine months of treatment, he did.

"From start to finish, he was my patient," she said. "It was amazing. He stands on his feet most of the day. It makes me feel so good because I know I was the one who helped him get there." ler

Sieg loves to see patients walk into her office for the first time after receiving their prostheses. (Photo courtesy of Hanger.)

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


Istockphoto.com #12525304

Including injury history adds to value of FMS

Multiple studies indicate that poor movement, as assessed using the Functional Movement Screen, and past history of injury are risk factors for future injury, and a recent investigation suggests that risk is compounded in athletes with a combination of those two factors.

By MAJ Michael Garrison, PT, DSc, OCS, SCS; and MAJ Richard Westrick, PT, DSc, OCS, SCS

Injuries related to sports, recreation, and exercise are significant issues for athletes at all skill levels. Injuries can lead to time away from sports and exercise or reduce an athlete's performance level. The healthcare system is equally burdened by such injuries. It is estimated that more than 3.2 million emergency department visits across the US for children younger than 14 years are due to sports or exercise injuries.[1] This figure underestimates the true impact on the healthcare system, because the majority of those with less serious injuries present not to emergency departments but to primary care physicians, orthopedists, or physical therapists.

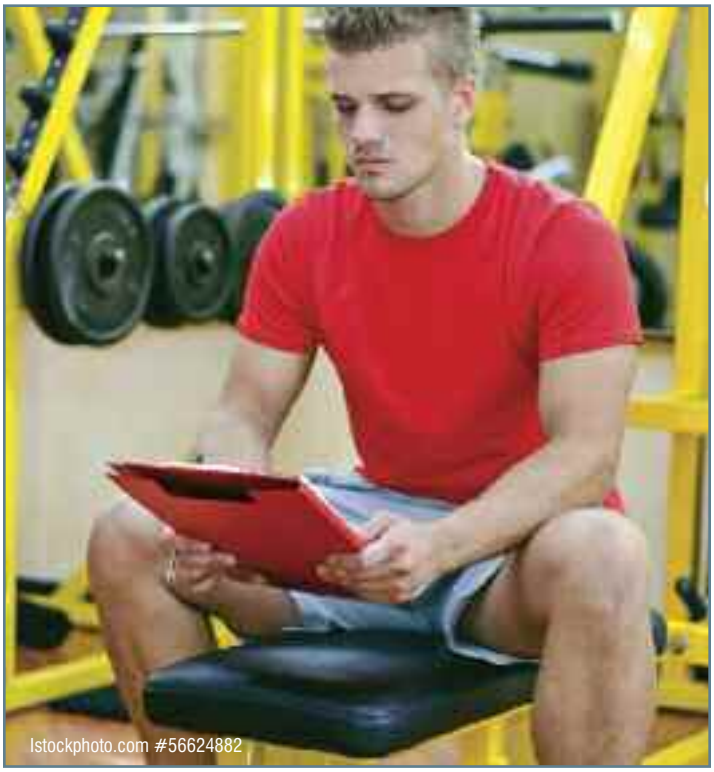
The financial impact of these injuries can be better appreciated by considering one common sports injury. The management of anterior cruciate ligament (ACL) tears costs more than $2 billion annually in the US.[2] This figure includes diagnosis, surgical management, and subsequent rehabilitation costs. Considering that approximately 70% of ACL injuries result from a noncontact mechanism, a large percentage of these injuries may be preventable. Relative risk reduction calculations reveal a prophylactic benefit to neuromuscular retraining programs for the prevention of ACL injury. However, numbers-needed-to-treat analysis indicates that approximately 100 participants need to complete a training program to prevent just one ACL injury.[3] Identifying athletes who are at highest risk for injury prior to implementing preventive programs is a major priority.

Practitioners often perform screening tests on asymptomatic populations to identify those who may be at risk for developing a particular condition. These tests may help identify issues early in the process and potentially lead to intervention programs that help prevent the onset of injury or illness.

Several properties enable effective use of a screening test. The test should maximize sensitivity to ensure that participants at a higher risk of injury are identified and progressed on to the next level of assessment. The test needs to be easy to use and relatively

When returning athletes to sports after lower extremity injury, there is a clear need for objective criteria that movement-based screening may potentially address.

Continued from page 35



inexpensive. Individuals administering the test should be able to do so without the need for advanced training. Because musculoskeletal injuries are multifactorial in nature, a fourth factor that is specific to screening for these conditions is that the test needs to look at multiple intrinsic risk factors. The Functional Movement Screen (FMS) meets all of these criteria, and published studies report good reliability when the same team of examiners is used.[4-7]

The Functional Movement Screen

The FMS is an objective screening tool consisting of seven movement tests. The tests are the hurdle step, deep squat, in-line lunge, shoulder mobility, active straight-leg raise, rotary stability, and stability push-up. Test scores range from 0 to 3 for each test; 21 is the highest total composite score. Examiners can collect asymmetry measures for the five tests that measured scores for each individual side. All participants perform each movement up to three separate times, with the highest score of the three movements collected. The screening examination is described in excellent detail in other publications and the reader is encouraged to reference these studies for more information.[7]

In 2007, Kiesel et al published findings indicating a relationship between a low FMS score and incidence of serious injury on a professional US football team.[8] They determined that a composite FMS score at or below 14 predicted injury in this cohort of professional athletes. However, there are several limitations to this study to consider prior to implementing the findings.

The study was retrospective, which limits its internal validity. Additionally, injury was defined as placement on the injured reserve list and a time loss from practice or competition of at least three weeks. There are many injuries, however, that significantly impact performance but don't result in such substantial time losses. The authors are certainly correct when emphasizing in their title ("Can serious injury in professional football be predicted by a preseason functional movement screen?") that these results are predictive of serious injury. Another significant limitation involves the reliability of reporting for the FMS measurements. FMS scores are often considered on a scale of 0 to 21, but in reality the scale is much tighter, as asymptomatic athletes typically don't score below 10, and rarely is someone perfect with all seven movements. In this particular study, the FMS scores ranged from 10 to 20. When the scores are in a tighter range, the reliability of the scoring system becomes more important, as even small irregularities can greatly impact results. The retrospective nature of this study also indicates that screening procedures may not have been standardized for all participants and examiners, which again can greatly impact results.

Chorba et al in 2010 and O'Connor et al in 2011 conducted similar studies looking at the relationship between injury development and movement screening.[9,10] Chorba et all utilized a small sample population (n = 38) and considered only female athletes participating in fall sports. Their results suggest that the cutoff score of 14 or less is predictive of lower extremity injury in female athletes. O'Connor et al looked at a large number of male Marine Corps officer candidates (n = 874) and found that scores of 14 or less were predictive of injury, though the sensitivity of the screen was undesirably low. Only 10% of their study population scored 14 or below, and the study relied on medical visits for injury reporting. A highly motivated cohort of men, already self-selected as US Marines, limits the generalizability of the study findings; recent evidence suggests that approximately 50% of musculoskeletal injuries are unreported by military service members.[11]

Our research

In designing our study,[12] we considered all these issues to improve both internal and external validity. Our study was prospective in nature, with screening tests planned well in advance and reliability reported. The same team of examiners was used for all athletes to ensure consistent grading of the seven FMS tests. We included both male and female athletes (n = 160) involved in contact and noncontact sports. Our contact sports included rugby (male and female) and soccer. Noncontact athletes participated in swimming and diving. We also included a broad definition of injury to ensure we captured all medical events that might impact overall performance, and we used redundancies in injury tracking to ensure that we captured all incidents requiring medical attention. These redundancies included medical record screening, interviews with team athletic trainers, and monitoring of our institution-specific injury tracking data.

Our data indicate that maximal sensitivity for injury screening is achieved by asking participants to self-report any history of injury over the past 12 months. The sensitivity of that question alone was 72% in our cohort. The problem with sensitivity measures for past history of injury in isolation is that they do not allow a clinician to determine the probability that an athlete with this risk factor is likely to be injured again. A highly sensitive test is useful when ruling out a condition, whereas a likelihood ratio is a more accurate measure with immediate applicability; a higher likelihood ratio indicates a greater likelihood of injury development.

In our cohort, combining a self-report of past injury with a movement score of 14 or below maximized sensitivity and produced a likelihood ratio of 5.88. These combined factors also generated the lowest negative likelihood ratio, which is the ideal scenario for a useful clinical test. In our study population, the pretest probability

Continued on page 38

Introducing the medi Tele-ROM™ Knee Brace

Ease of use, adjustability, comfort

Featuring:

- Telescoping struts
- Simple rotate and release flexion and extension settings
- Drop lock button
- Quick-release buckles for easy application
- Available in cool and full foam versions

PDAC –approved for L1832 or L1833

Continued from page 36

of injury development was 33%. Applying our injury prediction rule increased the post-test probability of injury development by 41%. In other words, 74% of the study participants who met our increased injury risk criteria experienced some type of injury during our data collection period.

To analyze the predictive power of the FMS combined with past history of injury, we conducted a logistic regression analysis. The generated odds ratio (OR) of 15.11 indicates that an athlete with a past history of injury combined with a poor movement score has a 15-times higher risk of injury than his or her teammates. The odds ratio generated from both factors together (OR=15.11) is larger than the individual odds ratios for poor movement (OR=5.61) and past history of injury (OR=3.45) added together.

Clinical implications

The clinical implication of this finding is obvious. An athlete with poor movement and a past history of injury needs to be assessed by a healthcare provider to determine if a specific intervention can decrease his or her injury risk. A sports-trained healthcare provider is uniquely qualified to perform that assessment and implement an injury reduction program.

The finding that history of injury is a risk factor for future injury is consistent with multiple previous studies.[13-15] This continues to indicate that individuals are returning to athletic endeavors before they are fully recovered from a previous musculoskeletal injury, or without having addressed the movement-related risk factors that contributed to the initial injury. Screening for history of injury with a patient self-report and a basic movement examination can help identify those that require further assessment. In an asymptomatic population, this screening can be conducted prior to the implementation of an offseason conditioning program. Team medical personnel can assess those identified as being at elevated risk of injury to formulate individualized approaches to address those athletes' deficits.

In situations involving a large group of athletes or when medical resources are limited, efforts can be focused on screening only those with an identified history of injury. But, if possible, participants with a combination of injury risk factors should be the first priority, as they are most at risk. Movement screening can also be valuable when progressing postoperative patients back to sports participation. When considering return to sport after lower extremity surgery, there is a clear need for objective criteria, and movement-based screening may have the potential to address that need.

An example

Again, one can consider ACL injury as an example. A tear of the ACL is a very common, but serious, sports-related injury. For competitive athletes participating in cutting, twisting, and pivoting sports, a reconstruction of the ACL is often recommended in the presence of recurrent instability.[16] The deleterious effects of sports participation with an unstable knee include meniscal damage, articular cartilage injury, and damage to secondary ligamentous stabilizers. While most athletes will return to some level of sports participation after ACL reconstruction, studies show the percentage who return to their preinjury level of competition can be as low as 33% to 44%.[17,18] In another study, less than 50% of the study sample returned to full sports participation up to seven years after surgery.[19]

There is also growing concern regarding the rate of second ACL injury when returning to sport after primary ACL reconstruction. Some studies report a six-times greater risk of second ACL injury (ipsilateral or contralateral to the initial tear) within two years of ACL reconstruction, compared with a group of healthy controls.[20] For Division I athletes returning to high-level competition, the rate of second ACL injury in the contralateral or ipsilateral limb is as high as 37%.[21] The inability to fully return to preinjury level of competition and the high rate of reinjury indicates that current rehabilitation protocols are not adequately measuring or addressing some component of overall function.

Objective criteria for return to sport after musculoskeletal injuries such as ACL tears are rarely used.[22] Most postoperative rehabilitation protocols base progression on easily assessed clinical measures such as range of motion, effusion, and laxity. The vast majority of protocols are time-based, meaning postoperative patients are progressed to the next stage of rehabilitation based simply on duration of time from surgery rather than on any consistent objective measure of function.

In a recently published study, Mayer et al tested patients to determine if a difference existed between patients who were cleared for sport after ACL reconstruction and those who were not.[23] Patients in the cleared-to-return group met basic clinical exam criteria, including measures of laxity, motion, and strength. There was no statistically significant difference in composite FMS scores between the two groups (12.72 vs 12.83). The FMS composite scores for both groups also fell well below established normative values.[24] Average FMS composite scores below 14 combined with history of injury put both the cleared-to-return group and the noncleared group at an elevated risk of injury. This study highlights that clinical measures alone are insufficient in measuring certain aspects of dynamic control that might be important for making a full return to sport participation; including movement-based assessments such as FMS testing in return-to-play protocols may help to address this issue.

Conclusion

Functional movement is a hot topic in sports medicine. We must be cautious about accepting literature results that might be influenced by personal or commercial bias. However, putting that aside, multiple studies do indicate that poor movement and past history of injury are risk factors for future injury. Combining these two factors seems to compound this risk. A standardized, objective, and reliable method of measuring movement is needed as we move toward implementation of effective intervention strategies. Measuring functional movement should be considered prior to offseason athletic conditioning and prior to clearing an athlete for return to sport following musculoskeletal injury. ler

MAJ Michael Garrison, PT, DSc, OCS, SCS, is a graduate of the US Army-Baylor University Sports Physical Therapy Doctoral Program in Waco, TX, and currently serves as the director of physical therapy services for the US Army installation at Fort Carson, CO. MAJ Richard Westrick, PT, DSc, OCS, SCS, is a graduate of the US Army-Baylor University Sports Physical Therapy Doctoral Program and currently serves as the chief of the Environmental Medicine Branch at the US Army Research Institute of Environmental Medicine in Natick, MA.

References are available at lermagazine.com.

medi

igli® carbon insoles for active patient's feet.

The igli Allround Light C+ model is a low-profile version of the popular igli Allround carbon orthotic that incorporates a stronger carbon base for higher stress and weight applications.

igliusa.com

medi. I feel better.

Running in an exerted state: mechanical effects

Kinematic and kinetic alterations in the lower extremities that researchers have observed during the course of a prolonged run may provide clinically relevant insights into patellofemoral pain and other conditions associated with a gradual onset of symptoms during exercise.

By Lauren Benson, MS; and Kristian O'Connor, PhD

Many people choose running as a convenient and inexpensive type of physical activity. Running has increased in popularity since the 1970s,[1,2] and not surprisingly the number of people injured while running has also increased. The percentage of runners who experience running-related injuries can be as high as 79.3% for lower extremity injuries.[3] The most common site of injury is the knee, which accounts for up to 50% of running injuries,[2-5] while patellofemoral pain (PFP) has consistently been the most common overuse running injury.[2,4,6,7]

Running injuries are typically the result of overuse or pain resulting from repetitive tissue (bone, cartilage, tendon, ligament, or muscle) microtrauma. These repetitive stresses are necessary for positive remodeling of tissue, and will not result in injury as long as the stresses are kept below critical limits. However, without sufficient time between applications of stress, repeated exposure of tissue to low-magnitude forces creates microscopic injuries that eventually strain the tissue until an overuse injury occurs.[5,8-10]

Impact forces, which result from contact between the foot and ground, contribute to these stresses in combination with lower extremity mechanics. Runners can manipulate hip and knee flexion, ankle dorsiflexion, and pronation at the subtalar joint to better absorb impact forces.[11,12] However, poor mechanics while running can play a role in developing an overuse injury. For example, research suggests PFP is caused by excessive patellofemoral joint stress.[13] Mean patellofemoral joint contact forces during running can be up to 7.6 times body weight; with many repetitions, this may explain why the patellofemoral joint is commonly injured.[14,15] Frontal plane loading, characterized by an increased internal knee abduction moment throughout stance, has been associated with PFP in both retrospective and prospective studies.[16] Excessive knee valgus movement has been shown to contribute to knee injuries, including PFP.[17] Additionally, transverse and frontal plane rotations of the hip and knee can change the Q-angle; an increased Q-angle causes greater retropatellar stress during knee flexion. Performing weight-

Running in an exerted state may increase a runner's risk of overuse injury if the muscle loses some shock-absorbing ability or if a change in movement pattern occurs.

Continued from page 41

bearing activities, such as running, with this alignment may cause inflammation of the tissues around the patella and lead to PFP.[15,18]

Focusing on fatigue

Since overuse injuries are considered the result of exposure to repetitive stresses, researchers often assess running mechanics during the course of a single running bout. Typically, the goal is to fatigue a runner and examine changes in lower extremity mechanics. However, there are several challenges when studying fatigue, including how it is defined and measured.

In relatively simple terms, fatigue can be considered a decrease in force production, such that there is an increase in the perception of effort required and, eventually, an inability to produce the force.[19] This type of definition suggests fatigue occurs suddenly at task failure; however, the force-generating capacity begins to decrease at the onset of exercise. Therefore, fatigue may be more aptly defined as an exercise-induced reduction in maximal voluntary muscle force due to peripheral changes in the muscle and reduced drive from the central nervous system.[20] It is possible that there is not one all-encompassing model of fatigue. The process by which a muscle becomes fatigued may have both central and peripheral factors, and is thought to be task-dependent.[19-21]

Fatigue in the context of exercise physiology has been objectively measured in terms of physiological effects, but it also has a subjective psychological component. Another term related to a reduction in performance during physical exercise is exhaustion. Exhaustion can be defined as the moment in which the sense of effort required to maintain a desired force is greater than a person's willpower to maintain that output.[22] Physiologically, fatigue due to running can be measured using blood lactate tests or a rating of perceived exertion. Heart rate can be used as a measure of effort.[23] Fatigue, defined as a loss of force production, can be quantified in specific skeletal muscles by observing a decrease in force produced during a maximum voluntary contraction following a fatigue protocol. It can also be observed as a decrease in speed during a maximal-effort run.[24]

Task-dependent fatigue is related only to the characteristics of the exercise or task inducing the fatigue. Some studies use an exercise protocol designed to bring runners to the point of exhaustion or maximum fatigue. This could allow investigators to examine the greatest changes in biomechanics that occur as a result of exertion. However, many different exhaustion or maximum fatigue protocols have been used, and not all studies use objective, physiologically measured criteria for fatigue or exhaustion. Different running durations and intensities may affect runners differently.[25] The shorter methods exhaust runners faster, yet may fatigue their cardiovascular system before compromising the neuromuscular system. The physiological and kinematic responses to this type of protocol have been reported to be different than responses to a longer protocol, such as a marathon run.[25] Additionally, while training, runners rarely run to the point of exhaustion or maximum fatigue. Therefore, designing a study with a protocol that resembles a typical running session may give a more accurate picture of the biomechanical changes that occur during running.

Effects of prolonged running

Running in an exerted state occurs when runners perform a prolonged run at training pace until their heart rate reaches 85% of their maximum heart rate or they score higher than 17 (very hard) on a rating of perceived exertion scale.[26,27] This protocol for running in an exerted state adopted by our lab closely mimics a typical bout of exercise for a runner, while also providing an objective measure of exertion for all participants.[28,29]

Runners with the most common running injury, PFP, often do not have pain at the beginning of a run, but complain of a gradual onset of pain as the run progresses.[27] This may indicate that prolonged running or exertion could cause changes in mechanics that contribute to PFP. However, there have been very few studies investigating the effects of exertion on running mechanics in healthy and injured runners. Comparisons among the studies that have been completed in this field are difficult due to differences in exercise protocols, which have included a marathon run,[30] a treadmill run at typical running speed,[26] a shorter run at maximal effort,[31] running until exhaustion at the ventilatory threshold,[25] and other variations. Many studies that examine running in a natural environment utilize 2D data collection and report only changes in sagittal plane mechanics,[30] though running injury is often related to frontal and transverse plane mechanics. Despite the discrepancies, there is some evidence in the literature and from a recent study in our lab[29] suggesting that running in an exerted state may elicit mechanics that could contribute to running injury risk.

The goal of kinematic adaptations while running may be to minimize metabolic cost, even at the expense of shock absorption.[32] However, shock attenuation, or the absorption of impact forces, is vital for the prevention of overuse running injuries. It can be

Continued on page 44

A Fit For A Queen

Queen COBRA

From **high heels** to **boots** to **flats**, the Queen Cobra custom orthotic fits easily into all of your patients' high-fashion footwear.

Feet get the royal treatment with Queen Cobra's unique, thin and lightweight design – it bends to adapt to different heel heights and shoe styles while offering superior arch support and control.

Handcrafted to each individual patient's prescription, the Queen Cobra offers custom correction for regal comfort.

Footmaxx

Call Customer Service today. 1.800.779.3668

›facebook.com/footmaxx ›twitter.com/footmaxxinc ›footmaxx.com

Continued from page 42

accomplished due to the shock-absorbing properties of passive anatomical structures such as bone and the calcaneal fat pad, as well as external influences such as running shoes and the ground.[33,34] Additionally, contraction of muscle plays a role in shock attenuation. It has been shown that muscle action at the joints, such as ankle eversion and ankle, knee, and hip flexion, help to reduce impact forces during running.[34] Running in an exerted state may increase a runner's risk of overuse injury if the muscle loses some shock-absorbing ability or causes a change in movement pattern.[35]

Exertion and running mechanics

Knee flexion at heel strike has been commonly studied after an exhausting run due to its role in shock attenuation. A few studies have reported no significant differences between pre- and postexercise knee flexion angle at heel strike,[36-38] while others have reported an increase with fatigue in knee flexion angle at heel strike after a run.[31,39,40] And, despite some evidence of an effect on sagittal plane knee angle at heel strike, this has not been seen throughout stance. Peak knee flexion angle during stance has been reported to decrease[30] and increase,[31] while some studies, including our recent publication, have reported no significant change.[25-27,29] These equivocal results suggest a typical training run results in limited changes in knee flexion.

While rearfoot eversion plays a role in providing shock absorption during running, excessive rearfoot eversion, coupled with compensatory internal rotation of the tibia, knee, and hip, could put runners at risk for overuse injury.[41] Previous work has shown an increase in maximum rearfoot eversion during stance, as well as an increase in maximum rearfoot velocity following a run in an exerted state.[26,27,31,42] We also found a greater rate of rearfoot eversion in healthy female runners after running in an exerted state (Figure 1).[29] Consistent with the theory that rearfoot eversion is linked to proximal transverse plane mechanics, this coincided with a greater rate of tibial internal rotation moment (Figure 2).[29] Our results are in line with those reported by Dierks et al, who used a similar exercise protocol in their studies.[26,27]

In addition to the changes at the ankle, we found changes in the transverse plane mechanics of the knee and hip. There was greater knee internal rotation (Figure 3) and a concurrent increase in hip internal rotation and decrease in hip internal rotation moment (Figure 4). The results of our study were generated using a waveform analysis that examines the mechanical effect over the entire duration of stance phase;[29] results can be compared with the discrete analysis by Dierks et al that showed increases in knee internal rotation excursion, peak angle, and peak velocity,[26,27] as well as an increase in hip internal rotation excursion.[27]

In general, the observed changes in rearfoot eversion and transverse plane mechanics at the ankle, knee, and hip suggest that runners may be in a more risky posture at the end of their typical training run than at the beginning.

Other effects of a run in an exerted state have been identified with regard to knee frontal plane mechanics. Focusing only on kinematic changes, Dierks et al showed that runners had decreased maximum knee adduction during stance, but a greater knee adduction

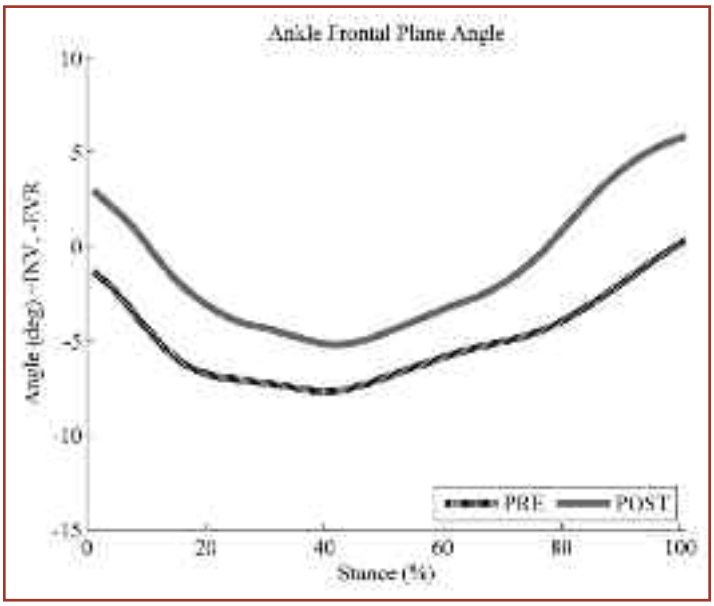


Figure 1. INV = inversion, EVR = eversion. Reprinted with permission from reference 29.

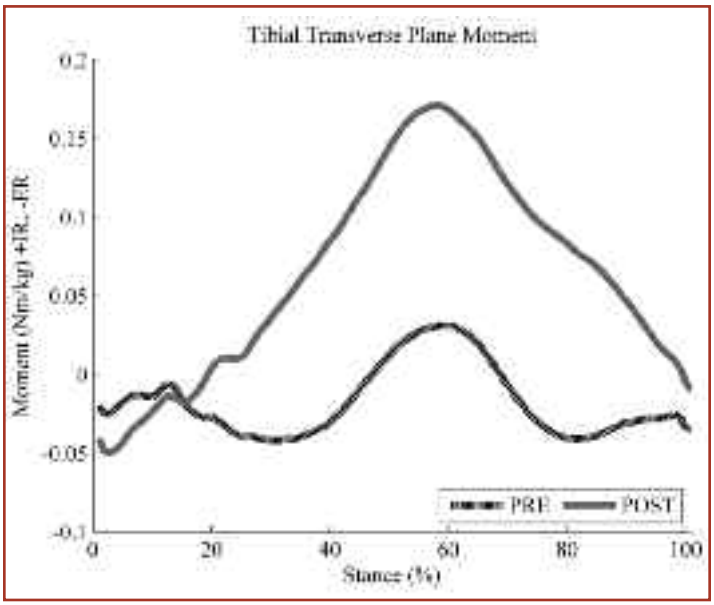


Figure 2. IR = internal rotation, ER = external rotation. Reprinted with permission from reference 29.

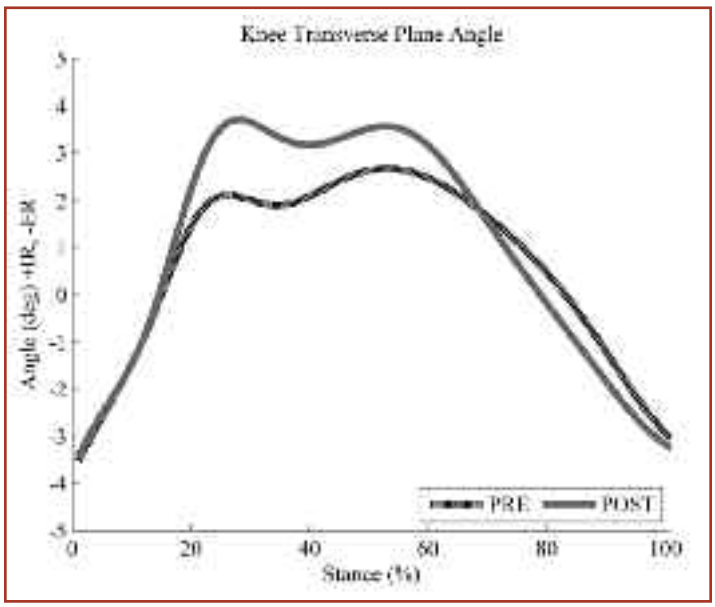


Figure 3. IR = internal rotation, ER = external rotation. Reprinted with permission from reference 29.

Continued on page 46

Autodesk Footwear

A new name that offers the industry great possibilities

"This focus on footwear means greater possibilities for both our existing **Delcam** customers and new customers. Having an even wider range of tailored solutions means the options available are endless."

Chris Lawrie, Director of Footwear, Autodesk
www.autodesk.com/footwear

AUTODESK.

Continued from page 44

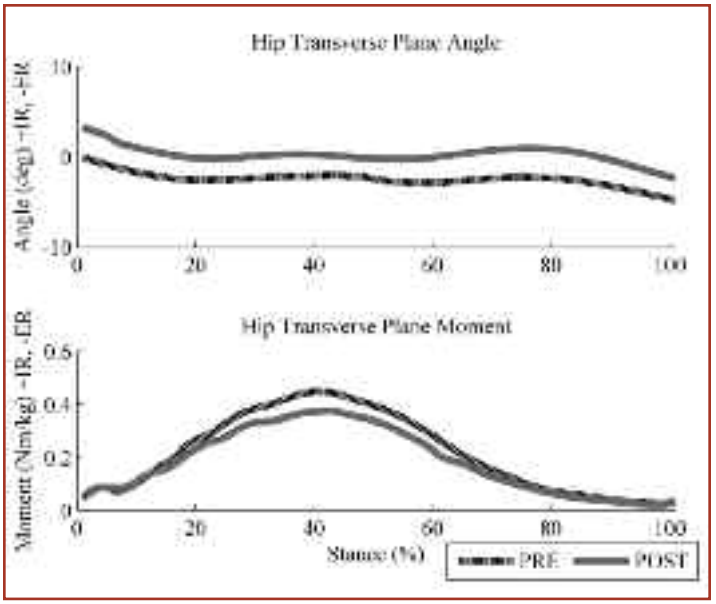


Figure 4. IR = internal rotation, ER = external rotation. Reprinted with permission from reference 29.

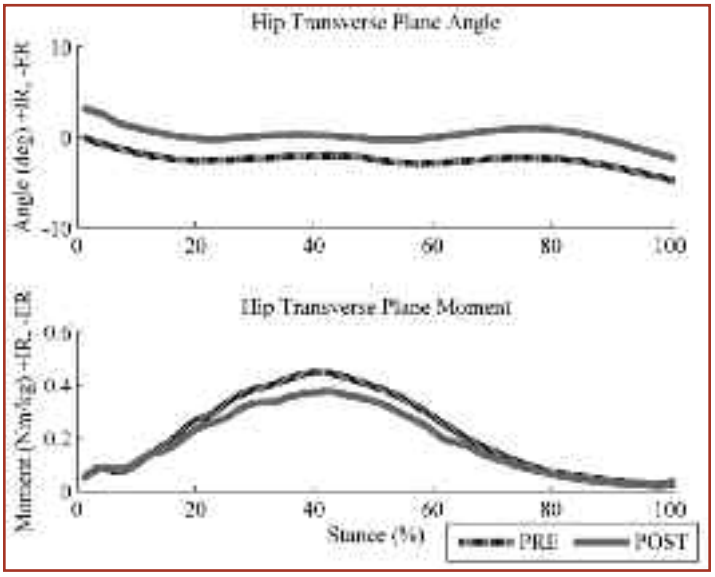


Figure 5. IR = internal rotation, ER = external rotation. Reprinted with permission from reference 29.

excursion at the beginning of a typical training run compared with its completion.[27] In contrast, our results showed a greater knee adduction angle throughout stance phase and a decrease in knee abduction moment when running in an exerted state (Figure 5).[29] The frontal plane knee mechanics we observed may indicate that the healthy individuals in our study adopted this posture as a protection against potential knee pain.

Implications for injury

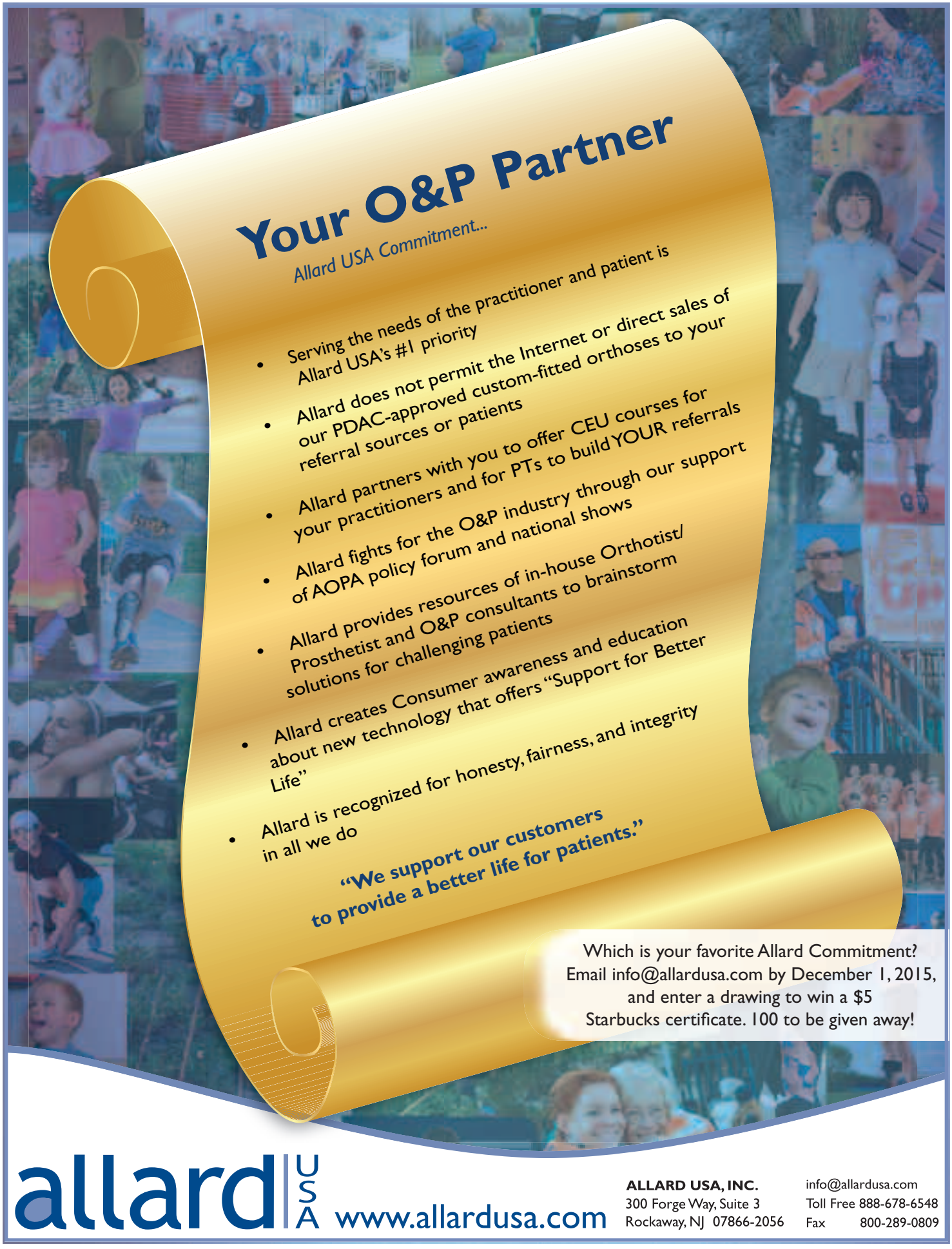
Examining the effects of a typical training run on mechanics for injured runners can provide insight about the mechanics of an injured state. Dierks et al showed that a group of runners with PFP had, in general, lower peak angles and maximum velocities than a control group, even for variables thought to cause or exacerbate PFP, including rearfoot eversion, components of knee valgus, and internal

rotation of the tibia, knee, and hip.[27] It is possible that these kinematics, which are opposite from the mechanics that would be expected to contribute to injury risk, are due to a pain reduction mechanism employed by the PFP group. The runners with PFP may have tried to avoid poor mechanics to avoid pain. This seemed to be successful at the start of the run, when they did not report feeling pain; however, by the end of the run, there was an increase in motion that coincided with an increase in pain. Similarly, the runners with PFP had less peak knee flexion than controls. While an increase in knee flexion would indicate greater shock absorption and the opposite might be considered an injury risk, a decrease in knee flexion is thought to reduce patellofemoral compressive forces and therefore reduce pain for injured runners.[27]

In conclusion, any examination of the mechanical effects of running in an exerted state is complicated by various definitions and methods of generating fatigue in runners. Studies that examine a normal training run may be in the best position to determine the typical exercise effects on lower extremity mechanics. With cross-sectional studies, the risk of injury cannot be determined; however, a trend toward mechanics associated with running injury risk has been observed for healthy athletes running in an exerted state. Injured runners, when in an exerted state, tend to adopt mechanics that may be protective against pain. Overall, there are exercise-related changes in lower extremity mechanics associated with an exerted state that could be even more pronounced when the duration or intensity of the run increases beyond what is considered typical.

Lauren Benson, MS, is a PhD candidate and Kristian O'Connor, PhD, is associate professor and chair of the Department of Kinesiology at the University of Wisconsin-Milwaukee.

References are available at lermagazine.com.



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

Post-polio syndrome: It takes a team approach

Along with technical issues related to muscle weakness, fatigue, and pain, the challenges of managing this heterogeneous population include patients' emotional response to the idea of needing an orthotic device for a disability they thought they had overcome.

By Larry Hand

There are two things practitioners can agree on regarding patients with post-polio syndrome (PPS): It takes a team approach to manage these patients effectively, and each patient is truly an individual case, unlike the last and unlike the next.

"Manage" is the key word here, because no effective pharmaceutical treatment or preventive measure exists for PPS, which, according to the National Institute of Neurological Disorders and Stroke, affects 25% to 40% of polio survivors. Recent research is sparse, compared with many other disorders, so practitioners are relying largely on longstanding studies done during the 1980s and 1990s.

A key factor in managing these patients, practitioners say, is balancing any exercise or device intervention aimed at maintaining muscle strength against the risk of possibly further weakening the same muscles. Another factor is managing what many describe as a unique patient population and their muscle weakness, fatigue, and pain.

"The needs of a post-polio patient can be very diverse, as can be their willingness to accept intervention," said Phil M. Stevens, MEd, CPO, of the Hanger Clinic in Salt Lake City. "The challenge with post-polio is that there is a lot of emotional history tied up in the individual. Most of them had to wear some type of orthopedic brace in an era when any sort of disability was poorly accepted by humanity. Many of these patients have since worked very hard to overcome and compensate for those muscle weaknesses and many of them reached a level where they can do so without braces."

However, Stevens noted, as that generation of polio patients continues to age, those compensatory mechanisms tend to have a cumulative effect.

"Many patients feel like they've overcome the disability of their youth and now they're being forced to confront it again," he said. "I have had many patients with post-polio who broke down in the treatment room because of the emotional component of getting a brace for a disability they thought they had already overcome."

Among the recently published research papers is one from the Netherlands that illustrates the individuality of PPS patients.[1]

Individual variability and lack of predictive factors underscore the need for tailored care based on actual functional decline in patients with post-polio syndrome.

Continued from page 49

Jacquelin Perry, MD, (right) works with a polio survivor at Rancho Los Amigos Rehabilitation Center, during the late 1980s. (Photo courtesy of Rancho Los Amigos Rehabilitation Center.)

Researchers followed 48 PPS patients over 10 years to assess their rate of decline in walking capacity and physical mobility. They found that average walking capacity declined 6% and mobility declined 14% as the patients also lost an average of 15% of isometric quadriceps strength.

However, almost one fifth of the patients lost substantial walking capacity (27%) and mobility (38%), and loss of quadriceps strength accounted for only 11% of the walking capacity decline. Baseline values did not predict decline, either.

"The individual variability, yet lack of predictive factors, underscores the need for personally tailored care based on actual functional decline in patients with post-polio syndrome," the researchers wrote.

The same group of researchers conducted another study that found ultrasound monitoring can be helpful in assessing patients' disease severity and changes.[2]

Another Dutch study found that usual care trumped both exercise therapy and cognitive behavioral therapy in treating 68 PPS patients but found no explanations as to why.[3]

Swedish research on late effects of polio, which is closely related to PPS but had a different diagnostic code until the implementation of ICD-10 this year, has revealed risk factor variability similar to that reported in the Netherlands.

A study published in the March 2015 issue of *PM&R* found that knee muscle strength explained only 16% of the variance in the number of steps per day taken by 77 patients with late effects of polio, and gait performance only explained between 15% and 31% of the variance.[4] A second study from the same group, published in the July 2015 issue of the *Journal of Aging and Physical Activity*, found that self-reported outcome measures of physical activity were only weakly to moderately correlated with self-reported disability.[5]

PPS patients are often highly motivated, said Beth Grill, PT, of the International Rehabilitation Center for Polio (IRCP), in Framingham, MA. But that can also end up working against them.

"Polio survivors are very independent, motivated individuals

Continued on page 52

The only balance brace clinically proven to reduce postural sway and increase postural stability*.

Think MBB

For your FREE Moore Balance Brace starter kit call **866.624.2113** ArizonaAFO.com ohi

* Clinical Biomechanics Dec 2014 , An immediate effect of custom-made ankle foot orthoses on postural stability in older adults, Sai V. Yalla, Ryan T. Crews a, Adam E. Fleischer a, Gurtej Grewal b, Jacque Ortiz a, Bijan Najafi

Continued from page 50

and are often described as Type A personalities. They have overcome so much in their lifetime that when they develop post-polio and they are no longer able to do the things that they have always done, it can be devastating," Grill said.

That's where the team approach to patient management comes in. At the IRCP, a unit of Spaulding Rehabilitation Network and Partners Healthcare system, patients see a physiatrist, a physical therapist, occupational therapist, and even a speech therapist if needed.

"Our program here at the IRCP is a comprehensive multidisciplinary program. The diagnosis of post-polio is one of exclusion. Dr. Rosenberg [Darren Rosenberg, DO], who is the medical director here at the IRCP, evaluates the polio survivor to determine what tests are needed. We not only evaluate a polio survivor's weakness but also focus on managing pain and fatigue, which are all hallmarks of PPS. Exercise was the Holy Grail for polio survivors, and oftentimes that is what they focused on. We have to determine what exercise is appropriate and avoid overfatiguing the muscle. If they overuse the already weakened muscles, there is potential for new weakness," Grill said.

IRCP professionals perform a thorough manual muscle exam on every polio survivor, she said. If the strength is scored three or higher on a five-point scale (able to move the limb against gravity through the full range of motion with light resistance), they may consider an exercise intervention. If the limb is weak, however, they may recommend a lower extremity brace.

If they find no other medical causes for muscle weakness, then they begin to plan the post-polio treatment. They begin by making recommendations to the patient, and then, step by step, try to get the patient on board.

"We try to do it in a way that is respectful of where they're at in their own process," Grill said. "I often use the words, 'I'm going to plant the seed. I want you to think about it. Or I want you to at least try it.' Many people come around and are open to trying things."

Bracing is complicated, she said, partly because it is a difficult thing for the patients to go back to, and partly because each patient presents so differently from the next in the clinic.

A polio survivor works with Beth Grill, PT, (left) and Nick Nappi-Kaehler, PT, (back) at the International Rehabilitation Center for Polio (IRCP) in Framingham, MA. (Photo courtesy of the IRCP.)

"Prescribing an appropriate brace and assistive device often plays a crucial role in improving gait and function for a polio survivor," Grill said. "When we consider bracing, we try to do less than textbook bracing, because we want to be respectful of how people have learned to compensate. If you take away people's ability to compensate, a brace may cause walking to be more work for the individual rather than less. For example, if a quadriceps muscle is very weak, and the individual has never worn a brace, we may want to give them a short-leg brace rather than a long-leg brace."

Similarly, patients who have been diagnosed with late effects of polio need a team-based approach to treatment, said Cecilia Winberg, RPT, MSc, of Lund University in Sweden and lead author of the two Swedish studies cited earlier.

"Persons with late effects of polio perceive different kinds of impairments, and these can be treated symptomatically," Winberg said. "The impairments have an impact on their whole life situation, which is best addressed by meeting different professionals."

Patients with late effects of polio are best treated with an individualized physical therapy plan, since their impairments and activity limitations differ, she said.

"Most often it is important to increase muscle strength in the muscle not affected by the polio, to make sure that they can walk without too much strain [for instance, by using mobility devices and orthoses]," she said. "A PT plan is always based on a thorough examination and a discussion with the patient regarding their problems. The goals of the treatment are decided between the PT and the patient."

Thorough evaluation

Another center that uses the team approach is Rancho Los Amigos National Rehabilitation Center in California, part of the Los Angeles Health Services Department. That's where one of the prominent researchers of the '80s and '90s worked, the late Jacquelin Perry, MD, who detailed the biomechanics involved in orthotic management of post-polio in a 1986 article in *Orthotics and Prosthetics*.[6-9] Other studies by Perry's group have looked at muscle tests, manual muscle testing, and calf muscle as a source of pain.

"What Dr. Perry came up with years ago, and what we still tell our patients today, is as far as exercising or activities, if they are doing some activity or exercise and when they stop they're still just beat for more than ten or fifteen minutes, then they've done too much. They need to look at what they did and look at decreasing it," said Valerie Eberly, PT, who has worked at Rancho Los Amigos for 20 years.

"Dr. Perry also said if a person has an active day and wakes up the next day completely fatigued and exhausted, that means the day before they did too much," Eberly said. "They either have to decrease how much they do or increase the number of rest breaks they take, but they really figure out for themselves what's the best way for them to be able to do all the things they want to do without increasing their post-polio syndrome. Bracing is not what they really want to hear, but they realize if it's what's needed, they're willing to try it."

When a person comes into the clinic for a new evaluation, he or she commonly has complaints of increasing fatigue, weakness,

Continued on page 54

Continued from page 53

and pain, she said. A multidisciplinary team—including a physician, physical therapist, and occupational therapist—will perform a full evaluation, looking in particular at strength in the arms and legs.

"The physical therapist does the muscle test, and the physical therapist and the medical doctor observe the gait and look at what deviations they have. Then we, together, come up with what orthosis we think would be best for them," Eberly explained. "We actually have an orthotist who is able to join us in our gait analysis and look at the muscle test. The orthotist will put together a temporary trial brace for the person to try. We have the patient walk with the brace in the clinic to see how it feels. We, as a team, make a recommendation of what we think would best help the patient."

Before and after

Before the evaluation, however, comes the history.

"You need a really thorough patient history to find out what they're doing—when did they experience the weakness and for how long—and then make recommendations to decrease the overuse of their muscles," Eberly explained.

That's where bracing comes in, she said.

"We recommend different types of orthoses, whether it's an ankle foot orthosis or a knee ankle foot orthosis, to help substitute for the weak muscles and allow patients to preserve the muscles they still have," Eberly said. "If they've tried all these other things and they're still having the issue of fatigue and increasing weakness, then we would recommend a wheelchair for mobility, to allow patients to continue to participate in activities that are important to them."

Thomas V. DiBello, CO, of Hanger Clinic in Houston, TX, whole-

heartedly agrees about the importance of patient history, even at the orthosis-fitting stage.

"The most important thing the orthotist should do—and I think this is sometimes missed—is instead of reading the prescription and going to work on providing the device prescribed, the first step has to be an absolutely complete and thorough history," DiBello said.

The orthotist should have an appreciation for any surgeries that were performed, particularly orthopedic procedures that may have occurred when the patient was a child and may have an impact on joint motion and pain.

"We need to understand the level of disability the patient had when they were younger and how that has changed, and then how their current level of ability has changed over the course of the last few years," DiBello said. "I always like to ask what prompted them to seek care at this point in time. It's also very important to know not just how often they fall, but how often in the course of a day or week do they nearly stumble and fall. The near falls are very important in helping us understand where that person is on their continuum of ambulation."

Most importantly, orthotists need to know the patient's expectations, and the expectations of the medical doctor and physical therapist treating that patient, he said.

"Then we can begin to discuss with them what we can do for them, within the parameters of the physician's prescription and the team's goals, and whether their expectations are achievable," DiBello said.

Sometimes, he said, one of the biggest challenges is gaining a patient's trust.

"Often in the past they've had bad experiences with devices they've been prescribed. They don't always have the highest level of regard for the work we do, probably justifiably so, but there's a period that involves them getting to know us better, as we are getting to know and understand their needs," he added.

In addition to patient history, follow-up is also important, DiBello said. He sees patients two weeks after device fitting to assess whether they need to be seen more often than every six months to a year thereafter. Even if a patient is satisfied with a brace, there may be some adjustments that could be made to improve his or her gait, he added.

"We might adjust the amount of movement they have at the ankle, or at the knee. We might change the density of the heel portion to affect the way they transition from the beginning of stance to midstance. We might make adjustments to a lift for a leg-length discrepancy," he explained.

Adapt and compromise

It's always important for practitioners to have the ability to compromise, but it's particularly true for those who work with post-polio patients, Stevens of Salt Lake City said.

"Post-polio is particularly challenging because developing a solution that is biomechanically sound isn't enough," Stevens said. "You have to develop a solution that a patient will accept and wear. In many cases, that involves compromise. You may not be able to use the intervention that you think is biomechanically the best approach, because the patient is unwilling to wear it. You have to reach a level of compromise where you can address some of the limitations with a device that a patient is willing to wear on a regular basis." ler

Larry Hand is a freelance writer in Massachusetts.

References are available at lermagazine.com.

Zeno Gait Analysis System

QUANTIFY. TRACK. EXPORT. TREAT.

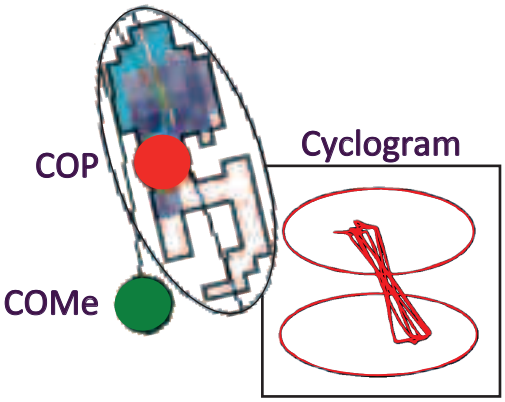
Zeno electronic walkway
powered by **PKMAS** software.

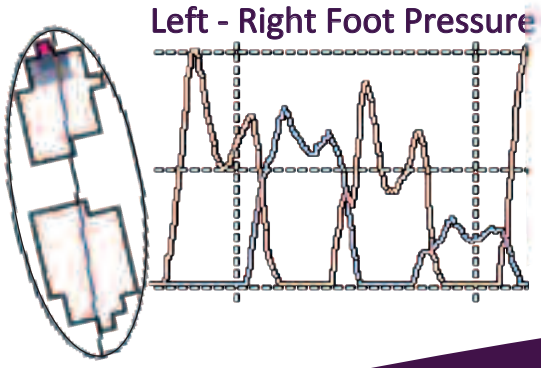
Measure the impact strengthening, bracing and gait training have on functional outcomes.

Track compensatory mechanisms, variation, gait phase transitions and asymmetries.

Use for multiple protocols: walking, standing, running, and jumping.

Export temporal, spatial, pressure, and Center of Mass estimated metrics.





PROTOKINETICS

EQUIPMENT FOR GAIT AND FUNCTION

800.352.2301
protokinetics.com
info@protokinetics.com


Istockphoto.com #17382519

Hamstring injuries: The clinical promise of PRP

Preliminary research suggests platelet-rich plasma (PRP) is a safe and effective means of treating hamstring injuries that do not respond to early conservative measures. As an adjuvant to physical therapy, PRP may help delay or obviate surgery for partial hamstring tears.

By Frank B. Wydra, MD; Ryan R. Fader, MD; Omer Mei-Dan, MD; and Eric C. McCarty, MD

Hamstring injuries, acute and chronic, are common in long distance runners, sprinters, and jumpers. The hamstring muscle group extends the leg at the hip and flexes the leg at the knee; it consists of three muscles contained within the posterior compartment of the thigh.

The semimembranosus, semitendinosus, and the long head of the biceps femoris originate from the ischial tuberosity. The short head of the biceps femoris originates from the linea aspera on the posterior femur. Each inserts just distal to the knee joint. The semimembranosus inserts onto the posterior surface of the medial tibial condyle. The semitendinosus inserts onto the anterior proximal medial tibia at the pes anserine. The long and short heads of the biceps muscles merge and insert into the proximal fibula and proximal lateral tibia.[1]

All hamstring muscles are innervated by the tibial component of the sciatic nerve with the exception of the short head of the biceps, which is innervated by the peroneal division of the sciatic nerve.[1]

Injuries to the hamstrings are commonly seen in athletes at all levels of competition. They are usually referred to as pulled or strained hamstrings. The typical injury mechanism involves an athlete performing rapid and eccentric contractions of the hamstring complex. Examples include sprinting, jumping, and swift acceleration and deceleration.[2-4] These types of actions can stem from kicking sports like soccer or other activities such as water-skiing.[5]

There are a wide variety of injuries to the hamstring muscle-tendon complex. The majority of acute injuries occur at the myotendinous junction, an area prone to muscular strains. However, the myotendinous junction of the hamstring muscles, unlike other muscles, spans most of the muscle belly due to long proximal and distal tendons as described by Woodley and Mercer.[1] Koulouris and Connell reviewed 179 acute hamstring injuries in athletes and found that nearly 90% of tears occur at the myotendinous junction, a finding that has been supported throughout the literature.[6-11] Approximately 12% of the patients in the study suffered proximal injuries, either avulsion of the ischial tuberosity or a partial tear proximally. Fewer

Accurately injecting the hamstrings can be difficult, but ultrasound guidance can help navigate the needle deep into the thick layers of subcutaneous fat and muscle.

Continued from page 57

Figure 1. The PRP preparation rich in growth factors (PRGF) technique. The leukocyte-poor layer lies just above the white blood cell (WBC) layer and is considered pure PRP, without WBC. (Photo courtesy of Omer Mei-Dan, MD.)

than 1% of the patients had injuries of the distal tendons. Taking into account all locations of hamstring injuries, the biceps femoris was most commonly injured, accounting for about 80% of the cases.[6,12,13]

Although the mechanism of injury and underlying pathology of hamstring injuries is well described, treatment options vary widely without an agreed-upon gold standard, and are affected by age, activity level, and the possible need for rapid return to play. The last variable can be the main determining factor in the decision-making process for professional athletes.[3,5,14-16] As with other muscle-tendon injuries, early treatment options consist of mostly conservative measures, including rest, activity modification, nonsteroidal anti-inflammatory drugs, physiotherapy, corticosteroid injections, therapeutic ultrasound, laser therapy, orthoses, and topical glycerine.[15,17-19]

A meta-analysis of 56 studies recently evaluated the role of eccentric exercises for the treatment of various tendinopathies and muscular injuries.[20] Although the results showed promise for Achilles tendinopathy and patellar tendinitis, their search yielded only one randomized controlled trial for partial tears of the hamstring myotendinous unit, not including avulsion or complete disruption injuries. The trial found that eccentric exercises had no difference in outcomes compared with a progressive running regimen for pain or timing of return to sport.[21]

A Cochrane Database search performed in 2012 identified only two randomized controlled trials looking at physical therapy for partial tears of the hamstrings.[22] The first suggested that stretching could reduce time to return to sport in elite athletes.[23] The second study looked at participants of varying athletic levels and found no difference in time to return to sport, pain, or participant satisfaction; however, the authors did see a decreased risk of reinjury in the individuals who performed physical therapy.[24]

More recently, in 2014, Askling et al performed a prospective randomized comparative study looking at a lengthening rehabilitation protocol versus conventional physical therapy in 56 Swedish sprinters with magnetic resonance imaging-confirmed acute hamstring tears. Sprinters who underwent the lengthening protocol had a significantly shorter return to sport compared with a conventional protocol; 49 days versus 86 days, respectively.[25] This is the first insight into an injury-specific rehabilitation for hamstring injuries as there are no currently accepted standardized physical therapy protocols for partial tears of the hamstring myotendinous unit. Further randomized controlled studies are needed to validate the effectiveness of various proposed protocols.

In unrelenting cases of proximal hamstring tendinosis, surgical intervention may be necessary. This is the scenario more commonly seen in complete avulsion injuries of the proximal hamstrings or unhealed partial tears. Options include open or minimally invasive endoscopic surgical debridement of the hamstrings footprint, drilling of the ischium, and various types of repair or reconstruction.[25]

Recent literature shows successful results from surgical treatment of hamstring injuries, although one must be aware of the indications and the rehabilitation course.[27,28] A literature review by Harris et al performed in 2011 found that individuals who underwent surgical treatment of hamstring injuries, mainly acute proximal tendon ruptures and proximal bony avulsion injuries, were more likely to return to their preinjury state, had higher levels of patient satisfaction, and demonstrated improved strength compared with those who received nonsurgical treatment.[29] Although promising, this analysis does have its limitations, including heterogeneity among patients included, the use of various surgical techniques, and low numbers of nonsurgical participants.

Bowman et al published a case series of 17 patients who underwent operative treatment of partial proximal avulsion injuries.[28] Outcomes show these patients have satisfactory functional results, however, surgery is best reserved for patients who have exhausted nonoperative management. Surgery comes with its own risks and can include a difficult rehabilitation protocol including splinting or bracing.[28,30]

There has been increasing interest in the therapeutic benefits of PRP for various soft tissue injuries. In the hamstrings, PRP may provide a reasonable alternative to surgery for partial tears that have not responded to the previously mentioned early conservative measures. Previous studies have reported varying results when using PRP for treatment of tendinosis.[2,15,31,32] Although the popularity of PRP for various injuries is increasing, the literature remains controversial due to inconsistency and lack of standardization of the techniques, indications, and even the protocols studied.

Biology and physiology of PRP

The clinical potential of PRP for soft-tissue injury healing stems from its ability to promote chemotaxis and neoangiogenesis. It attempts to mimic the body's natural healing response. The α-granules of the platelets are responsible for releasing inflammatory and neovascular factors such as tumor-growth factor ß (TGF-ß), platelet derived growth factor (PDGF), insulin-like growth factors 1 and 2 (ILGF), fibroblast growth factor (FGF), epidermal growth factor (EGF), vascular endothelial growth factor (VEGF), and endothelial cell growth factor (ECGF).[15,32-38] These factors promote chemotaxis, cell differentiation, and angiogenesis, and are used therapeutically at a concentration that is two to 27 times that of human plasma, depending on the preparation used.

Various authors have suggested that lower concentrations may be below the effective range, while concentrations that are too high may have an inhibitory effect.[15,34,39-45] Some authors believe the most biologically effective concentration lies between four and six times that of native plasma, while others believe the effective dose lies around 2.5-fold.[45-47] Graziani et al performed an in vitro study of PRP and found that concentrations around fivefold had an inhibitory effect on fibroblast proliferation.[45] Regardless of the ideal concentration, PRP has the potential to provide a healing environment that promotes regeneration of collagen and restoration of the fiber orientation, which is disrupted by microtears resulting from the inciting injury.[38,48,49]

De Mos et al performed a controlled laboratory study looking at the effects of PRP on cultured human tenocytes.[50] The PRP effectively increased expression of cell proliferation, matrix degradation enzymes, endogenous growth factors, and collagen production. Although more research is needed, the current belief is that PRP promotes degradation of the damaged area of tendon and then promotes angiogenesis and collagen production to create a fibrovascular clot for healing. More recently, Alsousou et al published a laboratory study looking at in vivo effects of PRP on Achilles tendon ruptures.[51] The researchers compared immunohistochemistry six weeks postinjection in individuals who received either a PRP injection or a placebo injection. The PRP group had significantly higher cellularity, glycosaminoglycan content, and type I collagen, which is believed to enhance the maturity of the healing tendon. Further studies are needed to look at long-term differences between groups, as well as the clinical implications of the findings.

Kajikawa et al demonstrated that PRP increases healing potential in tendons of rats.[51] Rats expressing green fluorescent protein were used in this laboratory study to look at increased activity of circulation-derived cells that play a role in tendon healing. These circulation-derived cells mainly include the inflammatory and angiogenic mediators mentioned previously. The researchers induced perpendicular injuries to the patellar tendons of the rats and subsequently injected PRP into the wound. Compared with the control group, which received no PRP, the study group had significantly higher expression of circulation-derived cells at days three and seven. Immunologic analysis also showed elevated type I and III collagen in the PRP group compared with the control group, highlighting the increased healing potential in the PRP group.

Clinical benefits

PRP has been used for a wide variety of tendinopathic clinical indications, including lateral epicondylitis, patellar tendinosis, rotator cuff tendinitis, and Achilles tendinitis. Its use has been mainly reserved for conditions that have failed conservative treatment modalities.

In a prospective clinical study, Kon et al injected three consecutive doses of PRP into the patellar tendon of athletes with patellar tendinosis who had failed conservative management.[53] After six months, participants reported significant improvements in symptomatic as well as functional scores.

Wetzel and colleagues were the first to publish clinical results on PRP for partial proximal hamstring injuries.[53] They retrospectively reviewed 12 injuries that failed conservative treatment modalities, including physical therapy, before undergoing one PRP injection into the hamstring origin. A separate control group of five participants continued with physical therapy alone. Although both groups showed improvements in subjective pain scales (ie, a visual analog scale [VAS] and the Nirschl Phase Rating Scale), only the PRP group had statistically significant results at an average follow-up of 4.5 months

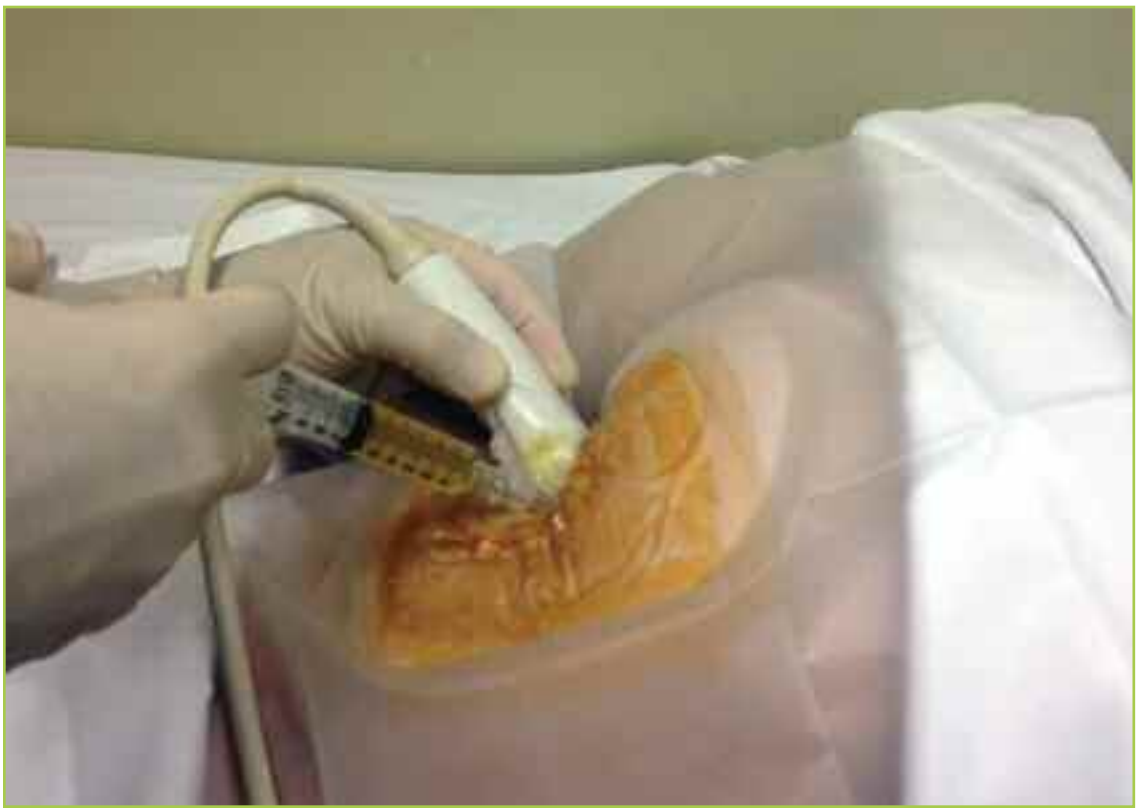


Figure 2. PRP preparation rich in growth factors (PRGF) injected under ultrasound guidance into a partial tear of the right hamstrings origin. (Photo courtesy of Omer Mei-Dan, MD.)

Continued on page 60

Continued from page 59

($p < .01$ for the PRP group and $p < .06$ for the control group). All 17 participants went on to return to their previous level of competition, which included high-level play in nine cases. Only one participant required a second PRP injection. This study is limited by its small number of participants and retrospective nature, however, it shows promise that PRP is a safe and effective means of treating hamstring injuries that are refractory to conservative management.

Fader et al recently published a study highlighting the effectiveness of ultrasound-guided PRP injections for chronic hamstring tendinopathy in 18 patients who had failed conservative treatment modalities.[2] All patients underwent a single ultrasound-guided PRP injection performed by a single radiologist. Six months after injection, there was an 80% or greater VAS improvement in 10 of 18 patients, while overall VAS improvement was 63% for the group. This study highlights the clinical benefits of PRP for hamstring injuries as an easy and alternate nonsurgical treatment in cases that do not respond to conservative measures.

A Hamid et al performed a randomized controlled prospective trial looking at 28 participants with acute (within one week of enrollment) hamstring injuries.[55] The experimental group received one PRP injection along with a rehabilitation course, while the control group received rehabilitation alone. The time required to return to sports was significantly shorter in the group who received a PRP injection compared with the control group ($p = .02$; 26.7 ± 7 days vs 42.5 ± 20.6 days). Furthermore, secondary outcomes showed significantly lower subjectively reported pain scores in the PRP group than the control group throughout the study. This study demonstrated that PRP in conjunction with rehabilitation is a safe treatment option that may be more effective than rehabilitation alone. It also challenges the current practice of using conservative measures alone in the early period after hamstring injury.

These studies focusing on the use of PRP for hamstring injuries indicate that PRP is a safe and effective means of treating hamstring injuries that have persisted despite early conservative measures. PRP can be an efficacious adjuvant to physical therapy and may serve to delay or obviate surgery for partial hamstring tears.

PRP preparations

Different commercial PRP preparations vary in their biologic makeup. There is a great deal of controversy surrounding the optimal consistency and ideal standardized preparation of PRP. Many researchers categorize PRP preparations based on concentration of white blood cells (WBCs) as leukocyte-rich versus leukocyte-poor concentrates. Leukocyte-poor preparations have WBCs intentionally eliminated, as some believe that WBCs will induce an exaggerated inflammatory response, leading to the destruction of healing tissue, and may contribute to a higher pain response postinjection.[42,44,56-58] (Figure 1.)

Normal clots that form at soft tissue injuries consist of almost 94% red blood cells, which have limited healing capabilities, and only about 6% platelets. The goal of a PRP injection is to replace the natural clot with one that is highly concentrated in platelets. This highly concentrated clot provides elevated chemokine production and a higher healing potential. Additionally, the leukocyte-poor PRP preparations effectively skip the inflammatory stage of the acute response to injury, since the presence of WBCs in the area is limited. This decreases macrophage migration to the injured area, decreasing soft tissue destruction by the macrophages.[42,47,56]

PRP injection technique

To accurately inject hamstring pathology, one must navigate the needle deep into thick layers of subcutaneous fat and muscle, which can be difficult. Imaging has been shown to substantially improve the accuracy and results of these therapeutic injections; therefore most PRP injections are now being performed with ultrasound guidance.[58,60] (Figure 2.) Ballaudière et al published results of 408 single ultrasound-guided PRP injections for various tendinopathies, showing significantly improved functional scores postinjection.[61] This is reinforced by the previously mentioned findings of Fader et al regarding the use of ultrasound-guided PRP injections for hamstring injuries.[2]

Future directions

We are still in the early stages of understanding the indications and effectiveness of the use of PRP for soft tissue injuries. While PRP may allow elite level athletes to forgo definitive surgery until the end of the season, it may also benefit elderly individuals who desire pain relief and wish to avoid a surgical procedure. Future studies on the use of PRP for the various types of hamstring injuries will need to include larger prospective randomized control trials and to evaluate proper indications, potential candidates, injury patterns, techniques, preparations, volume, location of injection, and regimens including one or multiple injections.

Conclusion

While platelet-rich plasma therapy for hamstring injures shows promising preliminary results, there remains a paucity of literature regarding the specific types of injuries for which it is best suited and which standardized protocol is most effective.

The current understanding that PRP elicits an elevated inflammatory response, thus creating an advantageous environment for healing, has been demonstrated in vitro. Several laboratory analyses have demonstrated a significant response to PRP that involves promoting inflammation and neovascularization as well as degradation of damaged areas of tendon. Few clinical studies have demonstrated the benefit of PRP in various soft tissue injuries in general and hamstring injuries in particular. It is well accepted that the use of ultrasound guidance helps improve the accuracy of such injections and will likely be of benefit in PRP therapy as it evolves. Future research is needed to expand our understanding of the use of PRP as a therapeutic option for hamstring injuries to allow for improved symptomatic relief and earlier return to sport. ler

Frank B. Wydra, MD is a third-year orthopedic surgery resident at the University of Colorado School of Medicine in Aurora. Ryan R. Fader, MD, is a fifth-year orthopedic surgery resident at the University of Colorado School of Medicine. Omer Mei-Dan, MD, is an associate professor at the University of Colorado School of Medicine and a certified orthopedic surgeon who specializes in hip preservation. Eric C. McCarty, MD, is an associate professor at the University of Colorado School of Medicine and chief of Sports Medicine and Shoulder Surgery for the Department of Orthopedics at the University of Colorado.

References are available at lermagazine.com.

ad index

ler new p

Elite Orthopaedic Fracture Walkers

Elite Orthopaedics offers two new walkers designed for applications including soft tissue injuries, grade two and three sprains, stable fractures, and postoperative rehabilitation. The Premier Fracture Walker has steel-enforced plastic-molded uprights that are slotted for easier and more secure strapping, a low-profile rocker sole, a wide footbed, and a treaded sole for patient safety. The Premier Pneumatic Fracture Walker features an inflatable air bladder to easily adjust the compression level in response to variations in swelling during the rehabilitation process. Both walkers are available in four sizes.

Elite Orthopaedics
800/284-1688
elite-ortho.com

Men's Hosiery in Dark Navy Stripe

When Sigvaris North America launched its Midtown Microfiber hosiery line in 2014, it was the company's first compression therapy collection designed exclusively for men in three compression levels. Since that time, the line has expanded with additional sizes and colors, including the new dark navy stripe. Constructed from a fine synthetic fiber, Midtown Microfiber products are designed with all-day comfort in mind. The socks and thigh-highs have a tailored look appropriate for work, travel, and daily wear. A high-tech thermo-regulating construction provides year-round comfort and breathability.

Sigvaris North America
770/631-1778
sigvarisusa.com

Spenco Medics Replacement Insoles

New from Spenco are Spenco Medics, adjustable replacement insoles featuring the company's Total Support technology along with interchangeable heel and midfoot pods. The product comes in Dress, Sport, and Diabetic styles. Spenco Medics Diabetic Insoles have the added benefit of a soft, low-density, PolySorb Memory Structured Foam body, a friction-reducing SpenCore, impact zones, and a Plastazote topcover to help eliminate pressure points. Spenco Medics are dispensed by doctors. The full-length insoles retail for $59.99, with a three-quarter version for $49.99. The diabetic version retails for $39.99.

Spenco
800/877-3626
spenco.com

Slide.fit Prosthetic Donning Aid

Designed around the motto "Donning Made Easy," Streifeneder USA has released the new Slide.fit donning aid for transfemoral prostheses. The gliding material offers diminished resistance, allowing the amputee to easily and accurately put on the prosthetic device. The stable pulling device is passed through the valve opening of the prosthetic socket, and the large grip handle allows for easy pulling. The Slide.fit is available in sizes XS-XXL, each size defined by its own stitch color. The low-maintenance Slide.fit is made of polyamide with a polyurethane coating, and comes in a practical storage bag.

Streifeneder USA
800/378-2480
streifenederusa.com

roducts

Black Volara 4E Closed Cell Foam

Now available from JMS Plastics Supply is its new Black Volara 4E material. Volara is a closed cell foam that is designed not to absorb moisture, bacteria, or odors. Black Volara is stocked in 30" x 36" sheets and in rolls, in 1/8" or 3/16" thicknesses. In addition to Black Volara, JMS Plastics also offers White Volara. White Volara is stocked in sheets and rolls in 1/8", 3/16", and 1/4" thicknesses. The closed cell foam is engineered to be an excellent material for manufacturing liners for ankle foot orthoses or spinal orthoses. JMS Plastics Supply offers same-day shipping, technical support, and product guarantees.

JMS Plastics Supply
800/342-2602
jmsplastics.com

NuWave Nail Enamel

MVI Footcare is the exclusive distributor of NuWave Antibacterial and Antifungal Nail Enamel. NuWave enamels include basecoat, topcoat, and matte styles, in 22 colors. Developed by two women podiatrists, NuWave enamels are enhanced with an antifungal, antibacterial, and antiviral preservative to reduce the risk of contamination, even when the same polish is used on several different nails. NuWave Nail Polish is free of formaldehyde, formaldehyde resin, toluene, phthalates, and camphor and is made in the US. Available in a new 5-oz size, the NuWave line of enamels can easily be dispensed from offices.

MVI Footcare
800/544-7521
shopmedvet.com

MyPainAway After-Burn Cream

Topical BioMedics announces its newest pain relief and healing cream formula, MyPainAway After-Burn Cream powered by Topricin. Formulated from 14 different natural biomedicines, the cream is designed to be an alternative pain relief option for those suffering with sunburn, windburn, and other minor burns and blisters, chafing, and itchy skin. It also contains ingredients known for their enzymatic activity, which helps to reduce scarring. The odorless, greaseless formula is free of parabens, petroleum, and counterirritants, absorbs quickly, and is suitable for patients of all ages, including those with diabetes.

Topical BioMedics
800/959-1007 ext. 1115
mypainawayafterburn.com

Cast Relief Spray from Dry Corp

Cast Relief by Dry Corp is a new aerosol spray designed to help relieve the itch and odor associated with wearing a lower extremity fiberglass cast. Cast Relief features a long application tube so lower extremity cast wearers can conveniently and safely apply the anti-itch solution between the cast and the patient's skin, directly at the site of the discomfort. The pleasant-smelling itch and odor solution can be also be applied through the fiberglass cast. Designed to be easy to use and safe for skin contact, Cast Relief aerosol spray can be easily applied to or under lower extremity braces and splints in addition to casts.

Dry Corp
800/6000-DRY (600-0379)
drycorp.com

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

ler new p

Peg Assist Walker Insole

Darco International announces an addition to its Peg Assist Offloading Insole family, the Peg Assist Walker Insole. The insole is composed of the same materials (Poron, Plastazote, and ethylene vinyl acetate) and is the same thickness as the company's other Peg insoles. The Peg Walker Assist is designed to be used with all standard walkers on the market to enhance the offloading capacity of those products in patients with foot wounds or those who have undergone foot surgery. The wider platform of this new product is designed to ensure proper fit and ample coverage on the plantar surface of the foot.

Darco International
800/999-8866
darcointernational.com

MegaComfort Anti-Fatigue Insoles

MegaComfort offers a complete range of ergonomic anti-fatigue insoles and orthotic devices for people employed in manufacturing, laboratory, warehouse, maintenance services, healthcare, construction, military, and retail industry settings. MegaComfort's Anti-Fatigue Insoles are made from dual-layer memory foam technology and are designed to help reduce muscle fatigue, relieve pain, and increase comfort. Personal Anti-Fatigue Mat (PAM) Insoles offer an alternative to costly standard anti-fatigue floor mats and help to reduce muscle strain, improve balance reactions, and increase blood circulation.

MegaComfort
877/634-2266
megacomfort.com

Doctor's Choice DME Crutches

Allied OSI Labs continues to expand its line of over-the-counter, durable medical equipment (DME) products with Medicare-reimbursable crutches for in-office dispensing. The Doctor's Choice DME brand of aluminum crutches comes in one youth size and two adult sizes (standard and tall). The lightweight, adjustable crutches feature arm padding and handgrips. Each crutch comes completely assembled, making dispensing to patients easy. Youth and standard adult sizes are priced at $14.95; adult tall sizes are $18.95. Practices can offset patients' out-of-pocket expenses with Medicare LCode E0114.

Allied OSI Labs
800/444-3632
alliedosilabs.com

Reflexa Therapy Socks

Doc's Socks offers the new Reflexa Socks for patients with poor circulation, cold feet, and foot pain. Several styles are available for athletes, individuals seeking the antimicrobial properties of silver, and patients with diabetes looking for graduated compression (15-20 mm Hg) to address small blood vessel disease in the feet and toes. Reflexa Socks are made in Italy using seamless technology. The socks contain a new synthetic yarn known as Celliant, which is engineered to be a thermoreactive catalyst for vasodilation, which in turn helps to relieve symptoms related to lower extremity circulatory problems.

Doc's Socks
561/369-3300

roducts

Desk Pilates, Second Edition

OPTP offers the second edition of Desk Pilates: Living Pilates Every Day by Angela Kneale. Desk Pilates is intended to increase movement, improve posture and alignment, deepen breathing patterns, and decrease muscle tension. The 22 exercises, including those for legs, feet, and hips, can be performed from a participant's desk. All exercises feature step-by-step instructions and full-color photographs that demonstrate correct form. Updates to the 50-page second edition include refined exercise instructions, new ergonomic workstation ideas, and a checklist for comfortable positioning while at a computer.

OPTP
800/367-7393
optp.com

Micro-Z II Stimulator

The Micro-Z II from Prizm Medical is a DC stimulator, from which the pulse-directed current penetrates deeply into the patient's tissue bed to promote microcirculation and the reduction of edema, which encourages healing. The Micro-Z II is approved by the Food and Drug Administration for neuromuscular electrical stimulation (NMES) and transcutaneous electrical nerve stimulation (TENS) therapy. The Micro-Z II provides DC stimulation in a microamperage range rather than a milliamperage range to maximize the biological effect of the treatment rather than just masking the pain.

Prizm Medical
800/447-4422
prizm-medical.com

Bionic Fitness Abstar Air

Bionic Fitness introduces the AbStar Air, a versatile, simple-to-use alternative to the unwieldy exercise ball. The rounded-star design offers the benefits of an unstable surface for exercises involving the muscles of the lower extremities, abdominals, and whole body. The product is only nine inches high, which helps to make it safer than larger products and also easy to store. Users can do seated, standing, or reclining exercises, using a space equivalent to that of a yoga mat. The unit is priced at $39.95, with free shipping in the US. Customers also receive access to free online exercise videos with their order.

Bionic Fitness
310/601-8837
abstar.com

Repel H20 Limb Protector

Total Vein Systems, a Houston-based medical supply company, recently introduced Repel H2O, a waterproof limb protector. The waterproof product is designed to fit over bandages, dressings, casts, and therapeutic boots to comfortably and effectively guard against the damaging effects of water while the patient is showering. The limb protector has a clear polyethylene cover and an elasticized band to provide a secure, water-tight fit. Repel H2O is engineered to be easy for patients to use and cost effective. Priced at just $3.95, each waterproof limb protector has a one-size-fits-most design.

Total Vein Systems
888/868-8346
totalvein.com

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

market mechanics

By Emily Delzell

AOPA honors advocates, student O&P poster winners at National Assembly

The Washington, DC-based American Orthotic & Prosthetic Association (AOPA) on October 9 recognized the three recipients of its Ralph R. "Ronney" Snell Legislative Advocacy Award at its National Assembly in San Antonio, TX.

The advocacy award is given to individuals who have made valuable contributions to advancing the O&P community's legislative and regulatory goals.

This year's honorees are Rick Riley, CEO of Bakersfield, CA-based Townsend Design; Teri Kuffel, vice president of Arise Orthotics & Prosthetics in Blaine, MN; and Charles Kuffel, MSM, CPO, FAAOP, Arise's president and clinical director.

AOPA also announced winners of the Otto and Lucille Becker Award and the Edwin and Kathryn Arbogast Award for best student posters in the orthotics and prosthetics categories. Tyler Klenow, MSOP, CPT-ACSM, a resident at James A. Haley Veteran's Hospital in Tampa, FL, won the Otto and Lucille Becker Award for his orthotic abstract, "A functional comparison of a carbon fiber AFO and two modular KAFO conditions using outcome measures in a veteran subject with traumatic brain injury."

Lisa Abernathy, a student in the Master of Science in Prosthetics and Orthotics Program at Alabama State University in Montgomery, received the Edwin and Kathryn Arbogast Award for her prosthetic abstract, "Going back in time: a content analysis on the media portrayal of characters with antiquated prostheses." ler

Delcam division is now Autodesk Footwear

Birmingham, UK-based Delcam announced in September the renaming of its Delcam Orthotic Insole Solutions division to Autodesk Footwear.

The new name reflects the company's joining of its orthotic insole software and Crispin production footwear software solutions into a focused division providing software for design of complete custom shoes, from last creation to complex upper and sole design to custom insoles, according to Delcam.

San Rafael, CA-based Autodesk acquired Delcam in February 2014. ler

FootcareXpress sponsors USA Rugby

Miami, FL-based FootcareXpress reported in September its new partnership with USA Rugby. The company is supporting the USA Rugby teams as they play in this month's 2015 World Cup and prepare for the 2016 Summer Olympic games in Rio de Janeiro, Brazil, with biomechanical consultations and functional custom foot orthotic devices aimed at injury prevention and increased performance. ler

Rehab Systems, OPAF host golf clinics

Rehab Systems Orthotics and Prosthetics and the Orthotic & Prosthetic Activities Foundation (OPAF) in September hosted First Swing Learn to Golf clinics in Boise and Twin Falls, ID, where the company has facilities.

Area therapists, practitioners, and golf pros learned about adaptive golf techniques and equipment and then worked with patients in "Train the Trainer" sessions.

Go to opafonline.org for more information on Charlotte, NC-based OPAF's First Clinics. ler

Fillauer opens new manufacturing facility

The Chattanooga Area Chamber of Commerce proclaimed October 1 Fillauer Day and hosted a ribbon cutting ceremony at the company's new manufacturing facility in the Tennessee city.

Over the past four months, Fillauer has expanded its orthotic and prosthetic manufacturing and relocated its Hosmer division into the new 35,000-square-foot facility.

The Chamber of Commerce recognized Fillauer for its efforts in creating economic growth and its commitment to a vibrant business environment in Chattanooga, where the company is headquartered. ler

Society works to raise gout awareness

The Gout & Uric Acid Education Society (GUAES) in September released a series of four educational brochures to raise awareness of the serious complications of gout, including heart and kidney disease, diabetes, and stroke.

The patient-focused brochures, Gout & Bone/Joint Health, Gout & Diabetes, Gout & Heart Health, and Gout & Kidney Health, are available at at gouteducation.org, the society's website.

In addition to the brochure series, the society has added content about each main comorbid health issue to the website.

All materials are part of the new "Go for 6" campaign from GUAES, which urges those who have gout to get their uric acid levels checked every six months and to work with their doctor to determine a treatment plan for controlling gout and keeping levels to 6 mg/dL or below. ler

Biom relaunches its brand as BionX

Bedford, MA-based iWalk, also known as Biom, on September 29 unveiled its new name, BionX, and logo during a presentation at the Ladenburg Thalmann Healthcare Conference in New York City.

The company's flagship product is the Biom Ankle with powered propulsion, and the name change is intended to highlight the company's core competency in the prosthetic device market market, according to BionX.

The corporate relaunch also reflects a series of company milestones, including the addition of an executive team, product enhancements, international commercial expansion, and ongoing support from reimbursement authorities such as the US Department of Veterans Affairs and workers' compensation payers across the nation, the company reported. ler

AlterG contest celebrates PT month

Fremont, CA-based AlterG is celebrating October's National Physical Therapy month with its PT of the Month contest. Go to learn.alterg.com/pt-month by October 23 to nominate a physical therapist.

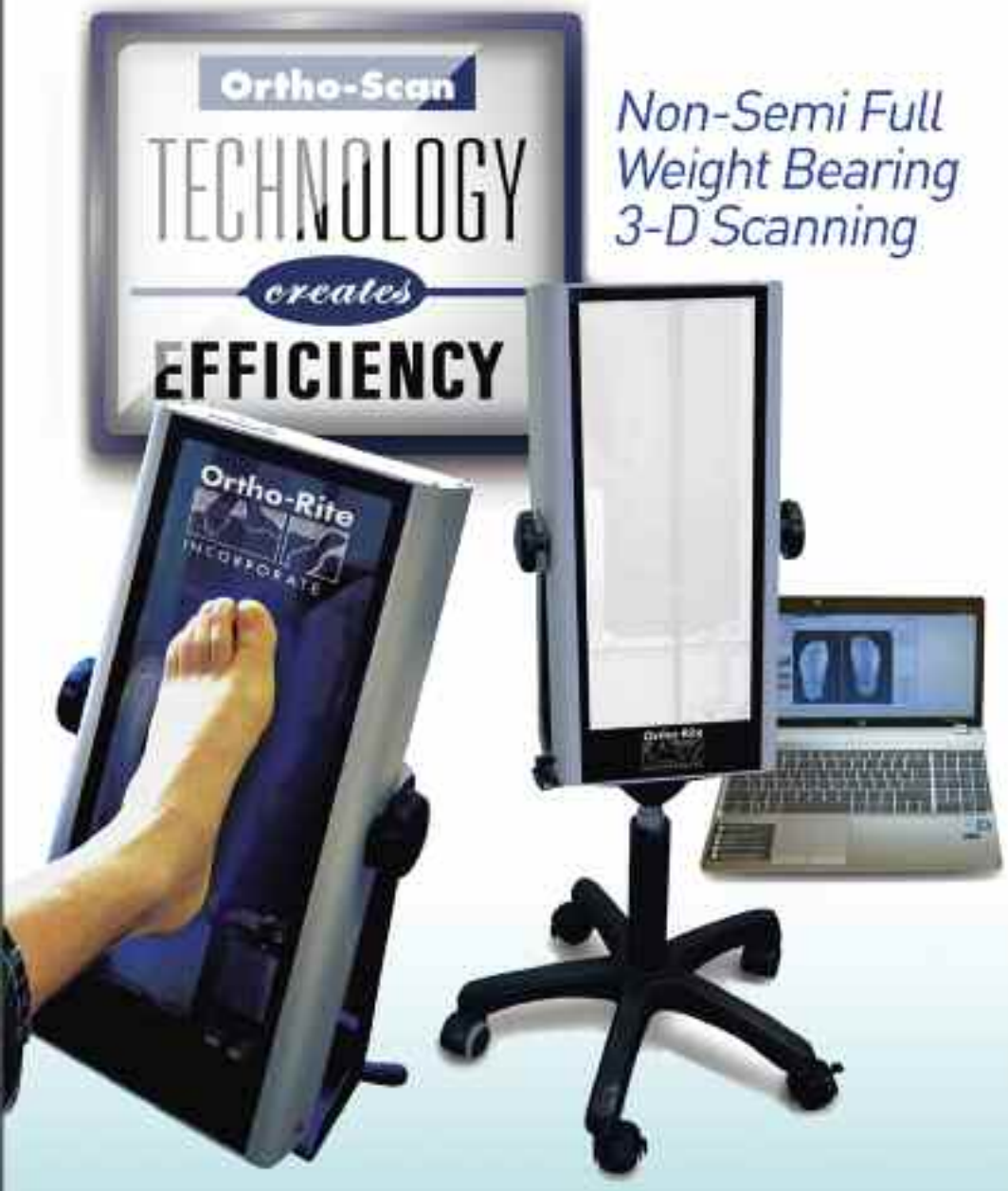
All entrants receive an AlterG dri-fit t-shirt and all nominees will get an AlterG exercise ball. The winning entrant will receive an AlterG dri-fit t-shirt, a pair of Performance Shorts 2.0, and a $100 Visa gift card. AlterG will award the winning therapist seven pairs of the Performance Shorts 2.0 and a $100 Visa gift card.

AlterG will announce the winner on its website, alterg.com, on November 2. 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

THE LANGER SPORTHOTICS LINE

FINE TUNING ATHLETES ONE SPORT AT A TIME

Langer Biomechanics

An Ohi Company

Call about our summer sporthotics special:

800.645.5520

The Langer Sporthotics Line

LangerBiomechanics.com

ohi