• REHABILITATION • TRAUMA • DIABETES • BIOMECHANICS • SPORTS MEDICINE

ler

LOWER EXTREMITY REVIEW
January 16 / volume 8 / number 1

BIOMECHANICS OF PROPULSION:
Implications for AFOs

+

PAIN MANAGEMENT
PFP RESEARCH RETREAT: EXCLUSIVE COVERAGE

VASCULAR HEALTH
COMPRESSION AND CLOTS IN ATHLETES WHO TRAVEL

FOOTWEAR
TURF, TRACTION, AND RISK OF SPORTS-RELATED INJURY

OSTEOARTHRITIS
YOGA FOR KNEE OA PAIN: A MIND-BODY APPROACH

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.

(10,10) nanotube
(armchair)

ADJUSTED

IT'S TIME TO EMBRACE THE RE-FORM.

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**

Dr. Comfort

exos®

DJO GLOBAL

DATE 01.2016

MODEL	COLOR	TRIM
No.46	Blue	Green

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

January 2016

features

VOLUME 8 NUMBER 1 LERMAGAZINE.COM

18 COVER STORY

Biomechanics of propulsion: IMPLICATIONS FOR AFOS

For many patients, the ability of an ankle foot orthosis to enhance propulsion is key to improving gait efficiency and reducing fatigue. But experts are only beginning to understand the biomechanical complexities that influence propulsion, which start with push-off but don't end there.

By Cary Groner

IN THE MOMENT

plus...

OWLS™ Know Better Orthoses™

WHO™ Heel Relief

WHO™ Forefoot Relief

WHO™ Chopart/ Lisfranc Relief

WHO™ Midfoot Walking AFO

ADO™

Orthomerica Whole Limb Solutions

The OWLS Program is a culmination of ten plus years of clinical orthotic development—treating orthopedic anomalies that result in diabetic ulcers classified Wagner 1-4 with custom orthoses. These orthoses will complement the ongoing wound therapies & post-operative care being offered at Wound Centers worldwide.

"I have successfully incorporated the OWLS program into my diabetic wound practice as a viable alternative to total contact casting in patients with plantar heel and forefoot ulcers. The custom orthoses reduce shear forces to the foot while stabilizing the foot and ankle complex and reducing pressure to the affected site."

—**Larry A. Suecof, DPM, FACFAS, CWS**
Diplomate, American Board of Podiatric Surgery

INDICATIONS

WHO Heel/Forefoot

- Any orthopedic anomaly that requires stabilization or support for ambulation
- Used in conjunction with the ADO night time orthosis
- Used as a post-operative walking orthosis
- Post TAL Procedure
- Wagner 1-3 wounds where un-weighted ambulation is desired

WHO Mid-foot/Walking

- Any orthopedic anomaly that requires stabilization or support for ambulation
- Relief for midfoot ulcer during ambulation
- Post-TAL with plantar ulcer
- Immediate post-op forefoot or midfoot amputation
- Post Charcot support and Rocker Foot support
- Post-Calcanectomy

WHO Chopart/Lisfranc

- Immediate post Chopart or Lisfranc amputation
- Protection of amputation site during ambulation
- Delayed closure at amputation site
- Relief for ulcer/wound that developed post Chopart or Lisfranc amputation

ADO

- Wagner 1+ ulceration of the heel. (Can be constructed to accommodate malleolus and forefoot wounds.)
- Post-operative wound care. ADO easily accommodates a Wound VAC
- Post-Calcanectomy

Look for this mark on genuine OWLS.™

ORTHOMERICA®
877-737-8444

Visit the OWLS Online Resource Center
www.orthomerica.com/owls

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
76,000 post views per month

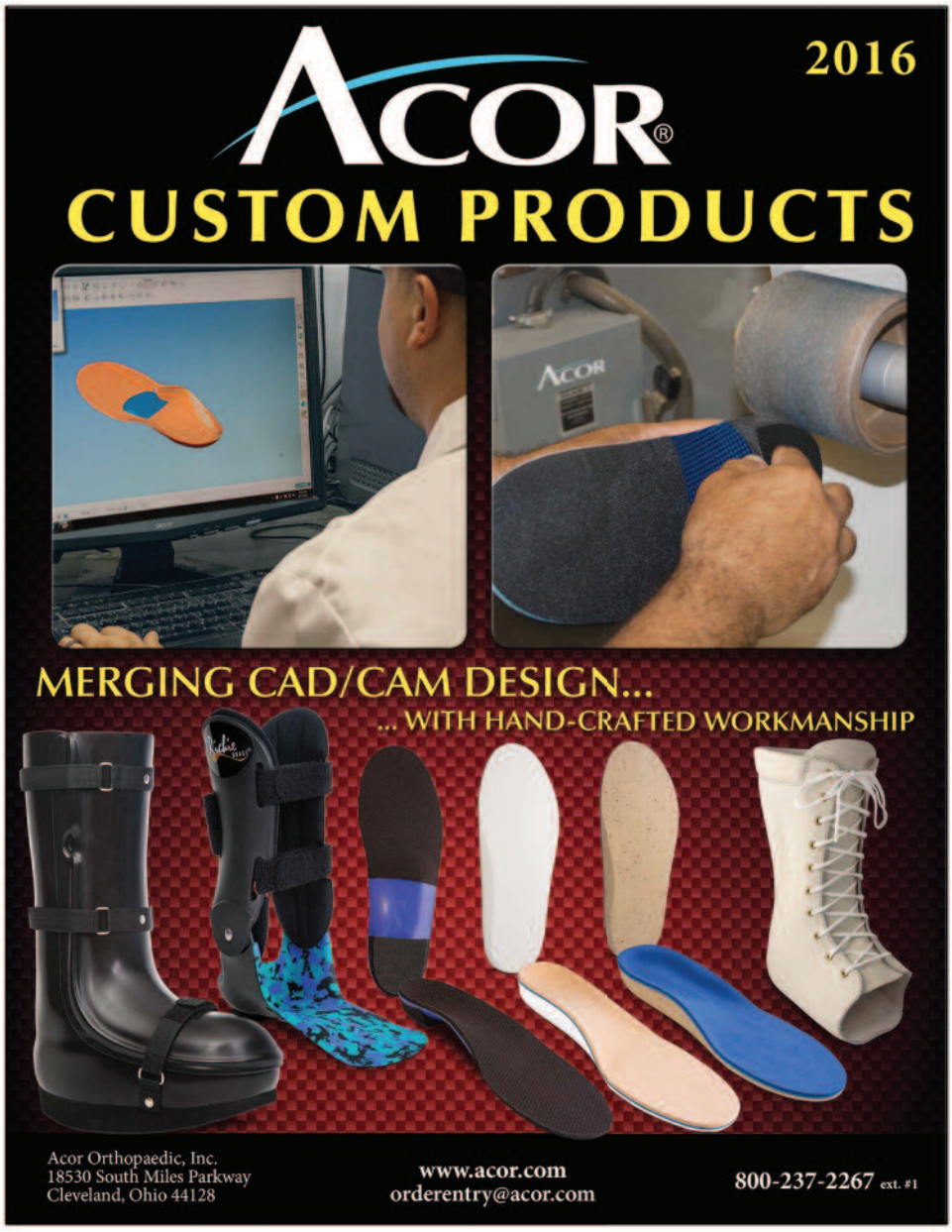
@lowerextremity
2,775 Followers

youtube.com/user/LowerExtremityReview
133,000 video views

instagram.com/lowerextremity/
233 followers

pinterest.com/lowerextremity/
291 followers

NEW CUSTOM CATALOG FROM ACOR®



ACOR CENTRAL FABRICATION SERVICES INCLUDE:

- CUSTOM FOOT ORTHOTICS
- CUSTOM GAUNTLETS
- RICHIE BRACES
- C.R.O.W. BOOTS
- TOE FILLERS

Contact ACOR to get your copy of the new catalog or download it at www.acor.com

www.acor.com
orderentry@acor.com

800-237-2267
(option 2)

Scan this barcode with your smartphone QR reader
or visit:
www.acor.com/downloads.php
to download our new catalogs

Look for us:

Lower Extremity Review
ler

out on a limb: TCCs and possibilities

Lower extremity clinicians have known for decades that the total contact cast (TCC) is the most effective means of offloading plantar ulcers in patients with diabetes. Now research has given us a much better understanding of why—an understanding that could inspire a new generation of more effective prefabricated offloading devices.

It's no secret that the irremovable nature of TCCs translates to superior compliance compared with removable offloading devices. We also know that restricting sagittal plane range of motion—by a TCC or any other device—leads to gait alterations, including shorter stride length and slower gait speed, that will reduce loading and limit activity. All of these things help improve ulcer-healing rates. But they have little to do with the offloading mechanism itself.

One theory has proposed that TCC offloading is accomplished by increasing plantar contact area, distributing pressure more evenly over the plantar surface of the foot and thereby eliminating high pressures at specific sites. It's a theory that makes sense, but in 2011 researchers from the University of Sydney in Australia reported that a TCC reduced pressure across each region of the foot, not just at the ulcer site, which called that theory into question.

Rather than redistributing plantar pressure, the Australian researchers hypothesized, TCC offloading is effective because the reduction in pressure across the plantar surface is offset by increased load bearing in the walls of the device. Several studies have documented this effect in healthy patients, but a new study from the Sydney group has finally demonstrated it in patients with diabetic foot ulcers.

The 17-patient study, published in January by the online *Journal of Foot & Ankle Research*, analyzed the offloading provided by a standard-height TCC, made with rigid and semirigid materials and modified with cellular urethane padding, and the same device with the walls removed just below the malleolus to create a shoe cast. The researchers found that, for the TCC condition, significant decreases in contact area, peak pressure, and maximum force seen at the plantar surface were offset by increases within the walls of the device. They also found that plantar contact area was significantly smaller for the TCC condition than for the shoe cast condition.

The findings suggest that an important component—possibly the most important component—of effective TCC offloading is the ability of the device's walls to suspend the foot, transferring load to the anterodistal and posterolateral-distal aspects of the lower leg.

> Research has revealed a key element of TCC offloading that could inspire a new generation of more effective devices.

And, although this mechanism has so far been demonstrated only in TCC devices, it's not a huge stretch to think that strategically designed prefabricated cast walkers—perhaps even some that are already commercially available—can achieve the same type of suspension effect with a more cost-effective, patient-friendly device.

Given that only a minute fraction of patients with diabetic foot ulcers are treated with TCCs, a new generation of prefabricated alternatives with similar suspension-based offloading could drastically improve ulcer healing rates and reduce the risk of lower limb amputation. And, given the escalating incidence of diabetes worldwide, that can't happen soon enough.

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

Impact implications

Loading helps predict running injury risk

By John C. Hayes

A two-year prospective study of female heel-strike runners found that those who suffered medically diagnosed injuries had higher impact variables at baseline than those who had never had an injury.

Although other studies had linked heel-strike impacts to injuries, none had ever done so prospectively, said first author Irene Davis, PT, PhD, a professor at Harvard Medical School and director of the Spaulding National Running Center, both in Boston. The study included female runners who had been free of injury for at least six months at the time of enrollment.

After two years, 144 of the 249 runners had experienced injuries. But of particular interest to the researchers were two subgroups: 103 who sought medical attention for their injuries and 21 who remained uninjured at the end of the study and who had never suffered a running injury before. Comparing these two groups led to the study's most significant finding, according to Davis.

"When you look at the people who have never been injured, they land significantly more softly than those who have injuries or an injury history," Davis said.

Those who sought medical attention were used for comparison because their injuries were more likely to be chronic than other

Continued on page 14

Most NBA players return from Jones fracture with no drop in performance

Most professional basketball players who sustain Jones fractures are able to return to elite competition with no significant effect on their performance, according to a recent study that should please fantasy basketball players as well as lower extremity practitioners.

Investigators from the New York University Hospital for Joint Diseases in New York City analyzed data for 26 National Basketball Association players who sustained fractures at the base of the fifth metatarsal over 19 seasons. They compared those players to a control group of 26 players matched for position, age, and player efficiency rating (PER, a statistical measure of basketball performance).

They found that 85% of the injured athletes returned to their previous level of competition. In those who did return, the PER for the season following the injury did not differ significantly from the season preceding the injury. PER values for those who returned successfully from the injury also did not differ significantly from the performance measures for the players in the control group.

The findings were epublished in December by *Sports Health*. (ler)

– Jordana Bieze Foster

Source:

Begly JP, Guss M, Ramme AJ, et al. Return to play and performance after Jones fracture in National Basketball Association athletes. Sports Health 2015 Dec 1. [Epub ahead of print]

Peak vGRF in ACL-reconstructed limb may influence collagen metabolism

After unilateral anterior cruciate ligament reconstruction (ACLR), mechanical loading in the affected limb is associated with altered patterns of collagen metabolism, according to research from the University of North Carolina at Chapel Hill that could help explain the development of knee osteoarthritis in patients with a history of ACLR.

The investigators analyzed concentrations of collagen type II cleavage product (C2C), a marker for collagen breakdown, and collagen type II C-protopeptide (CPII), a marker for collagen synthesis, in blood samples from 19 patients with a history of primary unilateral ACLR who had returned to unrestricted activity. They also assessed peak vertical ground reaction force (vGRF) and linear vGRF loading rate as the patients walked at a self-selected speed.

Higher peak vGRF in the injured limb was associated with a lower ratio of C2C to CPII, suggesting less collagen turnover. Serum concentrations of the collagen metabolism markers, however, were not significantly associated with vGRF or linear vGRF loading rate.

The findings were epublished in December by the *American Journal of Sports Medicine*. (ler)

– Jordana Bieze Foster

Source:

Pietrosimone B, Blackburn JT, Harkey MS, et al. Greater mechanical loading during walking is associated with less collagen turnover in individuals with anterior cruciate ligament reconstruction. Am J Sports Med 2015 Dec 18. [Epub ahead of print]

Continued from page 13

reported injuries, she said.

The authors evaluated vertical impact peak (VIP), which is characteristic of rearfoot-strike runners but not nonrearfoot strikers, as well as peak vertical force, vertical instantaneous loading rate, and vertical average loading rate (VALR). They found that VIP and VALR at baseline were significantly lower in the never-injured cohort than in the medically injured cohort.

"We suspect that it may not be the magnitude of the force that contributes to injury, but rather the rate of force development that is more important," Davis said. "We have not yet conducted a study, nor seen one, in which those who get injured have higher peak vertical forces than those who do not. However, rates of loading do differentiate, and that leads you to suspect that rates of loading, not magnitude, are what matters."

Of the types of injuries associated with high baseline VIP and VALR values, not surprisingly, bony stress injuries were the most prevalent. But muscle strains were reported as often as stress injuries in the 10 runners with the highest VALR values and were the second-most common injury in the 10 runners with the highest VIP values. Those two groups of runners also reported plantar fasciitis, Achilles tendinopathy, and anterior compartment syndrome.

The Boston researchers' findings were epublished in December by the *British Journal of Sports Medicine*.

It can be easy to overstate the significance of the results, said Reed Ferber, PhD, an associate professor of Kinesiology and Nursing at the University of Calgary, who helped collect data for the study but took no part in the analysis.

"It's a good study that adds a nice piece to the very complex puzzle of running related injuries, but it only addresses a part of the puzzle," Ferber said.

Also, he said, attributing injuries to a short phase of the gait cycle, in this case about 30 ms, may not be reasonable; the foot is on the ground for another 220 ms after that and the swing phase, which sets up the foot for impact, can add another 300 ms.

Future research directions might involve using kinematic and kinetic data to estimate loading within the joints involved in running, Ferber said. Another option is to use rapidly advancing wearable technology to monitor what happens among real-world runners outside the lab.

Davis said the next step will be to see if gait retraining can reduce impact variables in runners, and if that in turn reduces the risk of injury.

"Now that we have this study suggesting more strongly that impact is related to injuries, we need to see the effect of training people to run more softly," she said. ler

Source:

Davis IS, Bowser BJ, Mullineaux DR. Greater vertical impact loading in female runners with medically diagnosed injuries: a prospective investigation. Br J Sports Med 2015 Dec 7. [Epub ahead of print]

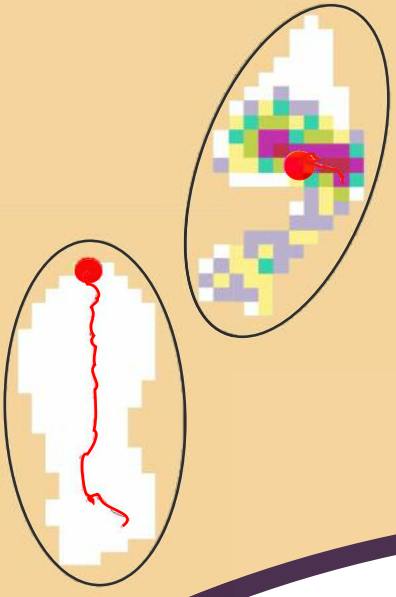
PROTOKINETICS

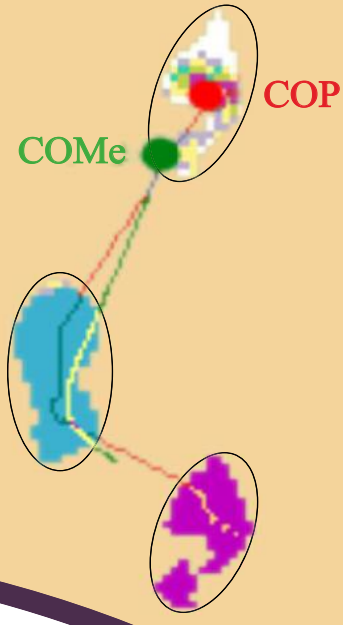
Leading Innovation in Gait & Balance Measurement

The Most Popular
"gait mat" Technology
In the World!

Best In Class
Product Knowledge
Combined with
Amazing Customer Service

PKMAS/Zeno
The Gait & Balance Performance Solution





Proto Kinetics

info@protokinetics.com
610.449.4879

www.protokinetics.com
facebook.com/protokinetics

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.

BIOMECHANICS OF PROPULSION:

Implications for AFOs

For many patients, the ability of an ankle foot orthosis to enhance propulsion is key to improving gait efficiency and reducing fatigue. But experts are only beginning to understand the biomechanical complexities that influence propulsion, which start with push-off but don't end there.

By Cary Groner

Istockphoto.com #55522972

In assessing and treating conditions that affect patients' ability to walk, it makes sense for researchers and clinicians to pay attention to the propulsive aspect of the gait cycle. Increasingly, however, experts have concluded that much of what we thought we understood about propulsion is oversimplified or just plain wrong.

Moreover, interventions to improve propulsion, such as energy-returning carbon fiber ankle foot orthoses (AFOs) or functional electrical stimulation (FES), are far more effective in some patients than others—a variability that may have more to do with the individuals themselves than with their diagnoses. It's crucial that clinicians be able to sort out such factors if they're to help their patients, but often they don't even agree on terminology, and assessing outcomes is a subjective art.

Disputed definitions

Propulsive force generation comprises two primary factors: ankle moment and the position of the center of pressure relative to the body's center of mass.[1] These, in turn, can encompass a variety of other complex biomechanical factors including ankle dorsiflexion and plantar flexion, knee extension and flexion moments, timing and magnitude of activation of the gastrocnemius and other plantar flexors, trailing limb angle, and energy consumption.

Each of these factors plays a greater or lesser role depending on the condition under consideration. Poststroke hemiplegia patients have different propulsion issues than kids with cerebral palsy (CP), or teenagers with Charcot-Marie-Tooth disease (CMT), or adults with multiple sclerosis—and therefore will require different therapeutic approaches. Disagreements over terminology and biomechanics aren't just theoretical—clinicians will have a hard time optimizing propulsion if they don't understand its complexities—and a few experts have recently begun an effort to clarify matters.

"People want the spring AFO to mimic the calf muscle, but then there needs to be clarity about what the calf muscle actually does and when it does it," said Elaine Owen, MSc, MCSP, a pediatric physical therapist at the Child Development Center in Bangor, North Wales, UK.

Clarity, however, can be hard to come by in this area, for a number of reasons.

"Push-off and propulsion may mean something different to a podiatrist than to someone working in a three-D gait lab," Owen continued.

Owen has recently traced part of the problem to a statement within an important text on gait analysis, David Winter's 1991 *Biomechanics and Motor Control of Human Gait*.[2]

"In that book, there's a graph depicting the gait cycle that, at one phase, shows decreased dorsiflexion that's described as plantar flexing. It seems that people ever since have passed down that semantic confusion," Owen explained.

Owen added that further problems can result when researchers and clinicians fail to distinguish terminal stance from preswing. In terminal stance, she explained, one limb is contacting the ground and the ankle remains in dorsiflexion; in preswing, which follows terminal stance and technically constitutes push-off, both limbs are contacting the ground and the trailing ankle is moving from dorsiflexion to plantar flexion.

"It's a big problem in terms of developing rehabilitation strategies and orthosis designs," she said. "We can't put 'normal' back into pathological gait if we aren't clear exactly what normal is."

Owen is a proponent of the gait cycle descriptions published

Continued from page 19

by Jacqueline Perry, MD, of Rancho Los Amigos National Rehabilitation Center in Downey, CA.[3] These include loading response, midstance, terminal stance, and preswing, as well as the point at which true ankle plantar flexion begins.

Despite this reliable source, misunderstandings about propulsion persist, and there is also disagreement about the way push-off occurs.

"There's an argument that the lengthening muscle in terminal stance acts like a spring tensioner on the [associated] tendon," Owen said. "When the muscle finally begins to shorten, some of the push-off may actually come from the release of the tendon."

Evidence exists for this view: Japanese researchers have elucidated a mechanism by which the gastrocnemius medialis tendon may act as a spring from the beginning of single-limb support to toe-off, increasing walking efficiency.[4]

Power & prejudice

Increasingly, researchers and clinicians are looking beyond push-off itself and exploring how other phases of the gait cycle contribute to propulsion. Owen said that experts see power generation in gait as important for two primary reasons.

"One is that something has to propel the lower limb into swing phase," she said. "The other is that it's important for general energy and momentum within the gait cycle, and for moving the trunk."

One question that's plagued researchers, she noted, is whether ankle plantar flexion and knee flexion in preswing merely propel the swing limb, or whether they're also involved in maintaining trunk momentum. In 2014, findings presented during a Thranhardt Lecture at the annual meeting of the American Academy of Orthotists & Prosthetists supported the first view. The Taiwanese authors offered evidence that the preswing movement of the thigh required power from the hip in addition to power from the ankle, which was consumed by the shank, knee, and thigh.[5]

Photo courtesy of Kinetic Research.

"They redid the calculations and said that a lot more of the force for propelling the trunk through the gait cycle came from loading response early in the cycle rather than later," Owen explained. "When you make initial contact, the heel lever forces the foot to the floor and the shank is pulled forward from reclined to vertical; I think it's massively propulsive, almost like a catapult. If we apply that theory to orthoses, we have to get first rocker and entry into midstance correct."

Owen has arrived at her own definition of push-off.

"I'd say it's from the time the calf muscles start shortening—forty to forty-five percent through the cycle—through toe-off," she said. "But that's with the understanding that in terminal stance, the calf muscles are shortening and the ankle is reducing dorsiflexion. Then, in preswing, the ankle moves from dorsiflexion to plantar flexion."

Photo courtesy of Cascade Dafo

Bryan Malas, CO, MHPE, director of orthotics/prosthetics at the Ann & Robert H. Lurie Children's Hospital of Chicago, and assistant professor of physical medicine and rehabilitation at Northwestern University in Chicago, agreed that clinicians need to develop and incorporate a more nuanced view of the way power flows through the propulsive gait cycle.

"Most people focus on the large power burst at the ankle during preswing, but there are smaller bursts as well," Malas said. "We see one at late loading, when the hip starts to extend; we see one at midstance as the knee extends; and then there's one at the initiation of swing, when hip flexion occurs. It's important to understand this, because if we provide an orthosis, we have to be clear what we want it to do."

Practical considerations

Malas added that the propulsive power generated in the gait cycle is usable primarily because it's transmitted by mechanisms of the foot—the windlass mechanism, the calcaneal-cuboid locking mechanism, plantar flexion of the first ray, and so forth. If those capabilities are compromised, and the foot's leverage diminished, propulsion suffers—and studies of partial-foot amputees have clearly shown the effect of reduced leverage on propulsive power.[6]

"We see this a lot in kids who have cerebral palsy," Malas said. "They tend to have a hyperpronated foot and they've lost that anterior lever arm, so they really have no push-off. It's hard for them to take a full step because they're standing on a compromised base. To compensate they have to use the contralateral limb."

Owen noted that kids with CP often have issues with the timing of the propulsive phase of the cycle as well.

Continued on page 22

allard USA

Mobility offers ...

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

Life Changing Outcomes!

Ypsilon | ToeOFF | BlueROCKER | KiddieGAIT | KiddieROCKER

ToeOFF 2.0 **BlueROCKER 2.0**

Specify ALLARD ToeOFF Family

Continued from page 20

Photo courtesy of Surestep.

"They may get the knee extension they need in terminal stance, but they couple this with plantar flexion, when in normal gait there is dorsiflexion," she said. "We'll use fixed-ankle AFOs, or plantar flexion-stop AFOs, to keep them from doing that so they get a good stretch on the calf muscle. You get more of a normal gait, and a normal terminal stance."

Children with spina bifida can't do any of that, she said, because their lack of calf muscle leads to excessive dorsiflexion in terminal stance. Nevertheless, in some cases the orthotic strategy may be similar to that for kids with CP.

"We use AFOs, often fixed ankle with a plantar flexion stop, whether they're weak and going into excessive dorsiflexion without heel rise, or whether they're stiff and going into early plantar flexion," she said. "People sometimes say we're preventing push-off, but the kids can pull off in preswing, the way a normal limb takes itself through the gait cycle. The hip flexors compensate, and the gains you make in hip and knee extension in terminal stance far outweigh the loss of that five percent of the gait cycle involving an active push."

"Kids with spina bifida have no plantar flexor strength and tend to walk in a crouched gait," added Malas. "They're in no position for any sort of propulsion because the knee is not extended, so they show more hip flexion to try to get the limb from stance phase into swing phase."

Owen noted that some experts object to the fixed-AFO strategy in children with CP because they feel that it reduces the work of the muscles involved in propulsion, potentially weakening them.

"That's one reason people want them to have the springy devices, or plantar flexion-free devices, that will allow them to use the calf muscle," she said. "However, some of these devices spring back into plantar flexion during terminal stance, and then people say that's OK, in normal gait there's plantar flexion in terminal stance—but there isn't! If you start to plantar flex the foot as the knee extends in terminal stance, you lose the calf muscle stretch, which is therapeutic in kids with CP."

Propulsion—as well as stability—may also be compromised if an AFO is not properly aligned, Malas said.

"If one of our objectives is to have the AFO share the work and create a relatively stable base during single-limb support, then some loading of the orthosis is required," he said. "If we want it to provide enough stability in single-limb support for the person to feel safe taking a step with the contralateral side, then loading through the orthosis should occur between midstance and terminal stance. However, this may not happen if a solid AFO, set with an ankle angle of ninety degrees, is placed into a shoe with a heel-sole differential that inclines the AFO too far forward. In that case, loading of the orthosis may not occur until late terminal stance or early preswing, and then it may be too late to create enough single-limb stability. The result is decreased step length, cadence, and speed."

A 2012 study by researchers in Amsterdam reported that energy-returning carbon fiber AFOs helped decrease the energy cost of walking by 9.8% in patients with multiple sclerosis, but not due to an augmented net ankle push-off. Rather, the effect was because the AFO simply took over 60% of the ankle work.[7]

"In that study, the average ankle angle of the AFO was around five degrees of plantar flexion," said Malas. "So you're giving the AFO a chance to load the orthosis as the person advances the tibia over the foot. I think that's one reason there's so much variation in study conclusions; it's often not clear what the ankle alignment is in the AFO."

For Malas, such findings raise bigger questions.

"Is the AFO working because it helps with power generation, or because of the increased stability it provides?" he asked. "I don't think we know, but if people don't feel stable, they shorten their step length."

Knees and ankles

Dutch researchers raised similar points in a recently published paper.[8] They suggested that gait efficiency in children with spastic CP could ideally be maximized by optimizing the tradeoff between the enhanced push-off power (from spring-like AFOs) and normalized knee flexion in stance (via rigid AFOs). They assessed kids with ventral shell spring-hinged AFOs, with the hinge set to a rigid, stiff, or flexible setting; the spring-like properties were eliminated in the rigid version. Ultimately they concluded that, in terms of energy cost, an AFO's effect on knee kinetics and kinematics may be more important than its effect on push-off.

Photo courtesy of Arizona AFO.

Continued on page 24

Put Some Spring in Their Step

Posterior Spring AFO Stores & Releases Energy with Every Step

A Dynamic AFO with Progressive Flexibility from Heel to Toe

Ultra Light Carbon Fiber Construction

Made from Prepreg Carbon Fiber

Custom Foot Bed with Foam Padding

Or Custom Proflex® SMO for Enhanced Ankle Control

Easily Fits in Shoe

Dynamic Energy Return

Adjustable Anterior Shell

Overlapping posterior section allows for compression of the proximal tiba. Removable for easy donning.

Open Heel Design

Provides soft initial floor contact preventing sudden knee flexion

Suggested L- Codes: L1945, L2755, L2820

CustomComposite

Custom Composite Manufacturing, Inc.

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

Continued from page 22

Photo courtesy of Allard USA.

Lead author Yvette Kerkum, PhD, who coauthored the paper as part of her doctorate at Vrije University Medical Center in Amsterdam, told *LER* the findings are more descriptive than prescriptive.

"The results varied a lot between patients despite the fact that we included a homogeneous group of children," she said. "Some children responded best to rigid devices, others to more flexible ones. Ankle power was preserved by the more flexible AFOs, but that didn't seem critical to energy costs. I think the main problem is that you can preserve the child's remaining push-off, but that's still only half of normal. If you really want to make a difference in energy costs by affecting ankle power, you have to add power."

Individual attention

In any case, lower extremity clinicians emphasize careful assessment of each patient.

"Your strategy depends on what outcomes you're trying to achieve," Elaine Owen said. "For example if you're treating an adult after a stroke—an acquired disability—the patient will have a normal, mature skeleton and you'll make different decisions than you would for a child who's skeletally immature, growing and trying to get to age sixteen with minimal surgeries."

Karen Nolan, PhD, a research scientist at the Kessler Foundation in West Orange, NJ, had a similar take.

"Prescription decisions are complicated," she said. "We need orthotic options that match the abilities of each patient but that function in terms of long-term rehabilitation goals. I'm not sure anyone has truly connected all the dots between propulsion, regaining and maintaining function, and increasing stability."

Nolan, who often deals with patients who have poststroke hemiplegia, added that the patient's desires are crucial to the process.

"The patient may choose a device that's not in line with what would be to their best advantage mechanically," she said. "That doesn't mean they're making a mistake. It's based on what's important to them, what most enhances their quality of life. Their primary goal may not be to increase walking speed."

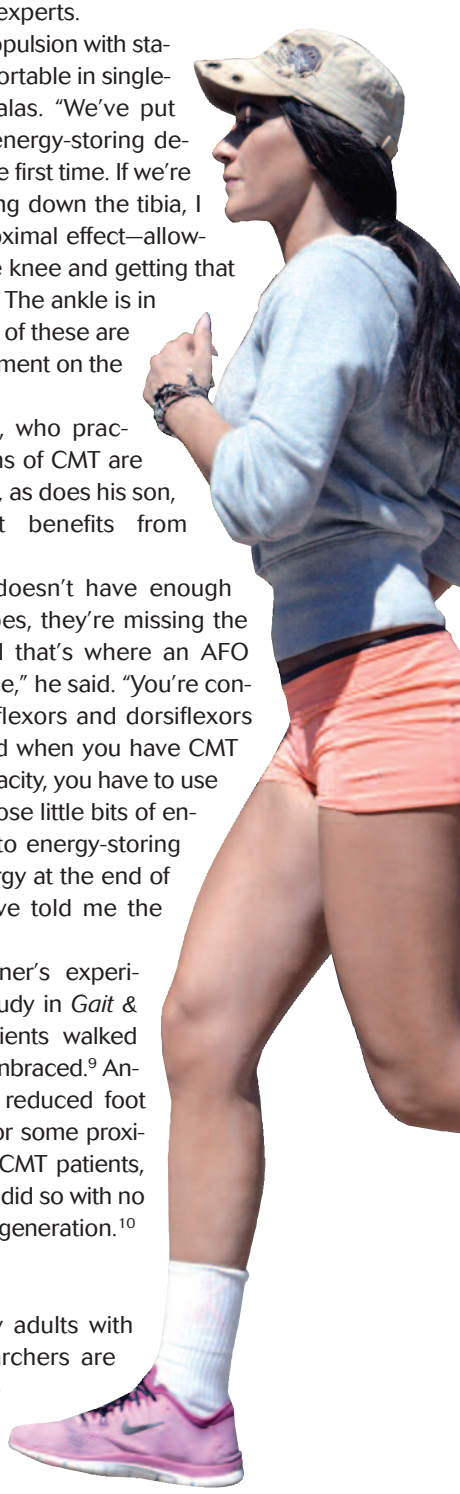
Energy-return systems seem to offer particular promise in patients with CMT, according to experts.

"Ideally you'll combine propulsion with stability, so the person feels comfortable in single-limb support," said Bryan Malas. "We've put younger kids with CMT into energy-storing designs and seen them run for the first time. If we're loading the system and slowing down the tibia, I think that's having a more proximal effect—allowing the thigh to come over the knee and getting that limb closer to knee extension. The ankle is in controlled dorsiflexion, and all of these are prerequisites for limb advancement on the contralateral side."

For David Misener, CPO, who practices in Albany, NY, discussions of CMT are personal; he has the condition, as does his son, and he's found significant benefits from energy-return AFOs.

"If someone with CMT doesn't have enough strength to get up on their toes, they're missing the propulsive stage of gait, and that's where an AFO makes a tremendous difference," he said. "You're constantly working your plantar flexors and dorsiflexors just to keep your balance, and when you have CMT and they're not working to capacity, you have to use more proximal muscles. All those little bits of energy add up. After switching to energy-storing AFOs, I have much more energy at the end of the day, and my patients have told me the same thing."

Research supports Misener's experience. For example, a 2014 study in *Gait & Posture* found that CMT patients walked faster in custom AFOs versus unbraced.[9] Another found that three AFOs reduced foot drop and removed the need for some proximal compensatory actions in CMT patients, and that two of the three AFOs did so with no decrease in peak ankle power generation.[10]



FES

In some patients, particularly adults with poststroke hemiplegia, researchers are exploring FES as a way to augment propulsive gait. Nolan and her colleagues at the

Kessler Foundation have investigated dorsiflexion-assist FES devices and reported results equivalent to those obtained with AFOs.[11]

At the University of Delaware in Newark, researchers have been exploring FES devices that stimulate both plantar flexors and dorsiflexors, and reported they help correct poststroke gait deficits at the ankle and the knee during both swing and stance phases of gait.[12] They have also added fast treadmill walking to the FES approach and reported the combination improved gait parameters including peak anterior ground reaction force, and trailing limb angle.[13]

Lead author Trisha Kesar, PT, PhD, told *LER* the team was interested because propulsion affects gait speed, which is an important rehabilitation target in stroke patients.[14]

"Able-bodied people get fifty percent of their propulsion from each leg, whereas those who've had a stroke might get as little as five percent from the paretic side," said Kesar, now an assistant professor of physical therapy at the Emory University School of Medicine in Atlanta.

Propulsive gains appeared relatively minor, however—propulsion in the paretic limb rose from 28.8% to 33.1% of the total—raising questions about clinical efficacy.[12]

"It was statistically significant, but was it meaningful; did the patients perceive a difference?" Kesar wondered.

Some did and, some didn't, as it turned out.

"In the short [test] span of thirty seconds to a minute, in one session, it was only perceptible to them if they were focused and engaged," she continued. "In the long-term study just being published,[15] where subjects had three sessions a week for twelve weeks, results are much more marked in terms of what people perceive."

The studies have produced some unexpected results, Kesar added. For example, the team found that dorsiflexion-assist FES alone worsened swing-phase knee flexion, whereas adding plantar flexion FES overcame that effect and brought things back to normal. The researchers are still investigating what caused those effects.

"As of now, the plantar stimulation is more of a motor learning tool," she said. "We use it to teach the nervous system how to use muscles after a stroke, not as a neuro-prosthetic, which is an important difference between our intervention and commercial stimulators. Hopefully, if you practice enough, and the stim teaches you correctly, you'll walk outside with more propulsion and decreased foot drop, without needing the stim."

Even so, Kesar acknowledged that, eventually, she'd like something patients could use on an ongoing basis.

"If there were an over-the-counter device for plantar- and dorsiflexor stimulation, I'd send my patients home with it," she said. "They wouldn't be limited to the clinic rehab and could get much more practice in that good-quality movement. The technology is there; now people are just working to make it portable." ler

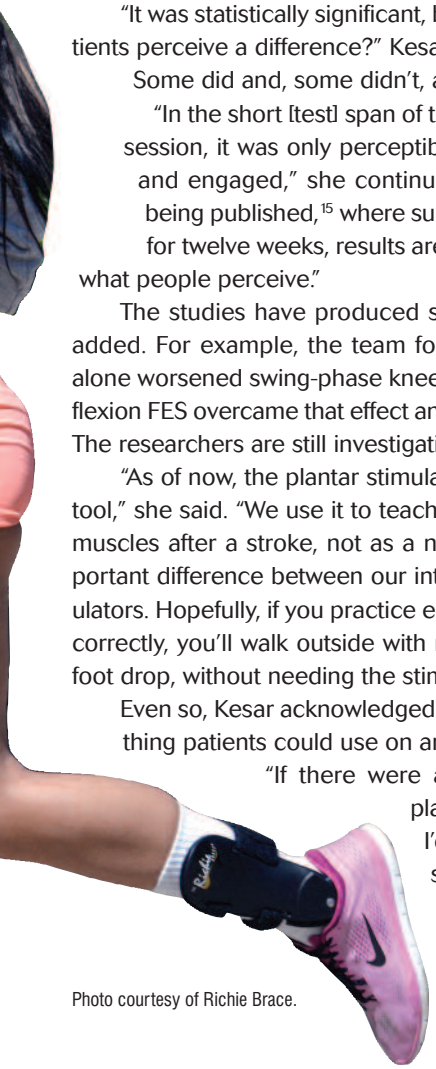


Photo courtesy of Richie Brace.

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

References are available at lermagazine.com.

Plantar fasciitis: Clinical considerations in runners

By Patricia Pande, MCIScPT, CSCS, CPed

Running is a hugely popular form of exercise due to its low cost investment, accessibility of appropriate environments, and obvious health benefits. As running has become mainstream, so has the prevalence of plantar fasciitis or fasciopathy. The incidence of lower extremity injuries in runners is estimated to range from 4.5% to 10% and the prevalence from 5.2% to 17.5%.[1]

Taunton et al[2] and Lopes et al[1] have noted the absence of prospective studies of running populations; Taunton et al, however, observed that a higher number of male runners (54%) than female runners (46%) injure the plantar fascia. In fact, plantar fascia injury is the third most frequent complaint of runners visiting sports medicine clinics. Unfortunately many relevant studies have not uniformly defined running injuries or running populations.[3]

Anatomy and diagnosis

The fascia divides into medial, central, and lateral bands that attach to the abductor hallucis, flexor abducto brevis, and abductor digiti minimi. The windlass mechanism transfers tension from the proximal attachment of the fascia to its insertion on the calcaneus, which causes the calcaneus to invert and turns the foot into a rigid lever.[4-7] The plantar fascia may become inflamed from repetitive stress or undergo degenerative changes, commonly called fasciosis.

Plantar fasciitis presents as pain in the plantar heel at the medial calcaneal tubercle and is most noticeable with the first step in the morning. This pain intensifies with long periods of standing and may be exacerbated with plantar fascia stretching. Although the two may coexist, plantar fasciitis (or fasciopathy) should be differentiated from plantar fat pad atrophy (FPA), which presents as increased pain with weightbearing and compression over the center of the heel.[8]

Plantar fasciitis in runners

The literature cites a number of causes of plantar fasciitis in runners, including long plantar arch alterations, rearfoot pronation, and magnitude of plantar loads.[2,9-12] Plantar fasciitis in runners can also be associated with fasciosis.[13-15]

Muscle atrophy. Several studies suggest an association between plantar fasciitis and muscle atrophy, particularly of the intrinsic foot muscles. Chang et al found that forefoot muscle volume, assessed using magnetic resonance imaging (MRI), was significantly lower in the affected limbs of patients with unilateral plantar fasciitis than in the healthy limbs.[16] In another MRI study, Cheung et al found that rearfoot intrinsic muscle volume was lower in experienced runners with chronic plantar fasciitis than in healthy runners, while forefoot muscle volume was similar between groups.[17] Kibler et al also found that runners with plantar fasciitis had significantly worse ankle plantar flexion strength than healthy runners;[18] this weakness could be related to muscle atrophy or to reflex inhibition with increased load on the plantar fascia.

Although these studies do not confirm muscle atrophy as the cause of plantar fasciitis or that strengthening exercises will relieve symptoms, research does suggest that intrinsic muscle activation from forefoot contact to toe off may reinforce ligamentous structures.[19] Further studies are needed to evaluate the effectiveness of exercises to improve muscle activity and orthotic interventions to support the foot for generation of muscle power.

Plantar loads. Recently, Ribeiro et al found lower loading rates in runners with acute plantar fasciitis (pain for more than four months) than in chronic cases (diagnosed a mean of 1.5 years earlier, presenting with fascial abnormalities but no acute inflammation or pain). However, loading rates in all runners with plantar fasciitis were higher than in healthy runners.[20] The authors hypothesized that the lower loading rates in the symptomatic runners than in the chronic group were due to a pain-avoidance response, and that higher loading rates in the chronic plantar fasciitis group were due to the loss of a protective mechanism against pain in the degenerated tissue, as well as a reduced ability to attenuate shock.

Similarly, Pohl et al found that maximum instantaneous load rate was significantly higher in female runners with a history of plantar fasciitis than in control runners.[9] Changes in tissue stiffness and fat pad atrophy may contribute to higher loads and may further complicate treatment by reducing lubrication and shock absorption.[8] Furthermore, loads related to the running surface may also contribute to plantar fasciitis.[21]

Running pace and volume. There is conflicting information about the impact of running pace and volume on the risk of injuries, including plantar fasciitis.[22] A study by Knobloch et al[23] found that marathon runners have a lower risk of plantar fasciitis than runners of shorter distances, which suggests faster pace may be a risk factor

Sponsored by an educational grant from Medi USA.

and higher volume may be protective. However, other prospective studies have linked lower extremity injuries, including plantar fasciitis, to higher running volume.[24] Whether due to pace or volume, the resulting stress may overload tissue.[22]

Structural variables. Thickening of the plantar fascia has been associated with plantar fasciitis, and may arise from a combination of bending, compression, and shearing forces from muscle weakness or from degenerative thickening.[12] Wearing et al found that thicker fascial structures were associated with a lower arch in patients with plantar fasciitis but not in healthy controls;[12] it is still not clear whether this finding suggests that having a low arch causes the disability or results from gait adaptation.


Istockphoto.com #48636328

Root's theory[25] that foot type contributes to plantar fasciitis remains controversial. The fact that the spectrum of foot types does not form a bell-shaped curve complicates the argument, as does the prevalence of subject-specific kinematic variations.[3,26] Additionally, the connection between foot structure and plantar fasciitis is unclear.[27] Some researchers found a lower arch index with increased range of dorsiflexion in female runners with plantar fasciitis than in their healthy counterparts,[13] but others suggest this relationship is not easily defined due to the foot's adaptability to prevent injury.[32] Nielsen et al found no increased risk of running-related injury in novice runners with moderately pronated feet.[28] Additional well-controlled randomized prospective studies of homogenous running groups are critical to furthering our understanding of these factors.

Biomechanics. Kinematics and kinetics during walking in individuals with plantar fasciitis differ from healthy volunteers,[29] and clinicians should consider the possibility that these or related differences may extend to running. The coupling mechanisms between the hindfoot, tibia, and arch during running are well-documented, but the relationship between segments of the foot is not clearly understood.[6,30,31] Still, it is important for clinicians to be aware that treatments or interventions focused on a single aspect of the foot can also affect other aspects of the kinetic chain.

Clinical applications

The American Physical Therapy Association's clinical practice guidelines for treatment of plantar fasciitis combine stretching, activity limitation, iontophoresis, night splints, and prefabricated or custom inserts.[32] The American College of Foot and Ankle Surgeons recommends initial treatment with ice, stretching, ergonomics, off-the-shelf arch supports, nonsteroidal anti-inflammatory drugs, and corticosteroid injections, with progression to custom foot orthoses and physical therapy if necessary after six months.[33]

Inserts must be able to absorb ground reaction forces, particularly in runners. Prefabricated and customized EVA (ethylene vinyl acetate) orthotic devices were associated with similar levels of pain relief in patients with noncomplicated plantar fasciitis after eight weeks.[34] Interestingly, another study found reduction of plantar pressures at the heel associated with two types of EVA sham orthoses (flat and contoured) were similar to those associated with custom foot orthoses—a finding the authors attributed to the attenuating and pressure-redistributing properties of EVA.[35] The findings of Pfefffer et al also support the use of less rigid orthotic devices in this patient population; felt and silicone or rubber were more likely to be associated with symptom relief than more rigid devices.[36]

The use of orthoses to control or supplement motions has been the traditional mainstay of treating runners and nonrunners with plantar fasciitis. Research has demonstrated that orthotic devices are associated with kinetic and kinematic effects in healthy runners. One study showed a decrease in forefoot to rearfoot coupling angles with the use of foot orthoses,[37] and another showed a change in rearfoot eversion angle and eversion velocity in female distance runners.[38] Mündermann et al found that molded foot orthoses and molded and posted foot orthoses both reduced vertical loading rates and ankle inversion moments in healthy runners.[39] However, researchers have not yet determined whether similar biomechanical effects can be expected in runners with plantar fasciitis, or to what extent those changes might affect patient symptoms.

Recent studies in which workload or strain causes pain in connective and muscular tissue support interventions to reduce kinetic effects on such tissue.[40] Nigg's Preferred Movement Pathway theory stresses force reduction and advocates self-selection based on comfort;[3,41] however, this and other similar theories need vigorous scientific inquiry.

Conclusions and recommendations

Clinicians should advocate for the cost-effective, judicious use of foot orthoses for runners with plantar fasciitis, in accordance with the present body of knowledge, which suggests such devices should:

- be comfortable[42]
- provide shock absorption[35,36]
- not increase torque at other lower extremity joints[43]
- fit well in the shoe without hindering use of the toe flexors and intrinsic muscles[44]
- be semicustomizable for patient comfort; and
- address any compensatory adaptations.

Future studies should continue to assess the kinematic causes and effects of plantar fasciitis in the running population, along with factors that predict positive response to treatment. ler

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

References are available at lermagazine.com.

Sponsored by an educational grant from Medi USA.

medi

Silicone gel insert along affected plantar fascia

igli CARBON TECHNOLOGY

igli Heel Spur Light

igli® carbon insoles for active patient's feet.

igli Heel Spur Light insoles enable individual, targeted guidance of the foot. The lightweight insole reduces heel pain and plantar fasciitis conditions, with a low-profile design which permits use in lower volume shoes.

igliusa.com

medi. I feel better.

Istockphoto.com#4924309

Conference coverage: 4th PFP research retreat

Studies presented at the Patellofemoral Pain Research Retreat in Manchester, UK, illustrate the progress researchers are making toward the ultimate goal of being able to tailor exercise protocols and other interventions to best address the needs of specific patient subgroups.

By Jordana Bieze Foster

In the lower extremity research community, patellofemoral pain (PFP) experts have long been trailblazers when it comes to identifying subgroups of patients who experience pain or respond to interventions in unique ways. The fourth PFP Research Retreat, held in September in Manchester, UK, expanded on that theme and broadened it, increasingly looking at subgroups defined by nonmechanical variables, in addition to those defined by biomechanics.

Abstracts for the studies presented at the retreat, as well as a thoroughly revised consensus statement, will be published later this year in the *British Journal of Sports Medicine (BJSM)*.

Tailored interventions

Of course, the ultimate goal of identifying subgroups of patients with PFP is being able to tailor interventions to best address the needs of each subgroup. This is easier said than done, but a number of studies presented at the research retreat did take steps toward achieving that goal by focusing on previously identified subgroups characterized by age, gender, and distal factors.

It's been well established that women are far more likely than men to experience PFP,[1] and more recent findings suggest that men and women have different risk factors.[2] But a study presented in Manchester also indicates that men and women with PFP may respond differently to strengthening interventions.

The authors of a North American multicenter study[3] comparing knee and hip exercise programs in patients with PFP revisited the data for 60 men and 125 women to look for gender-specific responses. They found that male and female patients experience similar increases in hip abduction and knee extension strength, but that men had greater gains in hip external rotation strength than women (10.5% vs 5.8%) and women had greater gains in hip extension strength (11.3% vs 7.4%).[4]

Although the gender differences were not statistically significant—a common problem when trying to tease subgroup data out of a study powered for analysis of a larger population—they do

The presentations and discussions at the most recent PFP research retreat explored the influence of nonmechanical variables on pain to a greater extent than ever before.

Continued from page 29

suggest gender-specific interventions for PFP may be worth clinical consideration and further study, said Lori Bolgla, PT, PhD, ATC, an associate professor in the Department of Physical Therapy at Augusta University in Augusta, GA, who presented the findings.

The teen years

Age continues to be a subgroup of interest in the PFP community, thanks in large part to the prolific Michael S. Rathleff, PT, PhD, a senior researcher at the Research Unit for General Practice in Aalborg, Denmark, who was one of several keynote speakers in Manchester.

Expanding on a theme from the 2013 PFP Research Retreat (see "Conference Coverage: 3rd PFP Research Retreat," November 2013, page 19), Rathleff reiterated that, in a study of 121 adolescents with PFP randomized to receive patient education or patient education plus exercise therapy, those in the exercise group were more likely to have recovered at one year than those in the education-only group—but even in the exercise group, only 38% had actually recovered by that time. This figure is much lower than what has been reported for adult populations.[5,6]

The published version of the adolescent study, which appeared in the March 2015 issue of *BJSM*,[7] also noted the patients in the exercise group who rarely complied were no more likely than those in the education group to have recovered at one year.

"I think this makes sense," Rathleff said. "The exercises only work if you do them. It's an easy visualization of the importance of adherence."

And, as it turns out, even when adolescents do their exercises, they still may not be getting the full benefit. In a study in press with the *Journal of Strength and Conditioning Research*, Rathleff and colleagues had adolescents with PFP perform hip and knee exercises using an elastic band with an embedded sensor[8] that recorded time under tension as an indication that the band was in use.

After six weeks, only 5% of all sets performed met the prescribed duration of time under tension, and half of all sets included fewer repetitions than prescribed, Rathleff said. The total exercise dose received averaged just 17% of what was prescribed, while the exercise dose that was self-reported by the participants was three times the actual dose, he said.

This disturbing finding suggests that, for clinicians who treat adolescents with PFP, developing effective exercise protocols may be even more difficult than previously thought. It also calls into question the previously mentioned finding that adherence leads to positive outcomes.

"Do patients who are adherent really do better if the self-reported exercise dose is vastly exaggerated? The self-reported data in this population is questionable at best," Rathleff said.

It's possible, Rathleff said, that exercise is less effective in adolescents than adults because teens tend to have a longer duration of pain; in a pair of 2013 studies, the self-reported average duration was 38 months for boys and 36 months for girls in adolescents aged 15 to 19 years[9] and 28 months in those aged 12 to 16 years.[10]

Another possibility is that hip and knee weakness—established targets for intervention in adults with PFP—may not be risk factors in adolescents. The 2013 study on younger adolescents found no evidence of weaker hip or knee strength in the patients with PFP than in healthy controls,10 and a recent study from Cincinnati Children's Hospital found that young female athletes who went on to develop PFP actually had greater hip abduction strength than those who didn't.[11]

"It could be that the lower strength we see in older adolescents is not a risk factor but is purely a consequence of diminished activity due to pain," Rathleff said.

Foot focus

Patients with PFP who respond positively to the use of foot orthoses account for one of the first biomechanics-based subgroups to be identified by researchers. Although several studies have proposed different variables that are likely to predict such a positive response, few have actually tested the effectiveness of tailoring interventions based on clinical prediction criteria. But researchers from the University of Queensland in Brisbane, Australia, used just such an approach in a case study presented in Manchester.[11]

Assessing a 23-year-old woman who had had bilateral PFP for 10 years, the researchers determined the difference in midfoot width between weightbearing and nonweightbearing positions was greater than 11 mm in both limbs; two previous studies[12,13] have reported that midfoot width changes of that magnitude or greater are associated with a positive response to orthotic intervention.

The case study, however, went beyond treatment with foot orthoses alone. The patient performed foot-focused exercises—calf stretching, arch forming exercises, and foot posture retraining—for 16 weeks, using foot orthoses for just the first three weeks. Following the intervention, her midfoot width difference had decreased to about 8 mm in both limbs, and the researchers were also surprised to find her hip strength had increased as well.

"Using foot orthoses in the short term provided pain control that led to more effective exercise," said Mark Matthews, a doctoral student at the university who presented the findings. "The exercise intervention was focused on the foot, but we seemed to see changes throughout the whole limb."

Particulars of PFOA

Patients with patellofemoral osteoarthritis (PFOA) represent one of the most intriguing PFP subgroups, as they are also a subgroup of the knee OA patient population. Neither PFP researchers nor knee OA researchers, however, have made much progress in developing

interventions for patients with PFOA. A study from the University of Melbourne in Australia did report that patellar taping was associated with reduced malalignment and knee pain in that subgroup,[14] and one from the University of Bristol in the UK found that a combination of taping and quadriceps strengthening was associated with benefits at 10 weeks, but not at one year.[15]

One challenge in studying interventions for patients with PFOA is that knee OA often is not limited to a single compartment, and diagnostic tests are not useful for differentiating between PFOA and tibiofemoral OA, noted keynote speaker David Felson, MD, MPH, a professor of medicine and epidemiology at the Boston University School of Medicine in Massachusetts and a professor of medicine and public health at the University of Manchester.

"Does it matter if we can diagnose patellofemoral osteoarthritis? Not for medical treatment, but for surgical treatment it does matter. For rehabilitation it may matter, and that's where our challenge is," Felson said. "The proof of treatment effectiveness lies in whether the targeted therapy is effective for patellofemoral osteoarthritis and not tibiofemoral osteoarthritis."

Another challenge in developing potential exercise interventions for patients with PFOA is that, while some researchers have reported kinematic differences between patients with PFOA and controls, others have not.[16-18] Hypothesizing that this inconsistency may be related to the different tasks studied, investigators from Philadelphia analyzed the biomechanics of two relatively challenging tasks—sit to stand (STS) and step down—in nine women with PFOA and nine healthy controls. They found that peak torque for knee extension and hip extension, abduction, and external rotation was lower in the PFOA patients than the controls, and that the patients demonstrated greater hip internal rotation than controls during the STS task.[19]

"The sit-to-stand task seemed to be the one that brought out the association between angles and torques at the hip," said Lisa Hoglund, PT, PhD, an associate professor of physical therapy at the University of the Sciences in Philadelphia, PA, who presented the results in Manchester.

The potential importance of hip external rotation strength in patients with PFOA was also underscored at the research retreat by a University of Queensland study in which more than one third of 80 patients with PFP also had early radiographic PFOA and one-quarter had more severe PFOA.[20] The study found that low hip external rotation isometric torque was associated with greater PFOA severity, along with older age and higher body mass index.

The findings of Hoglund and colleagues led them to then assess whether a 10-session intervention to improve hip and trunk strength in the same study population would lead to better performance on functional tasks, including the Timed Up and Go (TUG) test in addition to STS and step-down tests.[21] Along with improved pain and self-reported function in the PFOA group, the researchers found an association between improved hip extension strength and reduced TUG time and an association between improved hip abduction and external rotation peak torque and less internal rotation during STS and step down.

"As the patients became stronger, some of the angles became smaller," Hoglund said.

More than mechanics

Although biomechanics remains a comfort zone for many PFP researchers, the presentations and discussions at the most recent research retreat explored nonmechanical influences to a greater extent than ever before. Evidence continues to suggest that sensory information processing, kinesiophobia, and other psychosocial factors may help define PFP subgroups and offer a basis for alternative or adjunctive approaches to treatment.

A 2013 study by Rathleff and colleagues found that adolescent girls with PFP exhibit significantly lower pressure–pain threshold levels than controls, not only at the knee but also at the tibialis anterior—suggesting that a central mechanism may be underlying the pain experienced by that particular subgroup.[22] At the research retreat, Rathleff presented new findings suggesting differences between young women with PFP (participants from the adolescent study three years later) and controls with respect to conditioned pain modulation response. Specifically, cuff-induced pain at the arm reduced the perception of similar painful stimulation at the knee in the controls but not in the patients with PFP.[23] The new study also found significant between-group differences for the pressure–pain threshold at the patella, tibialis anterior, and lateral epicondyle.

Australian researchers, however, have not found significant differences in pressure–pain threshold values between patients with PFP and controls at either the patella or the tibialis anterior, according to unpublished research summarized in a Manchester presentation by Bill Vicenzino, BPhty, GradDipSportsPhty, MSc, PhD, a professor in the School of Health and Rehabilitation Sciences at the University of Queensland.[24] This suggests pressure–pain threshold may be yet another factor that could be used to define PFP subgroups.

The same presentation included findings from surveys conducted by Danish and Australian researchers related to cold sensations; previous research suggests that patients with PFP are less likely to respond to physical therapy if they report that their legs feel cold even in warm surroundings.[25] A small percentage of patients with PFP reported cold knees even in warm surroundings in the Danish (six of 28) and Australian (three of 20) surveys, Vicenzino said. However, half of the Danish respondents and 40% of the Australian respondents said their knee pain is worse when the environment is cold.

"Maybe there are some easy ways we can tap into some of these subgroups," Vicenzino said. "We may not need to do fancy laboratory tests. We may be able to do it with simple questions."

Like their colleagues in the anterior cruciate ligament injury field (see "Conference coverage: 7th ACL research retreat," May 2015, page 31), PFP researchers are starting to explore whether behavioral variables can help with the subgrouping process. In Manchester, researchers from the University of Melbourne reported that knee confidence and fear of movement influence PFP severity in patients with PFOA following anterior cruciate reconstruction,[26] and a team from the University of Queensland reported that kinesiophobia is a predictor of poor single-leg standing balance in patients with PFP.[27]

"Interventions to address kinesiophobia may enhance exercise interventions in certain patients," said Natalie Collins, PT, PhD, a postdoctoral research fellow at the University of Queensland, who presented her group's findings at the research retreat. ler

References are available at lermagazine.com.

surestep

Introducing a new look for the brand!

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

grow with us

17530 Dugdale Dr. South Bend, IN 46635 | 877.462.0711 | surestep.net

PILGRIM
SHOES

WORLD'S FINEST DIABETIC FOOTWEAR

areni® ONE
Made in USA

HOOPOE®
Ultimate comfort experience

TRUSTED QUALITY SINCE 1997

- Inspired by humans
- Reliable foot support & mapped protection
- PDAC A5500 & A5512 reviewed
- Evolved with podiatry and O&P needs in mind

1.888.493.2859
www.pilgrimshoes.com

Meticulously handcrafted
by environmentally friendly American
manufacturing fully dedicated to your wellbeing


shutterstock.com #198290258

Footwear, traction, and the risk of athletic injury

High degrees of rotational traction associated with athletic footwear can increase the risk of noncontact lower extremity injury following an unexpected neuromuscular perturbation, possibly by increasing biomechanical joint loading at the ankle and knee.

By John W. Wannop, PhD; Ryan Madden, MSc; and Darren J. Stefanyshyn, PhD, PEng

Any athlete, whether recreational, competitive, or professional, is at risk of suffering an injury whenever they participate in sports. The majority of sports injuries (up to 78%) occur in the lower extremities,[1] with ankle sprains being the most prevalent. Ankle sprains typically occur in sports that involve sudden stops and cutting maneuvers, such as football and basketball, and account for 15% to 30% of all injuries.[2-4] Knee injuries are also common, with anterior cruciate ligament (ACL) injury being a frequent, severe injury of the knee joint. ACL injuries tend to be caused by sudden deceleration, cutting or pivoting, hyperextension or hyperflexion, or by a blow to the posterolateral aspect of the knee.[5]

Sports injuries are generally classified as either contact (58% of all sports injuries) or noncontact (up to 36.8% of all sports injuries [5.2% of injuries in these studies could not be determined as contact or noncontact]).[6,7] One of the major variables associated with noncontact injury is the shoe-surface interaction, specifically footwear traction.[8-10]

Footwear traction

Although footwear traction has been studied for many years, it remains an area of contention within the scientific community. One of the main difficulties in measuring traction arises from the fact that traction of footwear does not follow the laws of mechanical dry friction.

Dry friction occurs when two surfaces in contact move relative to one another, with Amonton's laws governing the relationship that exists between the surfaces. Amonton's laws state that: (1) the friction force is directly proportional to the applied load, and (2) the friction force is independent of the apparent area of contact of the surfaces. Due to the nonuniform topography and the viscoelastic properties of footwear and sports surfaces, footwear friction is not well-characterized by Amonton's laws.[11] The boundary conditions observed when measuring footwear traction, such as the normal load, movement speed, temperature and moisture, will have a

Further work is required to determine the optimal range of footwear traction to reduce athletes' risk of noncontact injury while maintaining their performance.

Continued from page 35

Figure 1. Photograph of a third-generation artificial turf surface.

significant impact on the results.[8,12-20]

Commonly, when footwear traction is measured, it is divided into two components: translational traction and rotational traction. Translational traction is a coefficient calculated as the ratio of horizontal force to normal force. Rotational traction is described using the peak moment of rotation about the center of pressure,[21] which refers to rotation of the foot around a point of contact on the shoe sole.[22] Translational traction is thought to be necessary for athletes to start, stop, and run quickly, while rotational traction is important for cutting, pivoting, and rapid changes in direction.

Surfaces

Footwear traction depends on the interaction between the shoe and the sports surface. Although advancements in footwear design and technology are constantly occurring, the greatest changes during the past 40 years have occurred in sport surfaces, specifically artificial surfaces for field sports such as football and soccer (Figure 1).

Artificial turf was first used as an alternative to natural turf in 1966, with the first major installation occurring in the Astrodome in Houston, TX. These first-generation surfaces were made from fibers (usually nylon) densely packed with no shockpad or infill. Second-generation products began to appear in 1976, consisting of longer fibers with sand used to fill the spaces between the fibers, and shockpads incorporated under the surface. Third-generation surfaces were developed in the 1990s that were composed of less dense fibrillated fibers that closely mimicked natural grass due to the addition of an infill of rubber, sand particles, or both. Many facilities have begun to install third-generation infill surfaces due to their renowned durability allowing for year-round activity, as well as being relatively low maintenance compared with grass.[23]

Since the first iteration of artificial turf, researchers have sought to determine how comparable these new surfaces were to natural grass with respect to injury risk. Early studies concluded that first- and second-generation surfaces were associated with much higher injury rates than natural grass, with artificial turf injuries generally being more severe.[8,9,12,13,24-26] Overall, lower extremity injury rates increased by 30% to 50%[27] when sports were played on these first- and second-generation artificial surfaces.

Results have been less clear when comparing the injury rates associated with newer third-generation surfaces and those associated with natural grass. Some studies of American football have

shown an increased risk of ACL injury on third-generation artificial surfaces,[23,28] while others have found a slightly decreased risk of ACL injury[29] or no difference in ACL injury risk between surfaces.[30] Of particular interest is that two of the studies investigated the same population (National Collegiate Athletic Association athletes) during the same time period and reached different conclusions.[23,30] This may have been due to the differences in the overall ACL injury incidences in the studies, and that only one specific type of artificial turf (FieldTurf) was investigated in one of the studies.[30]

When accounting for all injuries, a change in sports surface is associated with changes in the location, severity, and distribution of injuries sustained by athletes.[29-31] Investigations into other sports, such as soccer, played on similar artificial surfaces have provided data as conflicting as those associated with American football. Some have observed increased rates of injury when soccer clubs install artificial turf at their home venue.[32] Others found no overall differences in injury rates between the artificial and natural surfaces, but did observe differences in the location, magnitude, and distribution of injuries.[33,34] Another study reported a lower incidence of total injury and lower substantial trauma on artificial turf (FieldTurf) compared with natural grass.[35]

Other sports in which surfaces have influenced injury include tennis, where in one study injury treatment during matches was required more often on grass and hard courts compared with clay courts;[36] team handball, where the ACL injury rate in women was significantly higher on rubber-coated artificial floors than on wood floors;[10] and women's floorball, where players had a greater risk of injury on artificial floors.[37] While these studies provided evidence that the sporting surface can influence athlete injury rates, the specific aspects of the surfaces that may increase the risk of injury remain unknown.

Confounding factors related to artificial sports surfaces include the infill used,[38] the fiber structure of the artificial surface,[38] the maintenance or contamination of the surface,[39] the surface hardness,[40] infill compaction and surface wear,[41] surface temperature,[42] surface moisture,[13] and the type of grass/soil comprising the natural grass surfaces. Any of these different surface properties may influence athlete injury rates; however, footwear traction is specifically mentioned by the majority of authors who have studied this topic as a mechanical property of the surface that contributes to the risk of noncontact injuries, with higher injury rates occurring on surfaces that provide greater footwear traction. However, in the majority of the previously mentioned studies, rarely were mechanical measurements of the playing surface or footwear reported.

In order to establish context and identify the potential mechanisms for injuries on these surfaces, the mechanical characteristics related to the confounding factors mentioned above must be determined. The need to quantify the mechanical properties of a playing surface is not limited to artificial surfaces, as the mechanical properties of natural grass surfaces can change vastly throughout the course of a season.[43] While the majority of studies have focused on differences in injury risk between playing surfaces, mechanical testing must also be conducted to inform recommendations on how to manipulate the surfaces to reduce injury risk.

Footwear traction and injury risk

For the past 40 years, footwear traction has been implicated as a major cause of noncontact lower extremity injuries in sports. Foot

Continued on page 38

Continued from page 37

fixation was first speculated to be affiliated with injury in 1969, when a study by Hanley[44] found a significant decrease in knee and ankle injuries in varsity football players when the heel cleats were removed from typical football shoes. Subsequent studies attributed injuries not only to the heel cleats but also the forefoot cleats, with a reduction in forefoot cleat size being associated with a reduction in lower extremity injuries.[45]

In an effort to reduce injuries related to footwear traction, Cameron and Davis[46] conducted an intervention study in which high school football athletes were given either a conventional football cleat (2373 athletes), or a swivel disc shoe (466 athletes) that replaced the typical forefoot cleats with a cleated turntable. The cleated turntable was designed to provide resistance to rotation of at least 10 Nm (the exact resistance changed depending on the normal load), after which the turntable was free to rotate. In addition, the heel cleats were replaced with a rigid plastic heel disc. The study found a lower injury rate in athletes wearing the swivel shoe (5.14% of swivel shoe athletes were injured, compared with 15.68% of control shoe athletes).

In a subset of these athletes, no difference was found in agility drill performance between the shoe conditions, indicating comparable performance between the cleats. While the results of the study appeared significant, failure to define and classify the severity of injury, including exposure rates, or subject their results to statistical analysis largely limits their utility. Furthermore, none of the studies mentioned previously directly measured traction associated with the footwear being tested.

Torg et al did the first study to quantify the traction of footwear and combine the results with a previous injury study. They observed a decrease in the incidence and severity of knee injuries as well as the number of injuries requiring surgery when high school football players wore "soccer-type" cleats with molded soles, rather than the conventional seven-cleat shoes.[47] The authors followed this study by measuring the rotational traction of the soccer-type cleat and the typical football shoe, among other shoes models worn at the time.[8] The results revealed that the conventional football shoe had higher rotational traction than the soccer-type cleat and further strengthened the link between footwear traction and lower extremity injury.

In a landmark three-year prospective study, Lambson et al[9] examined the rotational resistance of modern football cleat design and the incidence of ACL tears in high school football players. Cleats with an "edge" design (longer irregular cleats placed at the peripheral margin of the sole with a number of smaller pointed cleats pointed interiorly) had the highest rotational traction and led to a significantly higher number of ACL tears compared with all other shoes common to high school athletes.

While this study was the first to examine the link between footwear traction and injury prospectively, there were some limitations to the interpretation of the results. Specifically, the actual playing surface and shoes that were used in the study did not undergo traction measurements; only representative sample surfaces and footwear were tested. In addition, the study looked only at injuries to the ACL, which may be the most expensive and traumatic noncontact injury but is not as prevalent as ankle injury, for example.

Expanding on the work of Lambson et al,[9] Wannop et al[48] performed a three-year study following 555 high school football

athletes. The traction of the specific footwear to be used by the individual athletes during practices and games was measured at the start of the season on the actual field of play using a portable traction tester (Figure 2), while injuries suffered by the athletes during each season were recorded by certified athletic therapists.

The data showed a steady increase in injury rate as the rotational traction of the footwear worn by the athletes increased. Low rotational traction yielded an injury rate of 4.2 injuries per 1000 game exposures, while high rotational traction resulted in 19.2 injuries per 1000 game exposures. The study also found evidence that translational traction may be related to lower extremity injury, with a "midrange" of translational traction being associated with higher rates of injury than lower and higher levels of translational traction.

The previous studies that specifically investigated the influence of footwear traction on lower extremity joint injury offer strong evidence that high amounts of rotational traction increase an athlete's risk of suffering a noncontact injury. There also appears to be a link between translational traction and injury, which has been largely ignored in past research. Although rotational traction and translational

Continued on page 40

Continued from page 39

Figure 2. Photograph of the footwear traction tester performing a traction test on the field of play with the athlete's actual shoes used for competition.

traction are thought to be highly correlated, current-generation footwear includes many directional traction elements that allow for increases in traction in specific directions or during specific movements, thus reducing the overall correlation between translational and rotational traction.[48]

While these previous studies have provided evidence that footwear traction is associated with athletic injury, research on the mechanisms underlying this relationship is lacking. One common theory regarding this mechanism is that, as footwear traction is increased, loading at the knee and ankle joints is also increased. Data indicating that increased joint loading is associated with an increased risk of injury has been published using cadavers,[49,50] simulation studies,[51,52] and active participants.[53-55] This potential mechanism has been investigated in biomechanical studies in which joint loading at the knee and ankle was estimated by calculating the resultant joint moments (net twisting load on the joint) and angular impulse (cumulative loading experienced by the joint throughout stance phase) as athletes performed athletic movements in a laboratory setting.[54,55] While joint moments and angular impulse do not determine the exact loading on an actual joint structure, they have been validated as predictors of the total load across a joint.[56,57]

Multiple biomechanical studies have shown that increased footwear traction is associated with increased joint loading during rapid changes of direction and cutting movements.[58,59] These studies had athletes perform cutting movements in footwear with different mechanically measured levels of traction (both translational and rotational traction), while joint loading was calculated using data from a motion capture system and force plate. When performing movements in high traction shoes, athletes had higher joint moments and angular impulse at the knee and ankle joint than when they wore low traction shoes.[58,59] Unfortunately, in these studies the high traction footwear was characterized by both high translational traction and high rotational traction, making it impossible to determine which aspect of traction was influencing the joint loading.

To determine how each aspect of traction influenced biomechanical joint loading, a follow-up study was performed with footwear conditions in which the translational traction and rotational traction were independently altered.[60] Athletes performed cutting movements under different footwear conditions, and the knee and ankle joint moments and angular impulse were calculated using a motion capture system (Figure 3). Decreased rotational traction was associated with decreased loading in the transverse and frontal planes at the knee and ankle, while changing translational traction

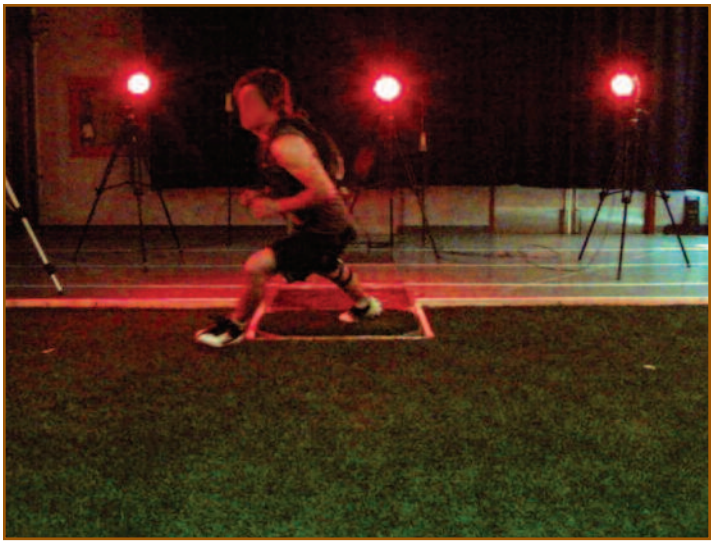


Figure 3. Athlete performing a plant-and-cut movement while the kinematics and kinetics are recorded using a motion capture system and force plate.

altered only frontal plane joint loading. These data indicate that both aspects of traction can influence joint loading, but that they influence joint loading in different ways.

Summary

Altering the mechanical properties of playing surfaces can influence the location, distribution, and severity of athletic injuries. One of the most prominent mechanical properties of playing surfaces—footwear traction—is linked with risk of athletic injury. Increases in rotational traction are associated with an increased risk of injury, which may be due to increased biomechanical joint loading at the ankle and knee. This joint loading, when coupled with an unexpected neuromuscular perturbation, may result in noncontact injury.

Further work is still required to determine the optimal range of footwear traction needed to reduce athletes' risk of suffering a noncontact injury while maintaining their performance. Surprisingly, the majority of research within this area has been conducted in American football; therefore, more research is needed in other sports, including nonfield sports such as basketball. A recent study showed footwear traction has an influence on basketball-specific performance,[61] but there are no data on how traction in basketball footwear influences injury risk.

Future epidemiological studies should strive not only to record all injury and exposure data from athletes, but also measure and record the surface properties and potentially the properties (or at least the model) of the footwear worn by study participants. While such a study would be lengthy and expensive, the data gathered would provide insight into the mechanical properties of the footwear and playing surfaces most often associated with injuries. This information will be vital for sports medicine professionals to effectively advise athletes about their footwear choices, and for footwear and sport surface manufacturers to alter the mechanical properties of their products in an attempt to reduce athletes' injury risk. ler

John Wannop, PhD, is a postdoctoral scholar; Ryan Madden, MSc, is a researcher; and Darren Stefanyshyn, PhD, PEng, is the associate dean (graduate) and professor at the Human Performance Lab in the Faculty of Kinesiology at the University of Calgary in Canada.

References are available at lermagazine.com.

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

Yoga for knee OA pain: A mind-body approach

Although the medical literature has not yet provided definitive evidence of effectiveness, a number of existing studies suggest that yoga interventions are associated with improved physical and mental health outcomes among adults with knee osteoarthritis.

By Monica R. Maly, PT, PhD

One in every six Canadians will experience arthritis—nearly six million by 2026.[1] By 2031, more than two million Canadians aged 45 to 64 years will have arthritis, and of these, one in three will be out of work.[2] Even more concerning is the chronic pain caused by arthritis, which results in immobility and dependence on others.[2]

The most frequent form of arthritis is osteoarthritis (OA), a complex chronic condition that degrades all tissues inside and around a synovial joint. The number of Canadians with OA will nearly double between 2010 and 2031; as a result, the total Canadian healthcare costs associated with treating these individuals will rise from CA$1.8 billion to CA$8.1 billion.[3] It most commonly affects weightbearing joints, such as the knee, which endure large loads associated with daily activity. Knee OA is the single greatest cause of chronic disability among community-dwelling older adults.[4]

Knee OA compromises quality of life by challenging both physical and mental health. It causes chronic pain and limits performance of tasks such as walking, stair climbing, and rising from a chair. Although these physical consequences of knee OA are well known, this disease also has a tremendous impact on mental health. The mobility limitations associated with knee OA foster social isolation.[5] It is not surprising, then, that people with knee OA are more likely than their healthy counterparts to experience depression, anxiety, insomnia, helplessness, and poor self-efficacy (confidence in the ability to complete a task).[2,6] Depression is strongly associated with poor perceptions of physical function,[7-11] and low self-efficacy[12,13] negatively influences mobility.[14-16] Importantly, these psychosocial issues are also associated with elevated pain and worsening knee OA over time.[6] Clearly, mental health must become an overt target in the management of knee OA.

Knee OA management

Currently, clinical practice guidelines for knee OA largely ignore the strong influence of mental health comorbidities on quality of life. Mainstay treatments for knee OA include pharmacology for pain

Findings that yoga is associated with improved strength, balance, flexibility, pain, and disability in older adults suggest it has promise as a clinical management strategy.

Continued from page 43


Istockphoto.com #23471600

relief and, ultimately, a surgical intervention such as total joint replacement. Clinical practice guidelines also highlight exercise as fundamental in the care pathway for knee OA.[17-19] Strengthening exercise in particular is a cornerstone of conservative knee OA treatment.[20-24]

A 2015 Cochrane review emphasized that high-quality evidence supports the use of land-based exercise to reduce pain, and moderate-quality evidence supports the use of exercise to improve physical function.[25] In fact, high-quality evidence showed that strengthening, even at a low intensity, improves knee extensor and flexor strength in patients with knee OA.[26] The standardized effect sizes associated with the use of exercise to improve pain and physical function were .40 and .37, respectively—equivalent to improvements associated with pain medications.[22]

Little is known about how to effectively improve mental health in patients with knee OA.[18] It is likely that exercise has a positive impact on mental health conditions such as depression and self-efficacy in people with knee OA, but relatively few studies demonstrate this effect. Some evidence points to exercise as useful in improving psychological outcomes. For example, in 199 participants with hip or knee OA, a nine-week web-based intervention that aimed to gradually increase physical activity improved tiredness and anxiety, even at the 12-month follow-up.[27] Interestingly, pain coping also improved, suggesting one mechanism by which exercise can improve mental health in people with knee OA. This ability to boost self-care is at the core of self-management programs that integrate education about arthritis, exercise, and pain management for people with knee OA.[28-31]

Recently, self-care for knee OA has been enhanced further with cognitive-behavioral techniques (CBT). CBT for chronic pain includes three components: education about pain and the role of pain-coping skills, training in coping skills, and applying coping skills to real-life situations. In a feasibility randomized controlled trial, 20 participants with knee OA were randomized to receive either exercise and pain-coping skills training or exercise and nondirective counseling for 10 weeks.[32] Both groups reported improvement in pain; however, no differences in this pain outcome existed between groups at follow-up. This trial was too small to form conclusions about effectiveness; it is possible that combining exercise with CBT will improve quality of life to a greater extent than exercise alone for people with knee OA. However, the CBT approach requires access to two professionals (or one professional with additional specialized training), increasing the burden of time and resources, at least in the short term, to improve health.

Yoga: A mind-body intervention

From a Western perspective, yoga is a complementary alternative medicine that directly addresses physical and mental health. However, a traditional view shows that yoga is one component of a holistic lifestyle—yoga means "union" and suggests a lifelong practice devoted to achieving harmony with self, society, and nature. It includes practices of self-restraint, physical exercise, breathing, deep relaxation, and meditation.[33] No mainstream research has investigated the impact of this holistic yogic lifestyle on quality of life, or health outcomes, in people with OA. It is exciting to note that the results of a clinical trial tackling the challenges of studying this traditional approach to yoga should soon be available at clinicaltrials.gov.[34]

Meanwhile, studies that focus on the physical exercise, meditation, and breathing elements of yoga—a Westernized approach—are available. These studies show that yoga has promise as a management strategy: It improves strength, balance, flexibility, pain, and disability in older adults.[35-40] The evidence supporting the effectiveness of yoga in people with knee OA, however, is less certain.

Several small studies show yoga improves both physical and mental health outcomes in patients with knee OA. For example, a pilot study enrolled seven women older than 50 years with symptomatic knee OA in an eight-week program of modified yoga postures.[39] Each week, participants attended one 90-minute class. Participants reported improvements in knee pain, self-reported physical function, and affect (expressed emotional responses); however, walking performance remained unchanged.[39] In a different study, after seven yoga classes, the number of nights with insomnia (self-reported) was significantly improved in 13 women with OA in any joint.[41] A case series of 14 people with symptomatic knee OA also showed yoga was associated with improved quality of life.[35]

Although these early studies point to the potential for improvement in physical and mental health after yoga, it is important to note

Continued on page 46

Give Bill a foot and he'll take a mile

When the cast comes off his foot after surgery, Bill plans to get back to his walking routine. But his foot will be too weak to bear weight unassisted for a while. Bill's orthotist knows that the answer is a custom Ankle Foot Orthosis from Spinal Technology. We have the expertise and technology to manufacture a custom AFO that's specifically fabricated and adjustable to the individual patient's needs—to get Bill back out on the road.

Bill's orthotist has always relied on Spinal Technology and our team of orthotists, CSRs, mold & finish technicians, and experts in foam & plastics. We're the lower limb orthosis experts that always go the extra mile.

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

Spinal
Technology, Inc.

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

Continued from page 44

that the improvements were limited to self-reported measures, and the exposure to yoga was relatively short and infrequent.

Because self-reported function and actual performance are not well-correlated,[42] it is important for research to include both types of measurements. Recently, we conducted a simple yoga trial in 38 women with symptomatic knee OA who completed 12 weeks of supervised yoga-based strengthening exercise three times a week.[43] A unique element of our yoga program is that we selected yoga postures (eg, lunges, squats, stretches) that would minimize patients' exposures to knee joint loads known to worsen structural disease in the knee.[43] Our "biomechanical" yoga program (see Figure 1) improved pain, self-reported physical function, objective measures of mobility performance (eg, walking speed), and knee extensor and flexor strength. However, we observed no changes in physical fitness or knee mechanics during walking and yoga postures or in muscle activation after the yoga intervention.[44]

These findings show yoga can improve muscle strength in women with knee OA, which translates to improved mobility. Nonetheless, it is important to note that, in all of these early studies, including ours, the small samples and lack of comparison with a control group means we cannot be sure if enrollment in the study itself (that is, the attention and the researchers' intention to address each patient's chronic knee problems) is responsible for the improvements, rather than the yoga intervention.

Controlled trials

A handful of studies have compared outcomes after a yoga intervention with those of a control group. For example, an eight-week


Istockphoto.com #63413085

randomized controlled trial of sedentary people with both rheumatoid arthritis and OA showed that yoga was associated with more improvement in walking performance, depressive symptoms, and perceived physical health compared with a waitlist control group.[45] Although this trial had greater-than-ideal losses to follow-up (24%),

Continued on page 48

Visco-GEL®
Hammer ToeCrutch™, #1037

Visco-GEL®
ToBuddy®, #1033

Visco-GEL®
Little ToeBuddy®, #1035

Visco-GEL®
Stay-Put Toe Spacer®, #1031

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

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

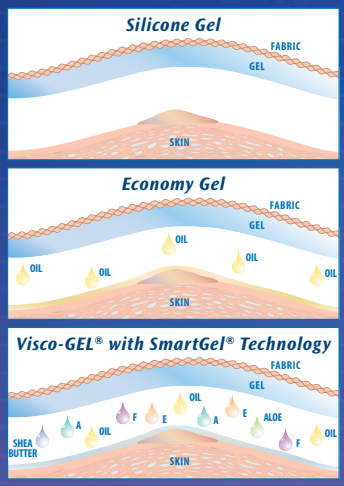
New!
ToeBuddy®
Bunion Guard Combo™ #1038

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

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

Nothing works better to relieve common foot conditions & deformities

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



Visco-GEL® with SmartGel technology from PediFix®

Effective. Economical. Easy.

PediFix® The Podiatrists' Choice®

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

Call: *1-800-424-5561*

Fax: *845-277-2851*

E-mail: *info@pedifix.com*

Return this Coupon to:
Dept. LER116, 281 Fields Lane, Suite 1, Brewster, NY 10509

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

Yes! Please send me:

Visco-GEL® with SmartGel technology from PediFix®

☐ Free Catalog

☐ Free Visco-GEL® Sample* PRODUCT NAME / #

☐ 11-Piece Sample Kit, one each, every item above, just $9.95 ($25 value)* My Name

Practice/Clinic Name

Address

City State Zip

Phone

Fax

Email

In our practice, we see approximately (#) patients each week. My favorite supplier is I prefer: ☐ to Dispense ☐ to Prescribe ☐ Patient Direct Order

Mail to: PediFix, Dept. LER116, 281 Fields Lane, Suite 1, Brewster, NY 10509

Fax to: 845-277-2851

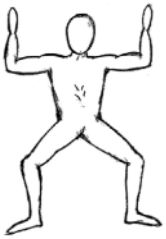
Please provide all information requested. Allow 2 weeks for delivery.
*For healthcare professionals only.

Figure 1.

Biomechanics Exercise Program

Below are descriptions of the required exercises and suggestions for modification and progression. Progression is an important component of the program. The exercise instructor will be consulted regarding the modifications to ensure the participants are cued to their modification. A general rule will be to encourage progression every two to three weeks.

Participants will be encouraged to work at a rating of perceived exertion between 5 and 7. Participants will be asked to seek a modification if their pain increases by more than 2/10.

EXERCISE	MODIFICATION	PROGRESSION
SQUAT 	**Minor:** Change exercise to wall squats (removes balance challenge). **Major:** Provide a chair and request participant to hover above the chair	**Level 1:** Hands on hips, bend knees to 30°. **Level 2:** Hands on hips, bend knees to 60°. **Level 3:** Shoulders flexed to 90° with elbows straight, bend knees to 60°. **Level 4:** Shoulders flexed to 180° (or as close as possible), bend knees to 80°. Look to the ceiling for an added balance challenge.
SQUAT – WIDE-LEGGED 	**Minor:** Reduce the width of stance. Change to wall squats. **Major:** Provide a chair and request participant to hover above the chair.	**Level 1:** Hands on hips, bend knees to 30°. **Level 2:** Hands on hips, bend knees to 60°. **Level 3:** Shoulders abducted to 90° with elbows at 90°, bend knees to 60°. **Level 4:** Shoulders flexed to 180° (or as close as possible), bend knees to 80°. Look to the ceiling for an added balance challenge.
SUPPORTED LUNGE 	**Minor:** Provide a pillow beneath the trail leg (hip in extension). Reduce hip range of motion for the lead and trail legs. **Major:** Kneeling position.	**Level 1:** Hands on hips, the hip of the trail leg is in neutral position (no flexion, no extension). **Level 2:** Hands on hips, the hip of the trail leg is in extension. **Level 3:** Shoulders flexed to 90° with elbows straight, the hip of the trail leg is in extension. **Level 4:** Shoulders flexed to 180° (or as close as possible), the hip of the trail leg is in extension.

EXERCISE	MODIFICATION	PROGRESSION
LUNGE – LATERAL TRUNK 	**Minor:** Provide support with a chair or block. **Major:** Sitting on a chair, work toward the upper body position.	**Level 1:** Place elbow on the knee of the lead leg. Place the other hand on the hip. **Level 2:** Place elbow on the knee of the lead leg. Stretch the other shoulder such that it is flexed to 180° (or as close as possible). **Level 3:** Place hand beside the foot instep of the lead leg. Stretch the other shoulder such that it is flexed to 180° (or as close as possible). **Level 4:** Place hand beside the lateral side of foot, of the lead leg. Stretch the other shoulder such that it is flexed to 180° (or as close as possible).
LUNGE – UPRIGHT TRUNK 1 	**Minor:** Reduce length of stride. **Major:** Supported lunge.	**Level 1:** Hands on hips. **Level 2:** Shoulders flexed to 90° with elbows straight. **Level 3:** Shoulders flexed to 180° (or as close as possible). **Level 4:** Shoulders flexed to 180° (or as close as possible). Look to the ceiling for an added balance challenge.
LUNGE – UPRIGHT TRUNK 2 	**Minor:** Reduce length of stride. **Major:** Supported lunge.	**Level 1:** Hands on hips. **Level 2-4:** Arms abducted to 90° with elbows straight.
BRIDGE 	**Minor:** Reduce height of bridge. **Major:** Place a support (eg, 4-in foam block) under the sacrum for a passive stretch.	**Level 1:** Arms by side. **Level 2:** Clasp hands together. Increase height of bridge as appropriate.

Figure adapted with permission from reference 44.

Continued from page 47

no adverse events were related to yoga. Similar findings were reported for a sample of women with knee OA.[46]

Older adults living in a senior center had greater improvement in depressive symptoms and life satisfaction after a sitting yoga program (n = 23) compared with a control group who received education but no exercise (n = 11).[47] However, pain, walking performance, and balance performance were unchanged, suggesting this intervention improved psychological but not physical status.

It is important to note that, while the study design called for concealed allocation, the nature of this trial required that we exclude 26% (n = 9) of individuals from randomization because of limited cognition, placing them into the siting yoga group. Nevertheless, though not a true randomized controlled trial, this study showed that older adults who cannot participate in standing exercise due to weakness, balance impairment, or pain could benefit from a sitting yoga class.[47]

Two studies have investigated whether adding yoga to traditional treatment for people with knee OA provides greater benefit than traditional treatment alone. In a nonrandomized trial of patients who had undergone knee replacement (n = 51), a combined program of yoga and physical therapy was associated with greater improvement in WOMAC (Western Ontario and McMasters Universities Osteoarthritis Index) pain and stiffness scores than physical therapy alone.[48] However, adherence to the home-based exercise in either group was not reported, making it unclear if the participants actually completed the requested exercises once home from the hospital.[48]

A large randomized controlled trial of 250 men and women aged between 35 and 80 years with knee OA implemented two study arms: traditional physical therapy for two weeks (exercise, transcutaneous muscle stimulation, and ultrasound) versus traditional physical therapy and yoga for two weeks. Adding yoga to supervised physiotherapy improved overall health-related quality of life, anxiety, morning stiffness, blood pressure, and pulse rate more than physiotherapy alone.[49-51] No information was given, however, about adverse events, or the number of participants who completed the study.

It is possible that the patients who received yoga in addition to standard care showed greater improvement simply because they received more treatment. It is also worth noting these randomized controlled trials involved relatively small volumes of yoga, below the typical standard of exercise (three times per week for 12 weeks)[52] considered necessary to induce changes in the musculoskeletal system.

Only one study has compared the impact of yoga-based exercise with another treatment regime.[53] A three-armed pilot study randomized participants to a chair yoga program and a Reiki program and included a control (education) group. Results showed improvements in self-reported physical function in older adults with OA are greater after a chair yoga program (45 minutes twice a week for eight weeks) than after a Reiki program (30 minutes once a week for eight weeks). Although this comparison is interesting and encouraging, the comparison of yoga to a treatment (Reiki) that is not established in Western literature as effective limits the strength of the findings. A comparison of yoga to a traditional treatment that

Continued on page 50

Continued from page 49

has been clearly demonstrated to be effective in patients with knee OA, such as strengthening exercise,[25] is warranted.

Limitations of the literature

Ultimately, while existing studies provide some encouragement that yoga has promise as a mind-body approach to knee OA, there are not enough high-quality data to prove effectiveness. Several limitations of the existing work mean we cannot be sure that yoga is an ideal, or effective, approach to treating the physical and mental health problems created by knee OA.

First, the majority of the available studies are limited by small samples, uncontrolled designs, and limitations in reporting important details, such as how many participants completed the intervention. These limitations result in bias toward favorable results; any improvements may have more to do with the attention participants receive than the intervention itself.

Second, existing studies of yoga for knee OA have focused on self-reported measures. These measures are essential for providing an individual's perspective on mental health, pain, and quality of life. However, objective measures (for example, mobility performance or blood pressure) are necessary to capture the extent to which physical and mental health improvements can be observed. Further, a focus on mental health measures directly relevant to issues in knee OA, such as depressive symptoms and anxiety, would be of great benefit.

Third, there is little consistency between studies with regard to the yoga protocols used, making it challenging to develop recommendations for people with knee OA.[54] The frequency, duration, supervision, and type of yoga must be clearly defined and should be consistent with recommendations for any exercise intervention for knee OA.[52]

Adverse events have been reported rarely in trials exploring the efficacy of yoga exercise in people with knee OA. As a result, the safety of yoga as an intervention for knee OA may be unclear, particularly with respect to concerns that the intervention's emphasis on range of motion may exceed the tolerance of tissues inside an osteoarthritic joint.[45] With this reporting limitation in mind, serious adverse events (that is, events that require hospitalization) were not noted in any study.

Some evidence suggests that musculoskeletal pain associated with sprains and strains in the low back, wrist, ankle, knee, or Achilles tendon may occur as a result of a yoga intervention.[44,55] In the interest of safety, extreme ranges of motion that may be practiced in advanced or specialized yoga approaches are unlikely to be appropriate for older adults. Further, specific comorbidities in older adults require attention; for example, postures challenging single-leg standing balance that could result in a fall likely have significant potential for harm in those with osteoporosis.

The bottom line

Individuals with musculoskeletal problems, such as those with knee OA, are frequent users of complementary therapies and alternative medicine.[56] The popularity of yoga as an exercise intervention provides an additional venue through which we as clinicians can promote physical activity among people with knee OA. Although the existing data do not provide definitive evidence of effectiveness, the studies are reasonably consistent in demonstrating improvement in physical and mental health outcomes among adults with knee OA. Providing more choices for physical activity, such as yoga, will hopefully improve exposure and adherence.

The Westernized approach to yoga, focusing on physical exercise, breathing, and meditation, appears reasonably safe; no serious adverse events have been reported in the literature to date. The main risk associated with engaging in yoga would be that future trials could reveal yoga is ineffective. However, while we wait for randomized controlled trials to provide higher-quality evidence, it appears likely that yoga is an excellent addition to a conservative treatment program for older adults with knee OA.

It makes sense to ensure that people with knee OA are completing time-tested interventions, such as traditional strengthening exercise. The addition of yoga is likely to be useful in further boosting physical and mental health in people with knee OA. ler

Monica Maly, PT, PhD, is associate professor in the School of Rehabilitation Science at McMaster University in Hamilton, Ontario, Canada. She is a physiotherapist and biomechanist who holds a New Investigator Award from the Canadian Institutes of Health Research.

Disclosure: The author gratefully acknowledges funding support from the Natural Sciences and Engineering Research Council of Canada and the Labarge Optimal Aging Initiative.

References are available at lermagazine.com.

STILL LOOKING FOR A FIT?

ComfortFit is Unmatched in Quality, Price and Service


Night Splints and Walkers


Stabilizer Brace


Richie Brace Products


Medicare-Approved Diabetic Shoes and Inserts


iTOM-CAT Scanning Technology


Comprehensive Line of Custom Foot Orthotics


Prefabricated Orthotics for All Ages

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

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

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

APMSA COMPANY OF THE YEAR

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

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

ComfortFit Orthotics

EMAIL contact@comfortfitlabs.com

VISIT www.comfortfitlabs.com

CALL 1-888-523-1600

SIGVARIS

STAY ACTIVE WITH SIGVARIS

Medical-grade graduated compression recommended by physicians, fitness experts and athletic trainers worldwide.

sigvarisusa.com


Istockphoto.com #79025781

Compression and clots in athletes who travel

Hemostatic activation following a marathon is lower in athletes who run with compression socks than those who run with typical athletic socks, suggesting the garments may help reduce the risk of post-exercise clot formation in athletes who travel to events.

By Amanda Zaleski, MSc; and Beth Taylor, PhD

There are several published case studies of athletes who have experienced deep vein thrombosis (DVT), pulmonary embolism (PE), or both following athletic competition or physical activity. Tao and Davenport, for example, reported on a female triathlete who was diagnosed with DVT and PE after competing in a half Ironman triathlon.[1] After competing in the triathlon she traveled five hours by car the following morning. She subsequently experienced symptoms of left lower extremity swelling and pain, accompanied thereafter by dyspnea and lightheadedness on exertion. There are also several published cases of DVT and PE occurring after marathon running. Mackie and Webster described two male marathon runners who developed DVT and PE approximately one week after running a marathon; in both cases, DVT was misdiagnosed initially (either as a muscle strain or Baker cyst).[2]

The myriad benefits obtained from regular sustained exercise are undeniable. However, such case reports indicate that, in at least a small fraction of otherwise healthy avid exercisers, there may be an augmented risk of DVT following endurance exercise.

Research has established that strenuous endurance exercise, such as marathon running, activates the coagulatory system (clot formation) by immediately increasing markers of coagulation such as thrombin-antithrombin complex (TAT), prothrombin fragment 1 and 2, and D-dimer.[3-5] In response, the fibrinolytic (clot breakdown) system (eg, tissue plasminogen activator [t-PA] antigen and activity) activate in coordination with the coagulatory system following exercise, such that changes in coagulation are paralleled by an activation of fibrinolysis to preserve hemostatic balance. In other words, in healthy athletes, postexercise clot formation is approximately equal to clot breakdown. This phenomenon, by which both markers of coagulation and fibrinolysis are increased in the bloodstream, is termed "hemostatic activation."

While exercise-induced hemostatic activation is not detrimental for most individuals, factors incident to marathon running may disproportionately activate the coagulatory system, increasing the risk

Car, bus, train, or air travel by an athlete who has recently engaged in endurance exercise may shift the hemostatic balance, increasing the risk of venous complication.

Continued from page 53


Shutterstock.com #65456923

for venous thromboembolism (VTE) and contributing to reports of DVT, PE, or both—all of which have been reported after prolonged strenuous endurance events in otherwise healthy athletes.[6-13] Given that marathon participation has increased 40% over the past decade, with 550,637 finishers in 2014,[14] this has implications for the increasing numbers of athletes who compete in endurance events.

Risk factors for VTE

The benefits of regular sustained aerobic exercise are indisputable. Paradoxically, endurance training and competition expose athletes to factors that may increase their risk for VTE. Virchow's triad is composed of three factors—venous stasis, endothelial cell injury, and hypercoagulability—that augment blood clot risk.[15] Endurance athletes are exposed to a combination of these factors; they experience repetitive microtrauma, endothelial damage, and dehydration during competition, followed by periods of inactivity, immobility, and stasis while traveling to and from athletic events or recovering from the event.

The superimposition of car, bus, train, or air travel on an athlete who has recently engaged in endurance exercise, for example, may shift the hemostatic balance in athletes postcompetition, thereby increasing the risk of VTE in certain individuals. The MEGA trial reported that any travel by car, bus, train, or plane longer than four hours increases risk of DVT twofold,[16] and, indeed, there are several published case reports[17,18] and substantial anecdotal evidence on the Internet detailing athletic individuals who have experienced VTE after the combination of competition and travel.[19,20] To the best of our knowledge, however, we are the first group to examine the effect of prolonged exercise and air travel on thrombotic risk factors.[5,21]

We examined 41 time-qualified runners participating in the 2010 Boston Marathon who either flew more than four hours (travel group) or drove less than two hours (control group) to the race. We obtained blood samples to assess coagulation (TAT, D-dimer, P-selectin, and microparticles) and fibrinolysis (t-PA) the day before the marathon, immediately after the event, and the day after the marathon following the flight home.

Baseline TAT, t-PA, D-dimer, P-selectin, and microparticle levels were not different between travelers and controls. Immediately following the marathon, all markers of coagulation and fibrinolysis were significantly higher than baseline, indicating that hemostatic activation had occurred. However, among individuals who flew more than four hours, the increase in coagulation factor TAT from baseline to after the race in the travel group was nearly double the increase seen in the controls (5 ± 4 to 12.9 ± 15.6 mg/L vs 4 ± 1.2 to 6.1 ± 1.2 mg/L; $p = .02$).

Similarly, exercise-induced increases in D-dimer, a clinical biomarker of DVT, were also significantly greater immediately after the marathon in the travel group of athletes than in controls (142 ± 83 to 387 ± 196 ng/mL vs 85 ± 26 to 233 ± 95 ng/mL; $p = .02$). In fact, six of the runners in the travel group (vs no local controls) had D-dimer values that exceeded the clinical threshold for preliminary diagnosis of DVT (> 500 ng/mL).[22]

Most notable, however, was that marathon-induced increases in the fibrinolytic factor t-PA did not differ between control and travelers, indicating a hemostatic shift toward a more procoagulatory state in athletes who flew to Boston and ran the marathon. Moreover, the increase in the TAT response was greatest in the oldest runners ($p < .01$), and older subjects also had greater P-selectin values (a marker of inflammation) than younger subjects, indicating that age appears to moderate the coagulatory response to endurance exercise in combination with cross-country air travel.

These data provided the first evidence that the combination of marathon running and air travel disrupts the hemostatic balance and favors a coagulatory response, which appears to be exacerbated with increasing age. Other factors specific to endurance athletes that could additionally exacerbate VTE risk include oral contraceptive use, presence/family history of a clotting disorder, sex, injury, bradycardia, atrial fibrillation, or previous history of VTE.[15,23,24]

Compression socks during a marathon

The Evidence-Based Clinical Practice Guidelines from the American College of Chest Physicians suggests the use of properly fitted compression socks to mitigate blood clot risk in high-risk populations.[25] The use of compression socks, or mechanical prophylaxis, to maintain hemostatic balance has been studied with participants at rest and has been shown to be effective in reducing VTE in some clinical populations (eg, patients with a previous history of DVT or recent surgery),[26] but contraindicated in others (eg, patients with arterial insufficiency).[27]

Awareness of VTE in endurance athletes has grown significantly in the past few years, and, consequently, running associations and events are increasingly urging athletes to wear compression socks during flight and competition to diminish DVT risk.[28,29] Although these informal (albeit common-sense) recommendations are grounded in evidence derived from clinical populations, the efficacy of compression socks to attenuate marathon-induced hemostatic activation has been tested only recently.[30]

Our group recently examined the safety and efficacy of compression socks worn during a marathon on hemostatic activation

Figure 1. Researchers obtained venous blood samples from marathon runners the day before the event, immediately after the event, and 24 hours later.

immediately following the 2013 Hartford Marathon in Connecticut. We randomly assigned runners (n = 20) to a compression sock group or a control group at the initial screening.[30] The runners reported to the marathon exposition the day before the event. We obtained venous blood to measure coagulatory factors (TAT, D-dimer), a fibrinolytic factor (t-PA), and hematocrit (Figure 1). We also obtained blood immediately after completion of the marathon in the main medical tent approximately 100 m from the finish line and within 24 hours of the race finish.

Runners in the sock group (n = 10) were compression sock naïve; they received their socks (19-25 mm Hg at the ankle) at the marathon expo and were instructed to wear them to the race start and throughout the duration of the marathon (Figure 2). Runners in the control group (n = 10) were instructed to wear their typical athletic socks, but refrain from compression sock use during training, the marathon, and on the day after the marathon.

Plasma concentrations of D-dimer, TAT, and t-PA did not differ between groups at baseline. Consistent with findings from previous studies, we observed parallel increases in markers of coagulation and fibrinolysis immediately following strenuous exercise, specifically, exercise-induced increases in D-dimer, TAT, and t-PA. Of note, these parallel increases of coagulation and fibrinolysis did not differ between recreational Hartford marathoners and elite Boston marathoners who trained more and performed faster, reinforcing the negligible impact of differences in training history and race time on exercise-induced hemostatic activation. Average t-PA across all three time points was lower in the compression sock group than the control group ($p = .04$). Similarly, average TAT across all three time points was lower in compression sock group compared with the control group, with a trend toward statistical significance ($p = .07$); however, plasma D-dimer did not differ between the groups across all three time points (all $p > .2$).

Because runners were not wearing compression socks at baseline, and there were no differences in hemostatic markers at baseline between groups, the findings related to t-PA and TAT suggest a significant effect of wearing compression socks on immediate and 24-hour post marathon hemostatic markers—specifically that overall hemostatic activation following a marathon was lower with compression socks than with typical athletic socks. Most importantly, compression socks did not appear to adversely influence markers of hemostasis during a marathon and thus they appear safe for overall use in runners.

Given that prolonged travel (greater than four hours) activates the coagulatory system, and many marathoners travel long distances to an event, the use of compression socks as a preventive measure should be considered, assuming they are tolerable and properly fitted.[31] However, the efficacy of compression socks still remains to be tested in combination with travel, as the athletes in this study traveled local, short distances to and from the marathon.

We caution that there is a need for larger studies, as well as studies of hemostatic alterations following a marathon in combination with other risk factors (eg, oral contraceptive use, prolonged travel, and genetic predisposition for VTE).[24] We maintain a DVT registry of athletes who have had a history of VTE after competition to better identify individual risk factors that may contribute to this phenomenon.

Performance, recovery and VTE risk

Athletes wear compression socks for a variety of reasons beyond reduction of blood clot risk, and thus their influence on noncoagu-

Figure 2. Runners in the sock group were given compression socks and instructed to wear them throughout the duration of the marathon.

Continued on page 56

Continued from page 55


Shutterstock.com #283319420

latory outcomes deserves further mention. Compression socks are increasingly popular with athletes due to perceived enhancement of exercise performance and recovery. To date, the research regarding the efficacy of compression socks to enhance performance, aid in recovery, or both has been equivocal.[32-36] This is partially due to the difficulty of conducting placebo-controlled trials and the use of subjective qualitative reporting as primary outcome measures. Studies that have measured objective physiological markers of muscle damage (ie, creatine kinase, a marker of muscle damage, and lactate, a metabolic byproduct) have been limited and inconclusive, perhaps because the studies are vastly heterogeneous in terms of a) the type of compression garment used (eg, whole body, sleeves, knee-high compression) and b) the modality of exercise being tested (eg, resistance or aerobic).

Hypothetical mechanisms underlying performance and recovery benefits of compression socks differ depending on their timing of use (ie, during or after exercise), but are similar in that all theorize that the mechanism of action targets components of Virchow's triad.

Compression socks worn during exercise are thought to reduce microtrauma and enhance venous return by applying an external circumferential pressure gradient that reduces swelling space, improves blood flow, and in turn improves performance.[37,38]

Compression socks worn during recovery are thought to accelerate metabolic waste clearance, attenuate edema and swelling, and improve oxygen delivery to muscle.[39,40]

A recent meta-analysis incorporating 12 studies found a favorable effect of compression socks for enhancing recovery from muscle damage, based on creatine kinase and reduced severity of delayed onset muscle soreness.[33] However, of the studies included in the meta-analysis, not one sought to examine the influence of compression socks in response to a sustained aerobic event (eg, marathon or triathlon), making the interpretation of the findings difficult to apply to endurance athletes.

A separate systematic review concluded the available literature does not fully support or refute the use of compression socks for improving performance or recovery.[41] For example, three studies found no difference in running performance while wearing compression socks,[35,37,42] while one demonstrated improvements in running speed and performance.[43]

To the best of the authors' knowledge, there are only two randomized controlled trials that examine performance and recovery in marathon runners.[42,44] One found compression socks worn for 48 hours after a marathon were associated with a 5.9% improvement in functional recovery (ie, time to exhaustion on a treadmill two weeks after a marathon).[44] The other reported that compression socks worn during a marathon did not result in better race performance or lower markers of exercise-induced muscle damage, as assessed via serum myoglobin and creatine kinase concentrations before and after the event.[42]

Conclusion

In conclusion, with the exception of one study,[35] the data do not appear to reveal any adverse consequences of compression socks, and in some cases suggest socks may result in psychological advantages that translate into performance gains. Assuming that socks are properly sized, marathoners can consider compression socks a sports garment that has preliminary evidence to support its use for preserving hemostatic balance during exercise and hastening recovery from exercise, but not for enhancing performance.[30,42,44,45]

Runners should be aware of manufacturer specifications and proper sizing techniques. Although a minimum threshold of pressure applied at the ankle is not yet clearly defined in the literature,[46] compression socks should be graduated (ie, lower pressure at the ankle gradually increasing to higher pressure at the knee). Lastly, socks should be sized according to calf circumference, not shoe size, to avoid excessive pressure at the calf and to potentially increase the risk-benefit ratio.[31] By following these specifications, athletes may be reassured that compression socks likely do not harm athletic performance and recovery, which is critically important given the time and effort associated with training and performance. ler

Amanda L. Zaleski, MS, is an exercise physiologist in the Department of Preventive Cardiology in the Henry Low Heart Center at Hartford Hospital in Connecticut and a doctoral student in the Department of Kinesiology at the University of Connecticut in Storrs. Beth A. Taylor, PhD, is the director of exercise physiology research in the Department of Preventive Cardiology in the Henry Low Heart Center at Hartford Hospital and an associate professor in the Department of Kinesiology at the University of Connecticut. Her interest in blood clot risk arose from the experience of her older sister, who experienced a DVT and PE after running a half marathon and flying home to Seattle, WA, from Hartford, CT.

Disclosure: Amanda Zaleski has received funding from the CT Space Grant Consortium Graduate Fellowship, Hartford Hospital, and the American College of Sports Medicine NASA Space Physiology Grants for her ongoing research to examine risk factors associated with VTE in active individuals. In addition, she discloses product sponsorship from 2XU Compression Socks.

References are available at lermagazine.com.

ad index

ler new p

iTom-Cat from ComfortFit

ComfortFit Labs, with technology partner Tom-Cat Solutions, is now offering the iTom-Cat, an iPad Air 2-based, full-function foot and ankle scanning system with integrated hardware and software. The system uses a structured sensor to quickly and easily capture a 3D image that has an accuracy of less than .2 mm. The software features an on-screen ComfortFit prescription form; all data are sent to the lab in seconds with the push of a button. The plug-in scanner, annual application license fee, and system calibration at start up are free to ComfortFit customers who average at least 12 orders per month.

ComfortFit Labs
888/523-1600
comfortfitlabs.com

Total Vein Boost Hosiery

Total Vein Systems recently introduced Boost, its new line of athletic compression therapy hosiery. The Boost socks use graduated compression to help increase blood circulation and enhance oxygen delivery to working and recovering muscles, in order to accelerate recuperation and reduce muscle soreness. Each pair of Boost socks has reinforced calf and shin stitching, Achilles tendon protection, arch support, foot sole cushioning, and an antislip toe and heel woven with antimicrobial silver-coated fibers. Three sock styles are available with 15-20 mm Hg or 20-30 mm Hg of compression and in a variety of colors.

Total Vein Systems
888/868-8346
totalvein.com

Balance Walking Poles

Balance Walking Poles are designed to align the spine during gait, keeping patients comfortably erect and allowing them to walk longer with better form. The poles offer an easy way to increase muscle engagement while decreasing joint loads. The pole action is designed to increase cardiovascular benefit while decreasing the perceived rate of exertion. The lightweight aluminum poles feature ergonomic, adjustable grips and snaps, along with interchangeable rubber and tungsten tips (softer tips are sold separately). Adjustable-height (80-135 cm) poles are available in black, dark pink, or light pink.

Balance Walking
770/916-5996
balancewalking.com

OdysseyK2 Prosthetic Foot

The OdysseyK2 from College Park has a curved hydraulic ankle, Intelliweave composite foot base, and customizable dual StrideControl. The ankle provides 12° of smooth hydraulic motion that works in tandem with the foot base. College Park composites provide gait-matched movement, increased ground contact for stability, controlled energy, and a flexible heel for a total range of motion of up to 27°. The curved hydraulic cylinder allows for one pivot point, resulting in a smoother sweep, longer life, and a lower profile foot. Independently adjustable plantar- and dorsiflexion valves facilitate in-office tuning.

College Park Industries
800/728-7950
college-park.com

roducts

Unequal Insoles from Spenco

Spenco and Unequal Technologies have collaborated to produce insoles for athletes at risk for lower extremity stress injuries. Unequal Protective Cushioning provides ultra-thin comfort, and Unequal Protective Stability has a lightweight orthotic cradle. Both cobranded insoles feature Spenco's Full Contact Comfort and The Shape That Feels Great, along with the protection and shock attenuation of Unequal's vibration-absorbing technology, featuring a composite that utilizes a "para-aramid" for strength, abrasion resistance, and fabric integrity at high temperatures. The retail price is $39.99 per pair.

Spenco
800/877-3626
spenco.com

Microfiber Shades Socks

Sigvaris North America has announced Microfiber Shades, a fun new line of microfiber compression socks for people who need to wear graduated compression but want more playful socks with a pop of color. The initial offering features a pink stripe pattern in 20-30 mm Hg of graduated compression to help improve circulation and relieve tired, achy legs. When new shades for men and women are released later this year, 15-20 mm Hg compression will also be available. The socks feature an extremely fine synthetic fiber material and high-tech, thermoregulating technology for year-round comfort and breathability.

Sigvaris North America
770/631-1778
sigvarisusa.com

KanoPrint Direct Forming Station

Kano-Labs has updated its KanoPrint Direct Forming Station, designed for the creation of custom total contact corrective orthotic devices—with the foot either in a subtalar-neutral, nonweightbearing position or in a corrected position—while accounting for soft tissue expansion. The KanoPrint 2.0 station is about 20% smaller than the original and about 50% lighter in weight, so it can be moved between rooms more easily. Updates include the ability to take two impressions at once and the option of positioning the controls on either the front or the back of the unit to accommodate user preferences.

Kano-Labs
385/240-KANO (5266)
kano-labs.com

ProComp Material

New from Cascade Orthopedic Supply, ProComp is a polypropylene-based composite, stabilized with discontinuous carbon fiber, for the custom fabrication of lower extremity orthoses. The 3D carbon fiber matrix is discretely imbedded into the core of the laminate, which eliminates contact dermal irritation; the individual fibers enable the composite to flow and stretch during melt-temperature vacuum forming. The polypropylene resin in ProComp is an FDA-approved food grade formula. Primary clinical benefits of ProComp include structural integrity, inhibited clinical creep, and postdelivery contour modification.

Cascade Orthopedic Supply
800/888-0865
cascade-usa.com

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

ler new products

Nail Creations Cosmetic Covers

Nail Creations are an attractive, safe, temporary cosmetic solution for damaged, infected, or missing toenails. These temporary, cosmetic grade cover-ups create the illusion of a healthy, beautiful toenail for a day at the beach or an evening out in open-toed shoes, while helping to protect the missing or damaged nail during the healing process. An easy-to-apply, latex-free cosmetic covering conceals the underlying problem toenail—clinicians or patients can just trim and polish to match the other toes as needed, and apply like a bandage. Each box retails for $19.95 and contains 16 strips in assorted sizes.

Nail Creations
844/TOE-WRAP (863-9727)
toenailcovers.com

Swede-O Thermal Supports

Swede-O announces a new generation of Thermal Supports engineered with MVT2 (Micro Ventilated Thermal) technology, which is designed to provide compression and warmth for pain relief in patients with sports injuries, repetitive strain injuries, arthritis, and other painful conditions. The microventilated, breathable membrane with moisture-wicking technology provides a free flow of air for added comfort, while the soft thermal lining captures and retains body heat to help relieve pain. Swede-O's Thermal Support line includes lower extremity products in a wide range of sizes to fit most body types.

Swede-O
800/525-9339
swedeo.com

Dycor H Series Foot

Dycor's new H Series prosthetic foot is a hybrid version of the company's K Series foot, and a simple, lightweight, and inexpensive approach to moderate-impact assisted and unassisted prosthetic activities of daily living. The H Series foot includes a cushioned heel, an elastic keel, and an integrated vertical axis transverse torque absorber for use with solid ankles. Although the average weight of the device—including the foot shell, integrated keel, ankle adaptor, and torque absorber—is just 9.3 oz, it is designed to support and control up to 400 times its own weight in the parasagittal, frontal, and transverse planes.

Dycor Prosthetics
800/794-6099
dycormfg.com

MyPainAway Fibro Cream

Topical BioMedics has launched MyPainAway Fibro Cream powered by Topricin, a new product for the topical treatment of fibromyalgia pain. Naturally formulated to address the issues causing the aches and pains of fibromyalgia, the cream is intended to help the body rid itself of toxins and excess fluids at the pain site, taking pressure off the capillaries so oxygen and nutrients can flow back into the cells. This may help reduce the duration and intensity of fibromyalgia episodes and improve restful sleep patterns. MyPainAway Fibro Cream has no known side effects and will not interfere with other medications.

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

market mechanics

By Emily Delzell

Surestep, Midwest Orthotics convert to employee stock ownership plan

South Bend, IN-based Surestep and Midwest Orthotics employees on January 13 celebrated the 50th birthday of founder Berne Veldman, CO, but got their own gift when Veldman and his wife Pam Veldman announced the companies had transitioned to a 100% Employee Stock Ownership Plan (ESOP), a qualified retirement benefit that holds company stock.

"Congratulations, you're now owners," Bernie Veldman told the group of about 170 staff gathered at the Gillespie Center in South Bend. "You now own your future."

On January 4, Dienen, parent company to Midwest Orthotics and Surestep, became an ESOP, but the Veldmans kept the news under wraps until the surprise announcement.

Day-to-day company operations and individual jobs won't change, but Bernie Veldman noted that employee-owned companies often see more engaged employees, as their future financial benefits are tied to the company's success and value.

"We are excited for the future of our companies; we already have such a compassionate and dedicated team of employees," company VP Pam Veldman said. ler

Campbell is Hanger's chief clinical officer

James Campbell PhD, CO, FAAOP, joined Austin, TX-based Hanger Clinic in November 2015 as chief clinical officer. Campbell joined Hanger after 17 years at Becker Orthopedic in Troy, MI, where he was most recently executive vice president for clinical services and research and product development, manufacturing engineering, quality, regulatory affairs, and central fabrication.

At Hanger his primary focus will be developing clinical practice guidelines for major medical conditions, as well as capturing the medical outcomes of Hanger Clinic patients and translating the data into value for payors.

Campbell has served on the Board of Directors of the American Orthotic and Prosthetic Association (AOPA) since 2012 and is its 2016 president. A named inventor on five US patents, Campbell has authored several book chapters and journal articles, and was editor in chief of the *Journal of Prosthetics and Orthotics* from 2000-2003. ler

Anodyne launches iPad scanner app

Milwaukee, WI-based Anodyne in January introduced iPad Scanner-based ordering for A5513 custom inserts and L5000 toe fillers. The free app, said Anodyne cofounders Bobby Kanter and Brian O'Reilly, improves suppliers' operational efficiency as they can avoid foam impression costs and benefit from short turnaround times.

Anodyne's lab is currently turning around the inserts and toe fillers in 24 to 48 hours, and suppliers using the app can have custom insert and toe filler orders delivered in as fast as three days. ler

BOC's Zacharias chairs ICE board

Claudia Zacharias, MBA, CAE, president and CEO of the Owings Mills, MD-based Board of Certification/Accreditation, is now serving as board chair of the Institute for Credentialing Excellence (ICE) Board of Directors.

The announcement was made at the October 2015 ICE Annual Meeting in Portland, OR. ler

Exo-L ankle brace limits risky motion

A Dutch-designed ankle brace limits the inversion–plantar flexion motion responsible for most ankle sprains without limiting plantar flexion or dorsiflexion, according to results of a 12-person study published in November 2015 in the *American Journal of Sports Medicine*.

The investigators tested participants' talocrural and subtalar joint mobility with a 3D computed tomography (3D CT) stress test before and after application of the ankle brace, made by Delft-based Exo-L. They assessed range of motion during dorsiflexion to plantar flexion and combined eversion and dorsiflexion to combined inversion and plantar flexion.

Use of the brace significantly restricted the rotation of motion from combined eversion and dorsiflexion to combined inversion and plantar flexion in both the talocrural and subtalar joints. No significant differences were found in either joint during dorsiflexion to plantar flexion. ler

Ottobock brings Bionx ankle to Europe

Duderstadt, Germany-based Ottobock reported in December that it has inked an exclusive deal with Bionx to distribute the Bedford, MA-based company's motor-driven ankle in Germany, Austria, Switzerland, and Scandinavia.

The Biom Prosthetic Ankle expands Ottobock's product portfolio of modern prosthetic feet and offers additional degrees of ankle movement to amputees, said Helmut Pfuhl, head of Ottobock's Prosthetics Business Unit.

Austin, TX-based Ottobock and Dallas, TX-based Scott Sabolich Prosthetics & Research (SSPR) in November 2015 inked a collaboration agreement with a goal of advancing prosthetic patient outcomes. The nonequity relationship includes sharing expertise on education, quality standards, and reimbursement strategies. ler

PediFix marks 130 years at APMA event

Quincy, MA-based PediFix Footcare Company celebrated its 130th anniversary with customers and friends at the October 2015 American Podiatric Medical Association (APMA) Region One Conference in Boston.

PediFix offers an assortment of more than 200 therapeutic products, including Visco-Gel and Pedi-Gel digital devices, postoperative splints, an in-office OTC dispensing program and, most recently, ShoeZap, a 15-minute UV shoe sanitizer.

Celebrations will continue throughout 2016, according to Jon Case, president of the family-owned company, which was established by Case's great grandfather, Heinrich Berkemann, in Germany in 1885. ler

AAOP webinar teaches evidence use

The American Academy of Orthotists & Prosthetists (AAOP) in December released a webinar designed to help practitioners understand systematic reviews and bridge the gap between evidence and practice.

"Applications of best available evidence in O&P: What can we learn from systematic reviews?" is based on a symposium given by experts at the 2015 International Society of Prosthetics and Orthotics World Congress in Lyon, France.

Practitioners can view the course for free or pay a fee ($30 for AAOP members, $50 for nonmembers) to take the exam and receive 1.5 continuing education credits. For more information or to view the course, go to the Online Learning Center on the AAOP website (oandp.org). ler

Continued on page 62

Continued from page 61

AAOS issues guidance on TKR, hip fracture and rehab, OCD knee in kids

The Rosemont, IL-based American Academy of Orthopaedic Surgeons (AAOS) in December released updated clinical practice guidelines on surgical management of knee osteoarthritis, as well as several appropriate use criteria (AUC).

"Surgical Management of Osteoarthritis of the Knee" focuses on total knee replacement (TKR). Key recommendations with a "strong" rating include reducing risk factors such as body weight and smoking, administering multimodal anesthesia to decrease pain and opioid use post-TKR, and starting rehabilitation the same day as TKR to shorten hospital stays.

"Appropriate Use Criteria for the Treatment of Hip Fractures in the Elderly" addresses patients 60 years and older with fractures caused by low-impact events.

It includes a preoperative checklist of 12 important care initiatives, including limiting preoperative traction, managing Warfarin, and discussing the patient's home environment prior to discharge.

"Appropriate Use Criteria for Postoperative Rehabilitation for Low Energy Hip Fractures in the Elderly," provides universal recovery recommendations for elderly patient populations and a future fracture prevention checklist that includes measures such as participation in a fall prevention program and therapy to improve bone density.

"Appropriate Use Criteria for Management of Osteochondritis Dissecans of the Femoral Condyle" covers treatment and rehabilitation of pediatric patients. It rates therapies based on whether they are reasonable and acceptable given the patient's condition, and are likely to improve outcomes. For example, restricting physical activity that produces impact or pain, and performing physical therapy to regain strength, mobility, and function were rated "appropriate," and bracing the knee instead of immediate surgical treatment was rated "may be appropriate."

Access the new clinical guideline and the AUCs at aaos.org. ler

DRFOP offers online *Capabilities* archive

The Digital Resource Foundation for the Orthotics & Prosthetics Community, popularly known as DRFOP.org, in December added the 22-year *Capabilities* archive to its database.

A legacy of the former Northwestern University Rehabilitation Engineering Research Center (NU-RERC) for Prosthetics and Orthotics in Chicago, *Capabilities* was published and mailed at no cost as a hard copy quarterly for 22 years from 1991 through 2013.

Access to the *Capabilities* archive on DRFOP.org enables free access and download of articles about the research, presentations, publications, and other activities conducted at the NU-RERC. ler

FDA approves Integra matrix for DFUs

The US Food and Drug Administration on January 7 approved Plainsboro, NJ-based Integra's Omnigraft Dermal Regeneration Matrix to treat diabetic foot ulcers (DFUs) that haven't healed after six weeks and don't involve exposure of the joint capsule, tendon, or bone.

The matrix device is used in conjunction with standard diabetic ulcer care and is made of silicone, cow collagen, and shark cartilage. ler

Sensoria pairs apps with its smart socks

Redmond, WA-based Sensoria in January announced two new apps that will pair with its smart socks, which integrate textile pressure sensor technology and send gait and walking activity data to an electronic anklet.

The Sensoria Walk app can track steps, cadence, and distance during rehabilitation after a stroke or surgery, with the goal of speeding recovery, and can help monitor activity in patients with neurological disorders, said Davide Vigano, Sensoria's CEO and cofounder.

Sensoria Walk will be available for download in the Apple Store in early 2016.

A second app designed to interface with Sensoria's smart socks, this one developed by Maine entrepreneurs known as the "Semle brothers," entered beta testing in January.

Developed with Alzheimer patients in mind, the upBed app will pair with Sensoria's socks to alert caregivers with a text message when the wearer leaves their bed. ler

ACSM issues injury prevention recs

The Indianapolis IL-based American College of Sports Medicine (ACSM) and five other professional organizations in December 2015 released a new team physician consensus statement that outlines best practices for injury and illness prevention for athletes of all levels.

"Selected Issues in Injury and Illness Prevention and the Team Physician," updates a statement originally published in 2007; new key recommendations involve the role of sport-specific prevention programs and equipment safety cautions.

The American Academy of Family Physicians, American Academy of Orthopaedic Surgeons, American Medical Society for Sports Medicine, American Orthopaedic Society for Sports Medicine, and American Osteopathic Academy of Sports Medicine collaborated with the ACSM to produce the statement, which they published jointly in the January issue of *Medicine & Science in Sports & Exercise* and the January/February issue of *Current Sports Medicine Reports*. ler

AOPA awards mobility contest winners

The Washington, DC-based American Orthotic & Prosthetic Association (AOPA) in December announced the winners of its Mobility Saves Testimonial Contest.

Jeff Lewis of Mesa, AZ, a quadruple amputee, won the grand prize of $500 for his video describing his active life, which includes bowling, dancing, and golfing.

Ruth Frieboes of North Powder, OR, who became an above knee amputee in her mid-50s, won the second place prize of $250 with footage of her adventures zip lining, hiking, and enjoying the beach.

The winning testimonials will be used as part of the Mobility Saves campaign, aimed at spreading the news that O&P care saves lives and money, promoting research on the cost-effectiveness of O&P, and showcasing patients whose lives are improved with modern technology.

View the videos and learn more at mobilitysaves.org. ler

Orthozone is distributor for Thermoskin

Kilsyth, Australia-based Thermoskin in January named Blaine, MN-based Orthozone the new exclusive North American distributor of the complete Thermoskin line.

Thermoskin's line of soft orthopedic goods includes FXT Compression Socks, CoolX-Change Cooling Bandages, and Thermoskin Sport Supports. ler

ohi

AFO | ESSENTIALS

The Patient Compliance Bundle

AFO Essentials marries a any custom-fabricated Arizona AFO that's worn in a shoe, with custom-fit, AFO-appropriate APEX footwear. The bundled products arrive in a single shipment – at a remarkably compelling price – and are dispensed and donned in a single follow-up visit. For the first time, patients exit your office with everything they need to achieve a successful outcome, and more likely than ever to remain compliant.

* Eligible Arizona AFO products include all AFOS that fit a shoe, with the exception of the Moore Balance Brace

THE BENEFITS?

- Sharply increase patient compliance and satisfaction
- Enhanced - and more rapidly achieved - patient outcomes
- Remarkably compelling 'Bundle' pricing plus vastly improved practice efficiency
- Receive a Brannock device, order forms, shoe selection guide and everything else needed to get started

GET STARTED WITH AFO ESSENTIALS TODAY!

VISIT OHI.NET/AFOE
OR CALL (877) 780-8382

The OHI Family of Brands

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

THE LANGER SPORTHOTICS LINE

FINE TUNING ATHLETES, ONE SPORT AT A TIME

The Langer Sporthotics Line

ALLSPORT BASKETBALL MARATHONER SOCCER SPRINTER

Langer Biomechanics
An OHI Company

For more info on the Langer Sporthotics line, visit LangerBiomechanics.com or call:

800.645.5520

The OHI Family of Brands

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