• REHABILITATION • TRAUMA • DIABETES • BIOMECHANICS • SPORTS MEDICINE

ler

LOWER EXTREMITY REVIEW
March 16 / volume 8 / number 3

Outcomes after ACL surgery: The importance of graft type

SPORTS MEDICINE
RUNNING MODIFICATIONS AND REDUCING INJURY RISK

GERIATRICS
STRENGTH TRAINING: BONE HEALTH BENEFITS FOR MEN

GAIT ANALYSIS
FLEXIBLE FLAT FOOT: DYNAMIC EFFECTS OF ORTHOTIC DEVICES

REHABILITATION
CHRONIC ANKLE INSTABILITY RESPONDS TO TAILORED 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.

ADJUSTED

IT'S TIME TO EMBRACE THE RE-FORM.

Dr. Comfort

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

exos®

DJO GLOBAL

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


ANODYNE
ANODYNE

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

Acor Orthopaedic
www.acor.com

Allied OSI Labs
www.aolabs.com

ComfortFit Orthotic Labs
www.comfortfitlabs.com

Eastern Podiatry Labs
www.epiorthotics.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 Lab
www.surefitlab.com

15 ELITE DISTRIBUTORS

joining together to support ONE BRACE

You don't get to be the best player on the field without the support of a fabulous team. The Richie Brace is the gold standard of the orthotics industry. It happened because a superior quality product is supported by an extraordinary team. Fifteen of the top orthotics companies in the country share and support the Richie Brace for one reason: they recognize the best product to provide for their customers. Fifteen elite distributors supporting one product...unprecedented for a good reason. Thank you!

THE Richie BRACE
RESTORING MOBILITY®

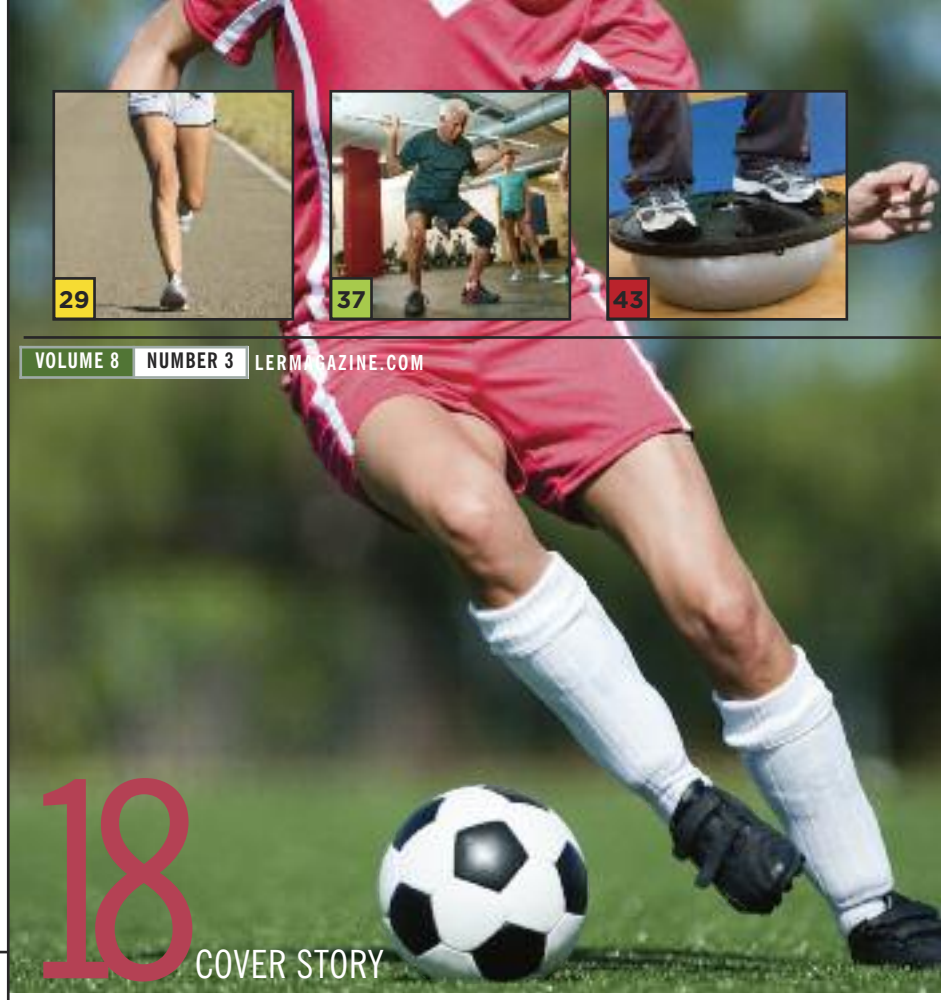
For more information visit
richiebrace.com

Lower Extremity Review

ler

March 2016

features



VOLUME 8 NUMBER 3 LERMAGAZINE.COM

18 COVER STORY

Outcomes after ACL surgery:
THE IMPORTANCE OF GRAFT TYPE

In an attempt to decrease the risk of re-rupture and revision surgery after anterior cruciate ligament reconstruction, practitioners are refining the decision process regarding which procedure is best for which patient.

By Cary Groner

IN THE MOMENT

plus...

Custom AFO Gauntlets FROM ACOR®

Made in the USA

Standard Features

- Soft PORON®-padded collar
- Molded polypropylene inner shell with PORON® padding throughout
- Lined with leather or optional X-Static®-lined NeoSponge™
- PORON® + Multicork™ orthotic
- In-house turnaround time of 7-10 business days
- *PDAC Letters available at: www.acor.com/PDAC-Sadmerc.php

L1940
L2330
L2820
L5000 *(G9118)*

Standard

Flexure Joint Articulating

Dorsi-Assist Articulating

Chopart Toe Filler

Acor AFO Gauntlets are available with your choice of three polypropylene reinforcements.

Multiple Closure Options

Lace | Boot Hooks | Speed Lacer | Velcro | Lace/Velcro | Navicular Strap

18 Color Options!

(natural leather - colors may vary)

black	brown	bone	white	taupe	navy blue
oak	sand	pink	red	orange	yellow
purple	royal blue	kelly green	light grey	medium grey	sky blue

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:
An analgesic assist

When it comes to improving outcomes after anterior cruciate ligament (ACL) reconstruction, lower extremity practitioners need all the help they can get. Fortunately, a recent study suggests they might be able to get some valuable assistance from their colleagues in anesthesiology.

Increasing numbers of studies have underscored the importance of quadriceps strength—and, in particular, quadriceps strength symmetry between limbs—in determining functional outcomes after ACL surgery. In fact, a number of orthopedic surgeons say the need to maximize quadriceps strength after ACL reconstruction is an important consideration in their choice of graft type, surgical technique, and rehabilitation protocols (see "Outcomes after ACL surgery: The importance of graft type," page 18).

But a smaller body of literature is starting to indicate the type of analgesia used in ACL reconstruction procedures also affects postoperative quadriceps strength—which could, in turn, affect functional outcomes.

Femoral nerve blocks, for example, have been widely reported to cause immediate postoperative quadriceps weakness, particularly in patients undergoing total joint arthroplasty, but also in those undergoing ACL reconstruction. One might not think analgesia-induced weakness in the first day or two after surgery would have longer-term implications, especially in athletes, but research from the Mayo Clinic in Rochester, MN, suggests it might.

The Mayo Clinic team reported last February in the *Journal of Knee Surgery* that ACL reconstruction patients who received a postoperative femoral nerve block (FNB) had significantly weaker quadriceps at six months than patients who did not receive a FNB. Vertical jump and single-leg hop performance was also significantly poorer in the FNB group.

Given the obvious downsides to the conventional FNB approach, surgeons and their anesthesiologist colleagues have been looking for alternatives. These include the adductor canal block (ACB), a more distal block of the femoral nerve, positioned in the midthigh to preserve quadriceps femoris strength.

Early studies on ACB use in total knee arthroplasty patients have been positive. And, in a study epublished in early March by *Anesthesiology*, researchers from the University of Toronto in Canada found that an ACB administered prior to ACL reconstruction was associated with significantly less quadriceps strength loss than a preoperative FNB, while providing equal or better pain relief.

> The type of analgesia used in ACL surgery can affect patients' quadriceps strength, which could influence functional outcomes.

Granted, the findings are preliminary, and we can't connect all the dots yet. The Toronto study only assessed strength loss preoperatively, so we can't assume those effects would be evident postoperatively. The Mayo Clinic results suggest they might, but we can't yet assume the findings of that study can be extrapolated beyond six months, or that they would have any impact on rerupture rates or cartilage degeneration.

Still, the findings are intriguing enough that lower extremity practitioners should at least be asking questions about analgesia when planning an ACL reconstruction or a postoperative rehab protocol.

And, when facing a clinical challenge as complicated as an ACL injury, lower extremity practitioners should also be encouraged to know that it's a battle being fought on multiple fronts.

.

Jordana Bieze Foster, *Editor*

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

Lower Extremity Review
ler

Publisher
Richard Dubin | rich@lermagazine.com

Editor
Jordana Bieze Foster | jordana@lermagazine.com

Senior editor
Emily Delzell | emily@lermagazine.com

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

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

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

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

Graphic design & production
Christine Silva | MoonlightDesignsNC.com

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

Circulation
Christopher Wees | Media Automation, Inc

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

Our Mission:

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

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

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

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

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

facebook.com/LowerExtremityReview
76,000 post views per month

@lowerextremity
2,849 Followers

youtube.com/user/LowerExtremityReview
137,000 video views

instagram.com/lowerextremity/
233 followers

pinterest.com/lowerextremity/
291 followers

2016
Early Spring Collection

Consummate style, superior comfort and industry-leading construction showcase this new collection of Apex footwear. Each pair is meticulously crafted with the highest quality materials and designed for agility and ultimate durability.

Apex is proud to offer this new collection while continuing its long tradition of manufacturing the finest foot health products available on the market today.

APEX®
An OHI Company

For our new catalog or to order
Call 800-252-2739 or log onto apexfoot.com

The OHI Family of Brands

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

Benefits of balance

YBT is associated with history of injury

By P.K. Daniel

Deficits in single-leg balance may contribute to the high rate of injuries among endurance athletes, but hip strength may not, according to two studies presented in February at the American Physical Therapy Association's annual Combined Sections Meeting in Anaheim, CA.

Istockphoto.com#63842549

Both studies were conducted by researchers at Ironman Sports Medicine Institute, Memorial Hermann Health System, and Texas Woman's University, all in Houston, TX.

In the first, researchers found the anterior reach component of the Y Balance Test (YBT) differed significantly between endurance athletes with a history of lower extremity injury in the previous three years and healthy participants.

The 71 male and 78 female athletes, who were not seeking medical attention, were selected from local running clubs and participants in the Houston marathon and Ironman races. Of the 149 athletes, 61 reported a recent history—within 36 months—of lower extremity injury.

While medial, lateral, and composite reach scores were not statistically different between limbs for either group, the researchers found a recent history of lower extremity injury was negatively associated with anterior reach. The injured athletes also demonstrated significantly less mean anterior reach for the involved lower extremity (57 ± 14.5 cm) compared with the uninvolved extremity (63.4 ± 13.1 cm) and the uninjured athletes (64.1 ± 14.6 cm).

Continued on page 14

Test for lower extremity asymmetry identifies risk in recreational runners

Asymmetrical lower extremity neuromuscular control is predictive of repetitive stress injury in recreational runners, according to findings presented at the Combined Sections Meeting of the American Physical Therapy Association in February in Anaheim.

Researchers from Nova Southeastern University in Ft. Lauderdale, FL, assessed anthropometric variables, proximal and distal isometric lower extremity muscle performance, isometric core muscle endurance, lower extremity flexibility, and neuromuscular control in 72 recreational runners and followed them over an 18-week period before a graded marathon training program. During that time, the athletes experienced 33 repetitive stress injuries.

Between-limb asymmetry, based on composite Y Balance Test scores, was significantly greater in injured runners than in their uninjured counterparts, said Steven Jackson, PT, PhD, OCS, a faculty member for the University of Chicago Physical Therapy Orthopedic Residency Program, who presented the findings. An asymmetry of 3.6% or greater predicted 69.2% of the injuries.

Ankle dorsiflexion with the knee extended also differed significantly between the injured and uninjured runners, but the statistical analysis revealed that variable was not predictive of injury risk. ler

Source:
Jackson S, Cheng MS, Kolber M, Smith AR. An investigation of relationships between physical characteristics of recreational runners and lower extremity injuries. J Orthop Sports Phys Ther 2016;46(1):A41.

Clinically useful 2D measurements predict patellofemoral joint force

Researchers from East Carolina University (ECU) in Greenville, NC, have identified 2D lower extremity kinematic measurements that accurately predict patellofemoral joint (PFJ) force during running and can be used clinically to identify runners at risk of injury.

The two-phase study involved recreational athletes aged between 18 and 35 years. The researchers first performed 3D motion analysis on 56 athletes and identified three variables that predicted mean PFJ impulse during the stance phase of running: knee angle at midstance, step length, and vertical excursion of the center of mass.

The investigators then performed both 2D and 3D kinematic analyses in 34 athletes, and found that using clinically feasible 2D methods (a video camera and free video analysis software) to assess the three predictive variables from the first phase of the study accounted for 70% of the variability in PFJ impulse.

Jennifer M. Warren, a physical therapy doctoral student at ECU, presented the findings at the Combined Sections Meeting of the American Physical Therapy Association in February in Anaheim. ler

Source:
Warren JM, Sanii AR, Huf MD, et al. Clinical prediction of patellofemoral joint contact force during running. J Orthop Sports Phys Ther 2016;46(1):A55.

in the moment: running

Continued from page 13

"I would say the most interesting aspect of the study was the dramatic difference in anterior reach distance on the involved side within the previous injury group," said lead author Andrew J. Nasr, PT, DPT, CSCS, now a staff physical therapist with the University of Texas Southwestern Medical Center in Dallas, TX, who presented the findings. "We hypothesized there would be a difference, but did not expect such a difference."

The researchers believe their study is the first to investigate functional performance in a sample of endurance athletes using testing procedures common to field sports. The findings suggest that utilization of the Y Balance anterior reach test to detect balance deficits may be able to help identify athletes at risk for lower extremity injury or to help determine whether an athlete is ready to return to sports.

"While we cannot make sweeping conclusions with the findings due to the retrospective nature of the study and inherent limitations, we do feel that the Y Balance can be used as a good clinical tool to track this athletic population as we rehab them back to sport participation," Nasr said.

Because little is known regarding endurance athletes' risk factors for injury, the same researchers conducted a second study involving the same participants to determine the relationship between hip abduction strength and history of lower extremity injury. For this study, the researchers also analyzed skill level (elite vs recreational) as a possible contributing factor.

The 149 athletes participated in a single session of clinical and functional testing. Surprisingly, there was no correlation between hip abduction strength and history of a lower extremity injury in the previous three years.

That lack of correlation was true for both skill-level groups. Among the injured recreational athletes (<25 mi/wk), no differences in hip abduction strength were observed between the injured (50.6 ± 18.2 lb) and uninjured limbs (51.9 ± 18.2 lb). Similarly, no differences were noted for hip abduction strength between injured (54.9 ± 18.8 lb) and uninjured sides (55 ± 11.7 lb) for elite injured athletes.

"Our data didn't support our hypothesis that there would be a difference in hip abduction strength and previous [lower extremity] injury," said lead author Caitlyn Lang, PT, DPT, a staff physical therapist at Memorial Hermann Health System, who presented the findings.

However, the researchers did find a positive relationship between hip abduction strength and a top-three placement within a competitive event, suggesting that hip abduction strength has a stronger association with performance than with injury risk. ler

Sources:

Nasr AJ, Lang C, Duncan BR, et al. Deficits in single-leg balance are associated with recent lower extremity injuries among asymptomatic endurance athletes currently participating in sport. J Orthop Sports Phys Ther 2016;46(1):A46.

Lang C, Nasr AJ, Duncan BR, et al. The relationships between hip abduction strength lower extremity injury history & performance in endurance athletes. J Orthop Sports Phys Ther 2016;46(1):A43.

PFOA prognostication

Sagittal plane factors predict worsening

By Jordana Bieze Foster

Sagittal plane mechanics and forces during gait in patients with patellofemoral osteoarthritis (PFOA) can help identify those who are likely to experience worsening pain or cartilage degeneration, according to research presented in February at the annual Combined Sections Meeting of the American Physical Therapy Association in Anaheim, CA.

The predictive potential of sagittal plane variables in individuals with PFOA underscores the biomechanical differences between PFOA and tibiofemoral osteoarthritis and the need to manage the two conditions differently.

"Sagittal plane mechanics during gait may influence the patellofemoral load and disease course, while tibiofemoral OA is more likely to be affected by frontal plane mechanics," said Alison Chang, PT, DPT, MS, an associate professor of physical therapy and human movement sciences at the Northwestern Feinberg School of Medicine in Chicago.

In one PFOA study, presented at the meeting by Chang, she and her colleagues assessed dynamic joint stiffness—a measure of knee flexion moment versus knee flexion angle as a percentage of the gait cycle—in 204 patients with OA in any compartment of at least one knee. They also assessed magnetic resonance imaging (MRI)-based markers for cartilage degeneration; two years later, they repeated the MRI exams to assess cartilage damage progression.

Tibiofemoral damage progression was detected in 26.5% of participants; patellofemoral damage progression was detected in

Continued on page 16

Years after Achilles tear, injured limb demonstrates elevated knee loading

A history of Achilles tendon rupture is associated with elevated knee loading during hopping and running, suggesting an increased risk of knee osteoarthritis and other overuse knee pathologies, according to research from East Carolina University in Greenville, NC.

Investigators analyzed 34 individuals who had experienced a unilateral Achilles tear a mean of six years previously, as they jogged at a self-selected speed and performed a single-leg hopping task. Peak concentric knee power, peak patellofemoral joint reaction force, and peak tibiofemoral contact force were significantly higher in the injured limb than the uninjured limb for both tasks.

The asymmetries were evident despite a high level of self-reported function for the group, a mean of 84 out of 100 on the Achilles Tendon Total Rupture Score.

"Rehabilitation may need to include the knee in addition to the foot and ankle," said Hayley Powell, a graduate student in the university's Department of Physical Therapy, who presented the findings in February at the annual Combined Sections Meeting of the American Physical Therapy Association in Anaheim.

Source:

Powell H, Silbernagel KG, Brorsson A, et al. Patellofemoral and tibiofemoral joint loading asymmetries are present during running and hopping in individuals 5 years post–Achilles tendon rupture. J Orthop Sports Phys Ther 2016;46(1):A50.

Clinical single-leg hop tests can help estimate risk of OA after ACL injury

Performance on single-leg hop tests a few weeks after anterior cruciate ligament (ACL) injury can predict the risk of radiographic knee osteoarthritis (OA) five years later, according to research from the University of Delaware in Newark.

In 65 athletes involved in cutting or pivoting sports who had sustained an ACL injury a mean of 1.8 months earlier, investigators assessed performance on four single-leg hopping tests that can easily be administered by clinicians: single, triple, crossover, and 6-m timed. A mean of 5.7 years after the injury, the investigators identified radiographic evidence of knee OA in nine of the athletes.

The athletes with evidence of knee OA at follow-up had better performance than those with knee OA on all the baseline hopping tests; the differences were significant for the single and triple hop tests. The tests with the best diagnostic accuracy, however, were the triple hop test and the 6-m timed test.

The findings were presented in February at the annual Combined Sections Meeting of the American Physical Therapy Association in Anaheim.

Source:

Wellsandt E, Axe M, Snyder-Mackler L. Single-legged hop tests as a screening tool for risk of posttraumatic osteoarthritis after anterior cruciate ligament injury. J Orthop Sports Phys Ther 2016;46(1): A56.

Continued from page 15

13.6%. However, only patellofemoral cartilage damage progression—specifically in the lateral aspect of the patella—was associated with dynamic joint stiffness at baseline. After adjusting for demographics and disease-related covariables, for every unit increase in dynamic joint stiffness at baseline, the odds of patellofemoral cartilage damage progression increased 3.5 times.

Although cartilage damage is not always associated with pain in patients with PFOA, investigators from the University of California, San Francisco (UCSF) reported in a second presentation that peak patellofemoral joint (PFJ) stress during the early stance phase of walking in individuals with PFOA is predictive of pain progression one year later.

The researchers assessed kinematics and kinetics in 50 individuals with PFOA as they walked at a self-selected speed, then used those measures to estimate peak PFJ stress during the first and second half of stance. The study participants also completed the pain and symptoms subscales of the Knee Osteoarthritis Outcomes Score (KOOS) questionnaire at the time of the gait analysis, and again a year later.

At one year, 10 participants had significant pain progression, defined as a KOOS-Pain score increase above a previously reported minimum detectable change score. Those with pain progression had significantly higher early stance peak PFJ stress at baseline than those whose pain did not progress; every one standard-deviation increase in PFJ stress during early stance resulted in nearly a sixfold higher chance of pain progression at one year.

The higher peak PFJ levels in those with pain progression were largely due to knee flexion moment rather than knee flexion angle, according to Hsiang-Ling (Sharon) Teng, PT, PhD, a postdoctoral scholar in the Department of Radiology at UCSF, who presented the findings.

Pain progression was also associated with higher peak PFJ stress in the second half of stance; that association was not statistically significant, but may be clinically relevant, Teng said.

"Prevention and rehabilitation protocols should focus on patellofemoral joint loading during the entire stance phase," she said.

Chang and Teng both emphasized the need for PFOA interventions to decrease knee flexion moment, which could include increasing step rate, decreasing walking speed, or wearing flat shoes instead of heels. The Northwestern findings also suggest there could be a benefit to increasing knee joint flexion angle during gait, Chang said, but noted that patients may need neuromotor training to learn to use any additional joint range of motion they achieve. ler

Sources:

Chang AH, Chmiel JS, Almagor O, et al. Baseline knee sagittal dynamic joint stiffness during gait is associated with 2-year patellofemoral cartilage damage progression in knee osteoarthritis. J Orthop Sports Phys Ther 2016; 46(1):A5.

Teng H-L, MacLeod TD, Nardo L, et al. Association between patellofemoral joint stress during gait and symptomatic progression in people with patellofemoral joint osteoarthritis. J Orthop Sports Phys Ther 2016;46(1):A26.

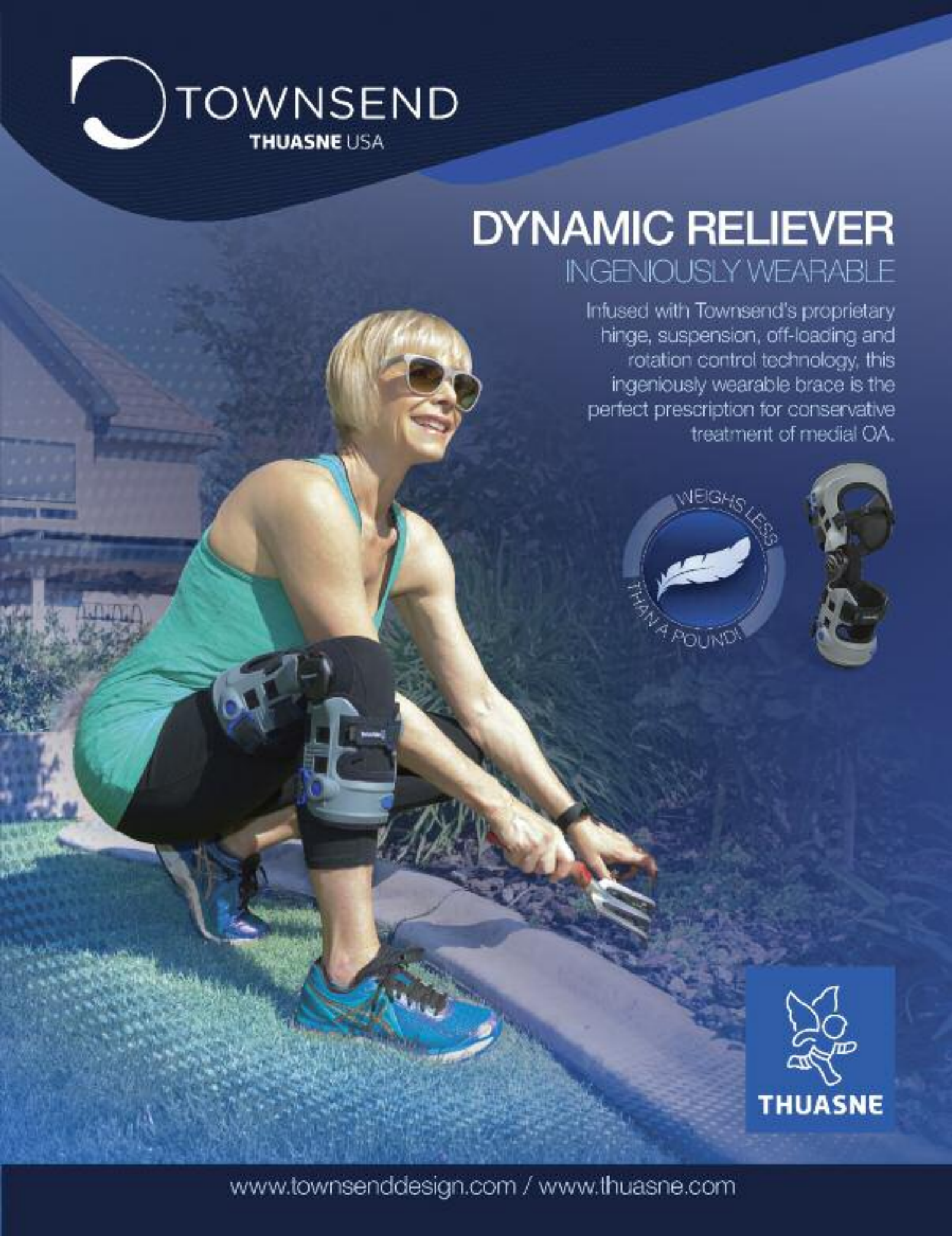
TOWNSEND

THUASNE USA

DYNAMIC RELIEVER

INGENIOUSLY WEARABLE

Infused with Townsend's proprietary hinge, suspension, off-loading and rotation control technology, this ingeniously wearable brace is the perfect prescription for conservative treatment of medial OA.



THUASNE

www.townsenddesign.com / www.thuasne.com

Outcomes after ACL surgery:

The importance of graft type

By Cary Groner

In an attempt to decrease the risk of re-rupture and revision surgery after anterior cruciate ligament reconstruction, practitioners are refining the decision process regarding which procedure is best for which patient.

Thomas Davis made headlines in February by playing in the Super Bowl with a broken left arm, but what's most impressive about the Carolina Panthers linebacker is his right knee. Davis ended the January 17 playoff game against Seattle by fielding the Seahawks' last-ditch onside kick with a spectacular leaping grab. It would have been a great play for anyone, but Davis made his jump on a right anterior cruciate ligament (ACL) that had been reconstructed three times.

Increasingly, people take such heroic athleticism in stride. But cases like that of Davis, in which patients reinjure the ligament and require revision surgery—sometimes more than once—have led experts to try to identify factors that may decrease the risk of subsequent rupture. The rigors of pro football notwithstanding, theories are all over the map. As more data become available, however, a guarded consensus is emerging.

Istockphoto.com #16884945

Continued from page 19

Recent research has helped define the scope of the problem. Reported five-year revision rates after ACL reconstruction have been as high as 8.7%, and are significantly higher for patients younger than 21 years than for their older counterparts.[1]

Graft selection

In ACL reconstruction, surgeons use either autografts (tissue from the patient) or allografts (tissue from cadaver donors), and each approach has advantages and disadvantages. Allografts circumvent the problem of donor-site morbidity and offer robust tendons, such as the tibialis anterior, that couldn't be harvested from a living donor. In one large US study, allografts were used in roughly 42% of primary and 79% of revision ACL reconstructions.[2] Disadvantages include the risk of disease transmission, slower incorporation, and strength limitations, depending on how the tissue has been processed.[3]


Istockphoto.com #16885127

Autografts include bone–patellar tendon–bone (BPTB) reconstruction, in which the graft is taken from the patient's ipsilateral or contralateral knee. Although this approach is often considered the gold standard in the US, it is associated with a risk of anterior knee pain and other problems at the harvest site.[3] As a result, many surgeons have turned to soft tissue grafts, particularly from the hamstring tendon; in recent years hamstring reconstruction has become the primary approach in Scandinavian countries.[4] Recently, a few surgeons have begun using the quadriceps tendon, as well, and the percentage of such surgeries is expected to grow.[5]

But as surgery becomes more customized, physicians continue to refine the decision process regarding which procedure is best for which patient. This affects choices about surgical procedure, graft harvest, and rehabilitation.

Not fail-safe

"We now know that the use of allografts in young people—particularly teenagers or very active people in their twenties and early thirties—is associated with a higher risk of graft tearing and revision," said Steven Singleton, MD, an orthopedic surgeon with the Steadman Clinic in Vail, CO.

There are various reasons for this, he explained. With allografts, the body recognizes the tissue as non-native, and though it doesn't reject the graft as it might a transplanted organ, it does mount an immune response that retards ligamentation and healing, leaving the graft weaker for a longer time than an autograft would be. The result, particularly in active young people, may be tissue stretching and breakdown leading to graft failure.

Jonathan Chang, MD, a clinical associate professor of orthopedics at the University of Southern California in Los Angeles, agreed.

"Graft selection is now influenced by age," he said. "If you're roughly twenty-five or younger, you're usually better off with a patellar tendon autograft—though there's discussion about where that tipping point is, and some put it at age forty or higher. As you get older, though, you probably have lower activity levels, so there are advantages to an allograft. The graft failure rates start equalizing at ages thirty-five to forty, so at that point, unless you're a professional athlete, you're likely to do well with any kind of graft."

Recent research supports this perspective. For example, a Kaiser Permanente study of 21,304 ACL reconstruction patients found that those younger than 40 years had a higher risk of revision after allograft surgery than those with BPTB autografts; moreover, those younger than 21 years with hamstring autografts had a revision risk 1.6 times those who had BPTB autografts.[1]

"We found that the greatest differences occurred in the younger patients," said Gregory Maletis, MD, the study's first author, who is chief of orthopedics at Kaiser Permanente in Baldwin Bark, CA, and lead physician for the ACL registry there. "We also found that females are a little less likely to undergo revision, as are those with higher BMI [body mass index], who may be less active."

Maletis told *LER* that he and his colleagues aren't yet sure why hamstring autografts failed more often than BPTB autografts.

"It may have to do with graft diameter; smaller hamstring grafts may not withstand the loads as well," he said. "We didn't see that in the older patients, so it's probably because the younger ones are doing higher-level sports and putting their knees at the greatest risk."

Several recent studies have reached conclusions about graft type and longevity. For example, a 2014 study from Scandinavia found that patellar tendon autografts had a significantly lower risk of revision (hazard ratio .63) than hamstring autografts.[4] A Norwegian paper from the same year reported a revision risk 2.3 times higher for hamstring grafts than patellar tendon grafts and four times higher for younger patients than older ones.[6] A 2014 Danish study found that hamstring reconstructions were 1.4 times more likely to fail than BPTB ones (the authors also noted that use of hamstring

Continued on page 22

NEW!

shark-o™

Charcot Orthosis

OWLS™

KNOW BETTER ORTHOSES™

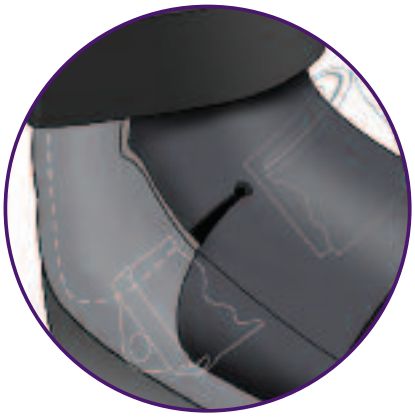
Custom to Cast or Scan from all industry standard file formats. Features: Liner made from ¼" aliplast foam. Outer shell constructed of polypropylene for maximum control of the foot and ankle complex. Molded copolymer anterior internal shell to limit shear forces and lock the leg in securely. Tri-laminated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

INDICATIONS

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

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

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



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

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

Look for this mark on genuine shark-o™

ORTHOMERICA®

877-737-8444 | www.orthomerica.com

Continued from page 20

tendons in Denmark increased from 68% in 2005 to 85% in 2011).[7]

A long-term randomized trial conducted in military personnel in Hawaii found that, 10 years after reconstructive surgeries with either a hamstring autograft or a tibialis posterior allograft, more than 80% of grafts were intact and stable; however, allografts failed at three times the rate of autografts (26.5% vs 8.3%).[3]

Lead author Craig Bottoni, MD, chief of sports medicine in the Orthopedic Surgery Service at Tripler Army Medical Center in Honolulu, said surgeons minimized variables by using the same fixation and rehabilitation techniques in all patients.

"Allografts are an acceptable alternative for ACL reconstruction, but some do have a higher risk of failure," Bottoni said.

Processing

Bottoni emphasized the importance of surgeons knowing as much as possible about the allograft tissue they use.

"It's imperative to know what type of graft you're using, where it comes from, and how it's been processed," he said. "Terminal radiation and some types of processing have been found to negatively alter the biomechanical properties of the allograft."

Indeed, the Kaiser team concluded that certain factors seem to increase risk of allograft failure, including irradiation greater than 1.8 mrad, BioCleanse processing, younger patient age, male gender, and BPTB allograft.[8]

"Nonirradiated, nonprocessed grafts seem to hold up the best," Maletis said. "There also appears to be a time-dependent relationship, in that we may not see failures within the first year or two. That may explain why studies with shorter time frames haven't shown such differences with allografts."

The finding that BPTB allografts had a higher risk of revision than soft tissue allografts (relative risk = 1.8) suggests processing may also weaken bone tissue, he added. A 2008 meta-analysis from the Mayo Clinic supports this finding.[9]

Technique

In a paper from the Steadman Clinic, researchers compared BPTB autografts to BPTB allografts and reported that, while functional outcomes were similar, 14% (n = 11) of allografts were revised by a mean of 4.7 years after surgery, whereas no autografts required revision. Moreover, patients aged 25 years or younger were 23 times more likely to require a revision than older patients.[10]

Like many surgeons, Singleton uses techniques he hopes will minimize his patients' revision rates. He prefers BPTB autografts to hamstrings—though he'll use the latter in patients with a history of patellar tendinitis or arthritis—and said that in his practice he sees very little anterior knee pain after BPTB surgeries.

"We've developed a small-incision technique to harvest the graft," he said. "We also mobilize the patella right away in our rehab program, and I think those things minimize the potential for scarring."

Jonathan Chang has his own take on the situation.

"I take twenty to thirty minutes harvesting the graft, carefully bone-grafting the harvest sites and doing a layered closure over the tendon without over-straining it," he said. "If you do that, you'll have less postoperative bleeding and better function. If you don't play close attention to how you treat that tissue, the patient has a higher risk of anterior knee pain."

Donald Shelbourne, MD, who practices at the Shelbourne Knee

Center at Community Westview Hospital in Indianapolis, favors a BPTB technique that many other surgeons shy away from: He harvests the graft from the contralateral knee rather than the injured one, and recently reported the approach was associated with better postoperative leg strength in both limbs and better strength symmetry while minimizing symptoms at the graft harvest site.[11]

"Back in the eighties, I found that we had trouble rehabbing the ACL-injured knee because we'd also taken a patellar tendon from it," he said. "You can avoid that problem with cadaver or hamstring grafts, but I didn't find those to be as successful—allografts failed, hamstring grafts left the patients weaker. When we started doing contralateral grafts in revision surgeries, we realized that it was a better approach because we had two independent rehabs instead of two rehabs in the same knee. We've now done over four thousand primary ACL reconstructions that way, and I think it's the best answer. My goal is to give the patient two good knees, and I can do that more predictably when I take the graft from the opposite knee."

Shelbourne, who keeps detailed data about his procedures and outcomes, said his team had collected information about their ACL repairs in 52 college soccer players. Of those who had ipsilateral BPTB reconstructions, 77% were playing at their previous level a year later, whereas 91% of those who'd had a contralateral graft returned to that level (unpublished data). One reason for the greater success, he said, is that contralateral harvesting leads to better healing at the donor site.

"The two thirds of the tendon we leave grows back to normal," he said. "We didn't see that when we took the graft from the same knee, because we had to rehab the ACL and couldn't focus on the donor site. You need high-repetition, low-resistance exercises in the first month, and you can't do that when you take the graft from the same knee that you've operated on for the ACL."

Other surgeons told *LER* that, though they use contralateral grafts for revision procedures, they remained reluctant to do so in primary reconstructions.

Anatomic accuracy of tunnel drilling can also affect outcomes, Singleton said.

"In the original arthroscopies in the late eighties and early nineties, surgeons used one approach to drill a tunnel in the femur and a second one to drill the tibia, and the graft was anchored in those tunnels," he said. "Then, in the mid-nineties, an all-endoscopic technique was developed in which you drilled the tibial tunnel first, then used that to drill the femoral tunnel. That technique is still used by many doctors, with reasonable success; the problem is that it doesn't allow one to get the [femoral] tunnel in the exact anatomic location of the native ACL. Steadman, Shelbourne, and a few others recognized this and continued to drill both tunnels independently. What I see clinically is that there is a lower rate of graft re-tears in ACLs done with independent tunnel drilling. You want the graft in the exact location it needs to be in."

Rehab

Surgeons and therapists stress the importance of proper rehabilitation, though there's professional disagreement about what constitutes it.

"Rehab may be more crucial than the surgery itself," said Craig Bottoni. "You want the patient to get back to activity as soon as possible without compromising the graft. Most of us are big advocates

Continued on page 24

Continued from page 23

of extension, because if you don't get it back in the early phase, it's difficult to get it back later."

Shelbourne emphasized both extension and delay in loading the ACL-injured leg.

"The first week after surgery, it's too soon for things like riding a bike and walking," he said. "Those can just leave the knee more inflamed and swollen. In terms of long-term rehab, though, we want to achieve full flexion, full strength, full function, and identical motion with the contralateral side."

Shelbourne and his colleagues have documented the importance of achieving full extension, including terminal hyperextension symmetric to the opposite knee, and suggest concerns that this may overstress the graft are unsubstantiated.[12]

For Singleton, controlling swelling and regaining full range of motion drive the protocol in the first couple of weeks.

"We teach the patient to elevate the knee so the leg wants to come straight, and to some extent we'll use a continuous passive motion machine to prevent adhesions and minimize swelling," he said.

Rehabilitation should account for graft type, too, according to Jonathan Chang.

"When surgeons use allografts, they usually slow the rehab process a little to be sure that the incorporation has really taken hold before they start pushing the patient," he said.

Bottoni added that, in general, clinicians are adjusting their expectations about return to sports.

"It used to be six months, but now people are saying that before nine or twelve months, patients don't really have their proprioception back. Their quadriceps are still weak, so there is a risk for re-tear, especially in elite athletes," he said.

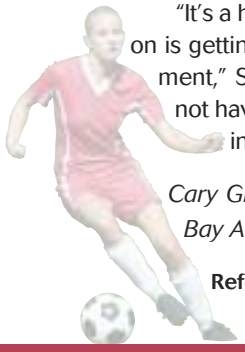
Other researchers have reported the importance of quadriceps strength for achieving biomechanical symmetry during rehab, in fact.[13,14]

Clinicians at the University of Delaware in Newark are exploring a new rehab protocol involving a form of neuromuscular work they call postoperative return-to-sports training.[15] The approach uses a series of progressive perturbations on unstable surfaces in both bilateral and unilateral stance, in conjunction with distractions and other tasks.

"People haven't been using uniform or even very stringent rehab criteria," said Lynn Snyder-Mackler, PT, ATC, alumni distinguished professor of physical therapy, and one of the study's designers. "In this approach, we perturb the support surfaces; something unexpected happens, so how do you control your knee? In ten sessions over a couple of weeks, we increase the challenges and they get better at it. You're trying to incorporate new movement patterns into sport-specific activities."

In the clinical trial, all patients will receive quadriceps strengthening and agility drills, while only some will receive the perturbation training. Ideally, results will be published within the next year or two.

"It's a hard thing to say to a kid, but if all they're focused on is getting back on the field, that might be to their detriment," Snyder-Mackler said. "They need to think about not having the second injury, and that might mean waiting a year." ler



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

References are available at lermagazine.com.

Better fit. Better function. Better life.

Custom carbon fiber AFO's made specifically for your patient's anatomy and lifestyle.

Energy Return

Select from this group of AFO's when your patient's ankle complex is structurally intact and only mild control of the ankle is needed. The four different designs allow you to tailor make an AFO for your specific patient's needs while allowing energy storing and release with each step.

Energy Return & Stability

This design with its four variations provides a stiffer AFO with good mid stance stability while allowing heel compression and toe flexion and extension. Choose from this group of AFO's when you need more control of the ankle without interrupting the rockers of gait.

Stability & Floor Reaction

The solid ankle designs provide your patient with extreme rigidity in a lightweight, floor reaction AFO. These AFO's provide maximum stability of the ankle complex.

Partial Foot Options

Our two Partial Foot designs provide normal foot biomechanics by restoring the lost anterior lever arm. The TMA model maintains ankle motion, while the Lisfranc Chopart model transfers energy from the shin to a dynamic carbon foot plate.

CustomComposite

Custom Composite Manufacturing, Inc.

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

Plantar fasciitis: Clinical concerns in basketball

By Patricia Pande, MCIScPT, CSCS, CPed

Basketball is associated with a high number of lower extremity injuries,[1,2] often related to footwear and the unique biomechanics and repetitious motion of the sport. This reflects the evolution of basketball from a refined sport to one of extreme physical contact and leverage. At elite levels of competition, the joint loading that comes with players' size also contributes to lower extremity injury risk; large players with large feet frequently have large problems.

The mainstream media has given considerable attention to the loss of playing time associated with plantar fasciitis in highly compensated athletes, but recreational players also present a challenge to sports medicine clinics. As many as 45.9% of players in Australia have been sidelined for more than a week with lower extremity injuries.[3]

Definitions

The plantar "fascia" is not actually fascia but an aponeurosis with mechanical and histological similarities to surrounding tendons and ligaments.[4] Plantar heel pain is one of the most common ailments in the US, accounting for up to two million annual visits to physicians and comprising up to 10% of all sports clinic visits.[5,6] It presents with pain with the first step in the morning or after prolonged bouts of sitting.

Repetitive stress can inflame the plantar fascia or lead to degenerative changes, commonly called fasciosis, which explains the recalcitrant nature of the condition. Altered hydrostatic pressure in the fascia may also impede blood flow.[7]

Plantar fasciitis in basketball players

Although there is a shortage of information about the incidence of plantar fasciitis in basketball players, plantar fascia rupture associated with basketball has been reported.[8] Factors contributing to the high incidence of lower extremity and foot and ankle injuries in basketball, and more specifically to plantar fasciitis, include the repetitive high loads associated with running,[9] as well as jumping, landing, and cutting by players who often are large in frame.[1,2] Other factors that may contribute to plantar fasciitis risk in basketball include footwear and fatigue.

Body mass index (BMI). Van Leeuwen et al found a positive association between patients with a high BMI and plantar fasciitis.[10] BMI was the only variable that predicted disability in an earlier study.[11]

The average National Basketball Association (NBA) player weighs 220 lbs and wears a size 14.8 shoe, maxing out at size 20.[12] Higher BMI theoretically causes increased vertical force during heel contact, with a concomitant increase in tissue stress.[13] However, reduction of body weight and lower extremity anthropometrics typically is not feasible for the basketball player.

Plantar loads. Although no studies have examined the association between plantar loads and plantar fasciitis in basketball players, evidence does suggest that runners with plantar fasciitis have higher plantar loads and loading rates than healthy runners.[9] Because much of basketball involves running—not to mention changes of direction, jumping, and landing on hard and unyielding court surfaces—it seems likely that plantar loads in basketball are at least as high as in running.

Basketball movements other than running have also been associated with high loads. Cutting movements, which are common in basketball, have been associated with high plantar pressures at the heel in other sports.[14] Lay ups, free throws, and jump shots are all associated with greater plantar loads than static stance.[15] Ground reaction forces (GRF) associated with jump shots in basketball have been reported to be more than five times body weight, heightening the risk of damage with repetition.[16] In fact, ground reaction forces are higher in basketball players than soccer players.[17] Learning how to land softly and on the forefoot or midfoot will reduce landing GRF;[16] however, this is an adjustment that recreational players may not have mastered.

Running volume. There is some evidence that plantar fasciitis may be associated with a faster running pace.[18] Basketball involves high acceleration and anaerobic bursts of running. Highly effective basketball players may run up and down a 90-foot court at high speed a minimum of 50 times per game, resulting in increased strain on the intrinsic muscles of the foot.[19]

Basketball shoes. The most coveted basketball shoes have transitioned from being highly structured to being lightweight and flexible. At the most elite levels, basketball players are restricted in their choice of shoes due to footwear contracts. Colleges often use basketball shoe brands as a tool in recruiting high school players.[20]

Most importantly, the shoe must be able to withstand high plantar loading without deformation and resist the rotational and cutting forces that stretch the upper in a very moist environment. Frequent

Sponsored by an educational grant from medi USA.

footwear changes can help reduce midsole fatigue. Shoes have been shown to reduce impact forces during unanticipated drop landings in basketball.[21]

For many basketball players, the shoe is not wide enough, especially with added bulk of high-profile orthoses.[22] If the shoe doesn't have sufficient volume to allow for proper activation of muscles (eg, abductor hallucis), this can impair the propulsive function of the longitudinal arch during walking and running.[19,23]

Lower extremity clinicians who treat basketball players say the game has changed since the late 1990s from one played close to the basket to one played around the perimeter. This switch requires more lateral footwork, with more stresses to the ankle and plantar fascia. In response, basketball shoe designs have evolved to reinforce the lateral border to reduce ankle sprains and promote quicker directional changes. This design shift has led to shoes with reduced medial support and amplified pronatory moments, which may increase the risk of plantar fasciitis.

There also has been a transition to lightweight shoes. Interestingly, a group of researchers in Calgary found that lighter-weight shoes were associated with improved performance of basketball tasks, but not when athletes were blinded to the weight of the shoes, suggesting a psychological effect.[24] There is a need for further research on the functional effects of lighter footwear, including foot orthoses.

Sport-specific factors. Although basketball originated as a noncontact sport, its physical nature has evolved over the years with regard to both offense and defense.[25] Rapid braking and acceleration (vertical and horizontal), along with lateral shifts of body weight, are very demanding on the foot and ankle.

Steve Vinson, who coaches girl's basketball at Ann Arbor Huron High School in Michigan, said plantar fasciitis in younger athletes is a growing concern, with competition for scholarships leading to more aggressive play, and intense schedules leaving little time to recuperate from the stresses associated with the sport.[26]

Treatment and prevention

The treatment paradigm of rest, cessation of activity, or both is often not feasible for high-level athletes. Changes in jumping technique, which can help reduce the risk of knee and ankle injuries,[16,27] have not been studied in cases of plantar fasciitis or fasciopathy. Taylor stressed prevention and proprioception programs to reduce the incidence of ankle sprains and lower extremity injuries, but there has been no attempt to study or adapt these programs for the prevention of plantar fasciitis.[27]

Plantar fascia corticosteroid injections in athletes may have unintended adverse effects, with some accounts of rupture after early re-entry into play.[28] Additionally, surgical management with plantar fasciotomy has only moderately improved patient outcomes in the general population, often resulting in extended recovery time.[29,30] The risks of adverse events must be weighed judiciously in any treatment paradigm.

Orthotic management

An orthotic device with intrinsic or extrinsic medial wedges was associated with greater soft tissue thickness under the heel, which may protect the fat pad (assessed statically) more than no orthosis or an orthosis with arch support only.[31] This may have implications for treatment of plantar fasciitis given the condition's association with fat pad atrophy in some patients.[32] Further investigation is warranted.

The diagonal cuts and lateral shuffle cuts in basketball are also associated with elevated forces under the metatarsal heads.[33,34] Plantar fasciitis interventions to redistribute plantar pressures must take care to avoid overloading the metatarsals.[35,36]

Treatment must mitigate deleterious forces on the foot with the following orthotic strategies. Orthoses must:

1. Reduce impact plantar loading without inhibiting performance or excessively increasing load in other areas; accommodative or shock-absorbing inserts are much better tolerated by basketball players;[22,37]
2. Not elevate the heel or destabilize the ankle;[7]
3. Not hamper the function of the abductor hallucis and intrinsic muscles;
4. Have reduced arch height to minimize pressure shift laterally and decrease fifth metatarsal head pressure;[31] and
5. Not impede blood flow to the foot from excessive pressure.[38]

Plantar fasciitis in basketball will continue to be a growing concern made even more clinically challenging by the lack of specific research on foot and ankle biomechanics in this popular and strenuous sport. Vigilant clinical judgement, informed by the broader body of research on the biomechanics of plantar fasciitis, will be essential to meeting this challenge.

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

References are available at lermagazine.com.

Sponsored by an educational grant from medi USA.

Heel Spur Heel Spur pro

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

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

mediusa.com

medi. I feel better.


Istockphoto.com #41130854

Running modifications and reducing injury risk

Evidence suggests that no one foot strike style can be expected to decrease injury risk in all runners, and that switching foot strike patterns can have unintended consequences. Using a shorter stride length, however, can be an effective alternative for some runners.

By Elizabeth Boyer, PhD, and Tim Derrick, PhD

Runners struggling with injuries may be curious about barefoot running or running on their toes if they've seen other runners doing it, or if they've heard it will decrease their risk of injury because it's "more natural." Although there is evidence in the medical literature that such changes may reduce the risk of some types of injuries in some runners, evidence also suggests injury risk can be reduced using an alternative running modification that might be easier to implement.

Large-scale epidemiological studies objectively quantifying how runners run (ie, footwear or foot strike pattern) and how those variables relate to injury risk are nonexistent. A few studies with either small sample sizes or self-reported information about footwear or foot strike style provide conflicting evidence of injury prevalence in rearfoot, midfoot, and forefoot strikers, and shod versus barefoot runners,[1-6] though shod rearfoot strikers might sustain more injuries than others.

Beyond foot strike

We need to be wary of studies using self-reported foot strike, though, because approximately one third of runners misclassify their foot strike style.[7,8] Additionally, since stride length may slightly shorten when switching from a rearfoot strike (RFS) pattern to a midfoot or forefoot strike (FFS) pattern[3,9-11] or when switching from shod to barefoot running,[12-14] the independent effects of stride length, footwear, and foot strike style appear to be equivocal. For instance, the decreased loading associated with running barefoot versus shod running may be primarily attributed to a shorter stride length,[15] and multiple studies have shown that a shortened stride beneficially decreases loading.[16-26] So, in addition to, or in place of, running barefoot or using a FFS modification, we might be able to decrease injury risk by retraining runners to use shorter strides.[26,27]

In our model, we consider the effects of shorter stride length and increased stride frequency to be synonymous. Although these variables aren't perfectly interchangeable, if running velocity is held

A shorter stride seems to decrease certain loading variables as much as switching to a forefoot strike pattern, without the negative effect of increasing ankle loads.

Continued from page 29

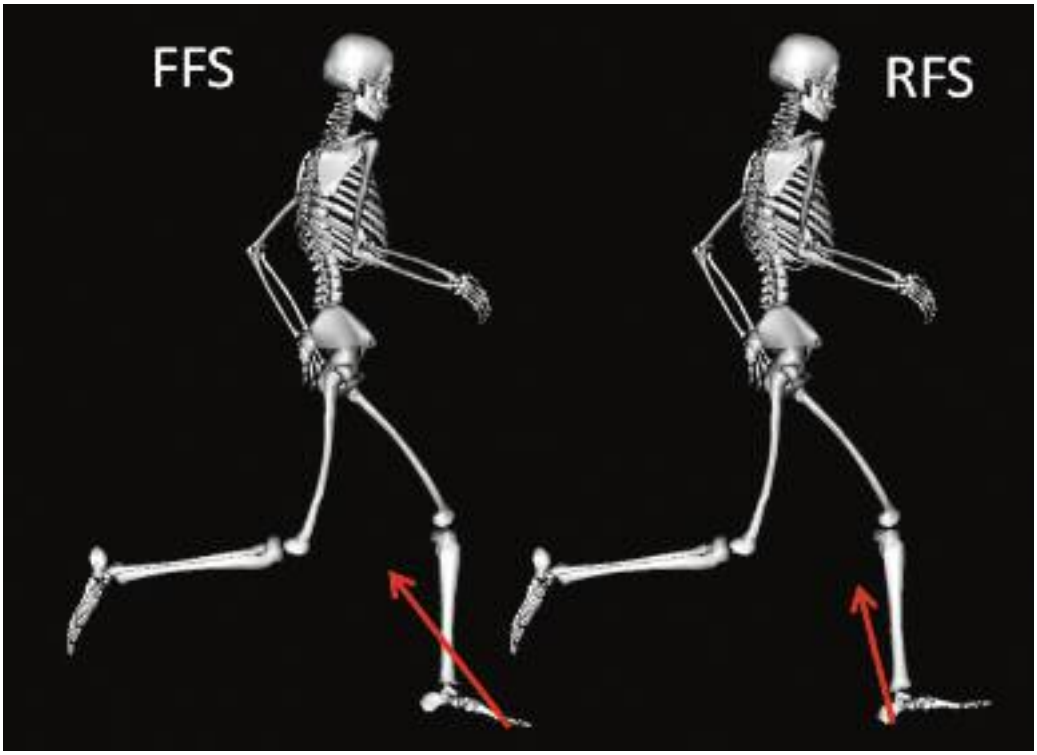


Figure 1. The resultant ground reaction force vector (red arrow) is larger and oriented more posteriorly for forefoot strike running (left) vs rearfoot strike running (right) in the early part of stance (~8% of stance). Adapted from reference 38.

constant, stride length and stride frequency vary inversely with each other. In other words, running velocity is equal to the product of stride length and stride frequency. For example, 3 m/s running velocity can be obtained by a stride length of 2.25 m and a stride frequency of 1.33 strides/s (or 160 steps/minute). If the same runner shortened his or her stride by 10% (to 2.03 m) but maintained that 3 m/s velocity, he or she would have to use a stride frequency of 1.48 strides/s (or 178 steps/minute).

Forces

Many studies investigating biomechanical differences between foot strike styles and footwear have focused on the vertical ground reaction force (GRF) and how quickly it changes, or GRF loading rate. Several studies have found that runners with high vertical loading rates are more likely than those with lower loading rates to sustain a future injury or to report a history of injury, particularly of stress fracture.[28-33] Zadpoor and Nikooyan[34] summarized 13 studies and found that higher vertical loading rate (not peak vertical GRF) was associated with the risk of stress fractures of the tibia and metatarsals. Typically, loading rate is higher with a RFS pattern than a FFS pattern,[1,3,35,36] which is one reason why FFS running is purported to help reduce injuries.

However, focusing only on vertical forces neglects the smaller shear forces. Considering that the leg is relatively perpendicular to the ground during stance and that muscles can apply force only through shortening, the femur and tibia/fibula are primarily loaded in compression. Bones are most resistant to these compressive forces and stresses, and less resistant to tensile forces and shearing forces,[37] such as those caused by shear GRFs. We found that, while habitual rearfoot strikers decreased their peak vertical GRF and loading rate when using a FFS, the shear (posterior and medial) GRFs and loading rates were higher during forefoot striking than rearfoot striking during impact.[38] These higher shear forces orient the resultant GRF vector more perpendicular to the tibia (Figure 1). We may also want to shift our focus to the resultant GRF and loading rate (ie, summation of all three orthogonal directions), as that force is what the body experiences, and it is always equal to or greater than the vertical force.

Moments

Taking it a step further, we can look at joint moments (or torques), which are surrogates for the net muscle activity at a joint. Joint moments during running have been fairly well documented for the sagittal plane, which is the plane associated with the largest moments during running. Generally, plantar flexion moment and power are greater for FFS than RFS patterns,[8,11,39-41] knee extension moment and power are greater for RFS than FFS patterns,[8,11,39,41,42] and studies of sagittal plane hip moments have been inconclusive with regard to foot strike.[11,41,43] Similar trends have been reported for barefoot versus shod running.[12,15,39,44,45]

However, the other planes have been largely neglected. Of the few variables that have been investigated, knee abduction moment was higher and ankle external rotation moment was lower for RFS than FFS.[11,43] Compared with habitual midfoot and forefoot strikers, when habitual rearfoot strikers ran with a FFS, they had larger hip abductor and ankle external rotation moments.[43] Additionally, ankle internal rotation moment increased when habitual rearfoot strikers ran with a FFS compared with a RFS.[43] We have supplemented these findings and found similar results with a few contradictions.[46]

Many studies have shown habitual rearfoot strikers can decrease loading by shortening their stride length,[18,19,21,30,35] but can they decrease it to the same extent as when switching to a FFS pattern? Our preliminary data comparing stride shortening and switching from a RFS to FFS pattern suggest they can for several variables, including peak knee extensor moment, hip internal rotation

Continued on page 32


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
©2010 Footmaxx

Continued from page 30

moment, lateral knee contact force, and posterior hip contract force.[46] Therefore, a shorter stride seems to decrease certain loading variables as much as switching to a FFS pattern. Plus, shortening one's stride does not increase ankle loads the way a FFS pattern does.

Net joint moments are limited in that they cannot tell us the extent to which all muscles are firing. Instead, they just tell us which muscle group is firing the most. For example, the quadriceps could be producing a +100-Nm moment while the hamstrings produce a -80-Nm moment, resulting in a net joint moment of +20 Nm. However, both of these moments contribute to gross loading at the joint.

Joint contact forces include both joint reaction forces (forces accounted for in net joint moment calculations) and muscle forces, which we can estimate using optimization procedures. It is important to consider these muscle forces, as they account for more of the total joint loading than reaction forces.[47,48] For instance, peak ankle joint reaction force might be two times body weight, whereas muscle forces might be six to eight times body weight. Only a few studies have reported contact forces for different foot strike styles, focusing on the axial[40] or patellofemoral contact forces.[11,42] Again, we supplemented their findings with data for all three planes.[46] Interestingly, because co-contraction is ignored in net joint moment calculations, it is possible that moments may be larger for one foot strike style, but contact forces could actually be equal or larger for the other foot strike style, which we observed.[46] The take-home message is that we need to consider muscle forces to get a better understanding of the actual joint loading during running.

Offsetting effects

Taken together, the literature suggests that ankle loads are higher for FFS than RFS patterns, while some knee and hip loads are higher for RFS than FFS. Some researchers have observed that habitual rearfoot strikers tend to have higher knee and hip loads than habitual midfoot and forefoot strikers for both RFS and FFS.[43,46,49] This continuation of more reliance on the knee extensors may be a lingering effect of the neuromotor programming associated with a RFS pattern. So, even though knee loads tend to decrease when habitual rearfoot strikers switch to a FFS pattern, if they do not decrease to the levels seen in habitual midfoot or forefoot strikers, this could potentially mute the effect on injury risk. Shortening stride length, however, decreases loading to a similar extent. If tolerated by the runner, this alternative to foot strike modification may be a better approach to decreasing injury risk. Additionally, studies have shown that, despite taking more steps per distance with a shorter stride length, cumulative loading (ie, the summation of loading from all steps per distance) remains lower for the shortened stride length condition versus normal stride length.[20,25]

Although loads may be higher at different joints for certain foot strike styles, bones may adapt so that the actual bone stresses and strains are unchanged. Our preliminary data and those of others have shown that tibial stresses, strains, or strain rates are highest during shod FFS running, moderate for barefoot FFS running, and lowest for shod RFS running.[46,50,51] Only shear stress decreased slightly with a shorter stride length.[46] As such, if runners' bones do not have time to adapt to the greater stresses and strains of FFS and barefoot running, running in these strike patterns may load the tibia excessively. Alternatively, if runners transition slowly to FFS or barefoot running, these higher loads may make their bones stronger.

In addition to peak joint loads, certain frontal and transverse plane variables have been linked to running-related injuries, such as patellofemoral pain, iliotibial band syndrome, and tibial stress fractures.[32,52-58] We previously investigated how these variables changed with foot strike style and step length in 42 runners.[16] Regarding beneficial changes, during FFS, contralateral pelvic drop (which has been associated with patellofemoral pain[52,58] and iliotibial band syndrome[54]) was reduced. During RFS, step width was increased, which is beneficial since a wider step width decreases frontal joint moments,[59] iliotibial band strain,[60] and peak free moment.[61] During RFS, peak negative free moment was also reduced, which is beneficial as research has linked larger peak free moments with risk of tibial stress fractures.[30,32] However, variables such as peak iliotibial band strain and strain rate, hip adduction, rearfoot eversion, and positive free moment were not different between RFS and FFS. Therefore, the risk of injuries related to these variables—such as patellofemoral pain, iliotibial band syndrome, and tibial stress fractures—is largely unaffected by foot strike style.

Most variables did, however, slightly decrease as runners used shorter strides, which may have been associated with their concomitant wider steps. Adding to the plethora of data supporting the benefits of shortened stride length, we found shortening one's stride length may decrease—or at least not increase—the propensity for running injuries based on the variables we measured.[16]

Clinical implications

Collectively, study findings suggest that a single foot strike style does not appear to explicitly decrease injury risk; rather, different foot strike styles may predispose runners to different types of injuries.

Continued on page 34

Continued from page 33

A shorter stride length, however, may be beneficial.

So, should runners modify their running style to prevent persistent injuries by running barefoot, on their toes, or taking shorter steps? The evidence suggests none of these modifications universally reduce loading on all structures.

If a runner is experiencing ankle or foot pain (particularly in the metatarsals or plantar fascia), rest is probably indicated, as running barefoot or using a midfoot or forefoot strike or both may make the problem worse. If resting isn't an option, shortening strides by 10% may reduce loading.

If a runner is experiencing knee or patellofemoral pain caused by excessive loading, either switching to a midfoot or forefoot strike (shod or barefoot) or shortening the stride by about 10% may help. The benefit of only shortening the stride is that the runner won't be increasing loading on different joints or tissues.

If a tibial stress fracture is the concern, neither switching foot strike nor running barefoot will likely decrease tibial stresses, and the runner may have to use at least a 10% shorter stride length to significantly decrease stresses.

If the runner is experiencing hip pain caused by excessive loading, he or she may decrease loading more by switching to a midfoot or forefoot strike (shod or barefoot) rather than by shortening the stride, though both modifications are options for decreasing load.

It would be logical to consider both running modifications (foot strike and stride length) simultaneously, which researchers have found to beneficially decrease GRF loading rate.[35] Indeed, most habitual rearfoot strike runners instinctively shorten their stride length when running at the same speed with a midfoot or forefoot strike.[3,9-11,16]

What if runners are not injured and just want to switch foot strike style? They can try it, but should transition very slowly (at least 10 weeks or more).[6] Because there is no evidence that a shorter stride length leads to injuries, runners wanting to adopt this modification do not need to transition slowly. As with making any running regimen change, it is important for runners to listen to their bodies to help avoid injury.

Elizabeth Boyer, PhD, is a postdoctoral fellow at Gillette Children's Specialty Healthcare in St. Paul, MN, studying movement disorders in children and adults. Tim Derrick, PhD, is a professor in the Department of Kinesiology at Iowa State University in Ames studying musculoskeletal loading during activities of daily living.

References are available at lermagazine.com.

AFFORDABLE

Custom Foot Orthotics
AS LOW AS $20/Pair

ASK FOR DETAILS TODAY

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

TRUSTED

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

Trust DARCO to Assist in the Healing Process.

WCS™ Closed-Toe

MedSurg™ with PTQ series
PegAssist™

PegAssist™ Walker

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

DARCO Wound Care products are:

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

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

WOUNDCARE-CIRCLE
Get pressure ulcers under control

DARCO


Istockphoto.com #86982231

Strength training: Bone health benefits for men

Men with low bone mass are much less likely than their female counterparts to receive treatment. But research suggests that resistance exercise is a safe and effective way to improve bone mineral density in men and, in turn, reduce the risk of fracture and related complications

By Pamela S. Hinton, PhD

Osteoporosis, which is defined[1] as "low bone mass and microarchitectural deterioration of bone tissue, leading to enhanced bone fragility and a consequent increase in fracture risk," currently affects more than 200 million people worldwide.[2] The World Health Organization defines osteoporosis as a bone mineral density (BMD) that is two and a half standard deviations (SD) or more below the average value for a young adult (T-score < -2.5).[3] Osteopenia is characterized as low bone mass, and is defined as a BMD that is between one and two and a half SDs below the young adult mean (T-score between -1 and -2.5).[3]

Low BMD is associated with increased risk of nontraumatic fracture; fracture risk is increased 1.5 to three-fold or greater for each SD decrease in BMD.[4] Each year, more than 4.5 million people in the US and Europe will suffer a fragility fracture.[3] Due to the growth of the aging population and the rise in life expectancy in recent years, the incidence of osteoporosis and related fracture is expected to increase.[5]

Osteoporosis affects men

Osteoporosis affects more than two million men in the US, and nearly 16 million more have low bone mass.[6] Men account for approximately 40% of the nine million new osteoporotic fractures that occur annually,[7] and the lifetime fracture risk in men aged 60 years and older is estimated to be as high as 25%.[8] Compared with women, men have a significantly greater risk for complications after a hip fracture, including increased morbidity, mortality, loss of independence, and rate of institutionalization,[9,10] yet treatment rates are much lower in men than in women.[11]

Recent estimates from the National Osteoporosis Foundation guidelines indicate that one third of white men older than 65 years, and more than half older than 75 years, should be recommended pharmacologic treatment for osteoporosis.[12] Yet, even after suffering an osteoporosis-related fracture, more than 90% of men remain undiagnosed and untreated.[13,14] Postfracture, men are less likely than

> Resistance training is well tolerated and appears to have a minimal risk of injury or discomfort, which predicts both good compliance and practical application.

Continued from page 37

women to receive follow-up care,[15] including calcium and vitamin D supplementation[16] and prescription of antiresorptive pharmacotherapy.[11]

Physical inactivity

Physical inactivity is a modifiable risk factor for osteoporosis, and increasing physical activity at any point throughout the lifespan positively affects bone health,[17-22] while reductions in physical activity can result in bone loss.[23,24] Cross-sectional and longitudinal studies have shown the skeletal benefits of physical activity during adolescence and young adulthood persist into middle age and older adulthood.[25,26] In addition to increasing BMD, bone loading during adulthood increases bone size, cortical area, and strength,[27] and reduces hip fracture risk later in life.[20]

Exercise can affect bone through multiple mechanisms, including muscle contraction forces, gravitational loading, and endocrine/paracrine effects. During physical activity, bone is subjected to mechanical forces exerted by muscle contraction and gravitational loading. At the cellular level, bone cells (osteocytes) perceive these mechanical forces as cell deformation, changes in extracellular fluid shear stress, pressure gradients, and electric fields.[28] The osteocytes communicate with osteoblasts and osteoclasts to modulate bone formation and resorption, thereby changing the bone's geometry and material properties.[29]

It is well-accepted that bone adapts to the mechanical demands to which it is subjected, and muscle contractions contribute a portion of those demands.[30,31] The importance of skeletal muscle contraction forces (ie, joint reaction forces) to bone mass is supported by the parallel changes in bone mass and muscle strength throughout the lifespan.[30,32] Similarly, in states of muscular disuse that result in muscle atrophy (eg, disease, inactivity, or paralysis), muscle contraction forces are severely reduced, and site-specific reductions in bone mass and bone strength occur.[31]

Site-specific relationships between skeletal muscle mass and BMD demonstrate the importance of muscle contraction to the preservation of bone mass. Studies of tennis players demonstrate that a player's dominant arm has greater muscle and bone mass than their nondominant arm.[32] In the lower extremity, the bones of the nondominant limb have greater bone density due to greater motor neuron excitability and activity of stabilizing muscles of the nondominant side.[33] Cross-sectional studies have shown positive site-specific associations between repetitive muscle contraction and regional BMD, such that resistance training of the upper body is associated with greater BMD of the arms.[34] Likewise, changes in skeletal mass following strength training are positively associated with changes in BMD.[35] Thus, there is considerable evidence that muscle contraction forces are important for bone strength.

Resistance training

The American College of Sports Medicine recommends weightbearing endurance activities, including those that involve jumping and jogging, three to five times per week, and resistance exercise two to three times per week to preserve bone health during adulthood.[36] Resistance training is also recommended by the National Strength and Conditioning Association to increase BMD or to prevent age-associated reductions in BMD.[37] The Surgeon General's Report on Bone Health also recommends progressive resistance training, as well as daily jump-training and participation in weightbearing recreational activities for individuals who can tolerate high-impact activity.[1]

The majority of clinical trials of resistance training have been conducted in women. Exercise that exerts high muscle-contraction or ground reaction forces on the skeleton, such as high-intensity resistance training or structured jump-training, respectively, is associated with increased BMD in pre- and postmenopausal women.[38-40] However, very few controlled trials have examined the effects of resistance training on bone mass in men.[22,41-48]

Generally, these studies reported positive effects of resistance training on BMD. Kukuljan et al found that 12 months of progressive resistance training and impact exercise (three days per week) was associated with increased BMD at the femoral neck and lumbar spine by 1.8% and 1.5%, respectively, in men aged 50 to 79 years with normal to below-average BMD at baseline.[42] Whole-body BMD increased by about 1.2% after 12 weeks of resistance training in elderly men and in women with an average age of about 60 years.[48] Ryan et al also reported a 2.8% increase in femoral neck BMD after four months of resistance training in men with an average age around 60 years,[46] and Menkes et al observed significant increases in lumbar spine (2%) and femoral neck (3.8%) BMD in men aged 55 to 60 years.[45] In a study of men and women aged 55 to 74 years, some of whom were osteopenic or osteoporotic, Bemben et al found that 40 weeks of resistance training significantly increased BMD of the spine, trochanter, and total hip by ≤1%.[41] However, because these studies included men and women, elderly men, or a mixed study population of men who had either normal or low BMD, or because the intervention included a combined exercise protocol (ie, resistance training plus high-impact activity), the effectiveness of resistance training for increasing BMD in men with existing low bone mass could not be determined.

Clinical trial

To answer this clinically relevant question, we conducted a clinical trial to determine the effects of 12 months of periodic progressive resistance training on BMD in apparently healthy men (mean age, 44 ± 2 years; median age, 44 years) with osteopenia of the hip or spine.[49] This study was conducted in accordance with the Declaration of Helsinki and was approved by the local Institutional Review Board. Informed written consent was obtained from each study participant.

Apparently healthy physically active (four or more hours of leisure time physical activity/week for the past 24 months) men aged 25 to 60 years with low BMD of the lumbar spine or hip (T-score between -2.5 and -1 SD) were eligible to participate in the study. Exclusion criteria were: use of medications or supplements that affect bone metabolism or prevent exercise; a previous or current medical condition affecting bone health; osteoporosis of the lumbar spine and/or hip (T-score < -2.5 SD); cardiovascular disease; metal implants; current smoker (ie, within the past six months); current regular participation in high-intensity resistance training and/or plyometrics; reversed sleep/wake cycle (ie, sleep during the day and work at night); and consumption of more than three alcoholic drinks per day.

The participants completed two resistance training sessions per week under the supervision of study personnel. The resistance training intervention included exercises that load the hip and spine: squats, bent-over-row, modified dead lift, military press, lunges, and calf raises. Participants were instructed to perform the eccentric phase of each lift in two to three seconds and to perform the concentric contraction "explosively." Prior to and every six weeks during

Continued on page 40

Levy® Diabetic Econ

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

ECON I

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

3 pair for $65

ECON II

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

3 pair for $75

Levy Rappel

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

Continued from page 38

the intervention, we performed maximal strength testing.[50]

To minimize risk of injury and to account for strength adaptations as a result of strength training improvements, the intervention also used a progressive intensity design based on a six-week cycle followed by a rest week; a total of eight cycles were completed. During the six-week cycle, the intensity progressively increased every two weeks based on the strength measured at the end of each cycle.

- Weeks one to two were light intensity, consisting of one warm-up set of 10 repetitions at 20% of the 1-repetition maximum (1RM) and three sets of 10 repetitions at 50% of the 1RM.
- Weeks three and four were moderate intensity, with one warm-up set of 10 repetitions at 20% of the 1RM, two sets of 10 repetitions at 60% of the 1RM, and one set of six to eight repetitions at 70% to 75% of the 1RM.
- Weeks five to six were high-intensity, starting with one warm-up set of 10 repetitions at 20% of the 1RM, followed by two sets of 10 repetitions at 60% of the 1RM, and one set of three to five repetitions at 80% to 90% of the 1RM.

At the end of the 12-month intervention, participants significantly improved their muscular strength, as evidenced by increases in 1RM for the squat, lunge, modified deadlift, calf raise, military press, and bent-over row of 79%, 114%, 64%, 79%, 52%, and 44%, respectively. Bone mineral density of the whole body, total hip, and lumbar spine, which was measured using dual-energy X-ray absorptiometry, also significantly increased after 12 months of resistance training. There was a positive relationship between percent changes in squat 1RM and in left leg BMD ($r = .605$, $p = .042$). The increases in BMD observed in the present study were associated with favorable alterations in serum bone turnover markers; specifically, there was a significant reduction in bone resorption and an increase in bone formation.

Biological and clinical significance

The biological and clinical significance of these results can be appreciated only if one considers that bone loss occurs with normal aging. Young adult and middle-aged men lose BMD at rates of about .4% to 1.5% per year.[51-53] The results are also important because they suggest that a time-efficient (two to three days per week) resistance training intervention can improve BMD in otherwise healthy men. We previously observed that physically active adult men with osteopenia, similar to those in the present study, lost hip BMD at a rate of .8% per year,[54] consistent with the literature consensus that bone loss occurs with aging. Therefore, the increases in BMD observed in this and previous exercise-intervention studies, though relatively small (.6% to 1.3%), are biologically significant, in that exercise reversed the bone loss that occurs with normal aging.

The increases in BMD observed following exercise interventions likely have clinical significance, as small increases in BMD result in much larger gains in bone strength. For example, increasing BMD by 5% increased bone strength by 65% in an animal model,[55] and, in women with postmenopausal osteoporosis, a 1% increase in spine BMD reduced fracture risk by 8%.[56] Similar to the increase in bone formation and decrease in bone resorption observed in our study, others have reported increases in bone formation markers relative to resorption following high-intensity resistance training in older men.[47,57,58] These data suggest exercise might counteract age-related bone loss in men, which has been attributed primarily to a deficit in bone formation relative to bone resorption.[59]

Feasibility of resistance training

From a practical perspective, it is worth noting that, in our study, the time and equipment required to complete the resistance training each week was minimal, ranging from 60 minutes during a "light" week to 120 minutes for a "heavy" week. If participants missed a session, they were required to make it up. While the training in our study was supervised, it could be done at home without supervision.

These observations, coupled with evidence of long-term compliance with voluntary unsupervised high-impact exercise interventions in premenopausal women,[60] suggests exercise-based interventions might be effective in the real world.

This conclusion is strengthened when one considers the alternative of pharmacologic treatment. Although antiresorptive medications are a Food and Drug Administration-approved treatment for osteoporosis in men,[61] less than 10% of men with osteoporotic fractures are treated with bisphosphonates. Enthusiasm for use of these medications in men appears to be limited by the relative lack of long-term safety and efficacy studies in men, the especially poor treatment compliance in men,[62] and data suggesting poor cost-effectiveness of bisphosphonate treatment in men.[63] Drug treatments for osteoporosis have low rates of compliance and persistence, and most patients who stop taking their osteoporosis medication do not restart.[64]

Safety issues

To evaluate safety of the resistance training intervention, we assessed the self-reported pain and fatigue associated with the exercise at each training session. On average, the participants rated the intensity of the pain caused by the training as a score of 10 or less out of 100, with 100 being the most intense pain imaginable. In addition, the pain ratings decreased from the baseline assessment at six and 12 months. Participants also rated fatigue associated with the interventions as less than 30 out of 100, with 100 being the most fatigue imaginable, at all time points. In addition, there were no injuries reported during any of the approximately 1800 supervised training sessions.

Thus, the resistance training was well tolerated by the participants and appears to have a minimal risk of injury or discomfort, which predicts both good compliance and practical application. Other studies have reported that older adults with low bone mass can safely perform maximal strength training (squats)[65] or jumping.[66,67] Moreover, a recent review by a panel of experts strongly recommends multicomponent exercise that includes resistance training for individuals with osteoporosis. Osteoporosis Canada, the National Osteoporosis Foundation, and Osteoporosis Australia's Medical and Scientific Advisory Committee endorsed the recommendation that individuals with osteoporosis engage in resistance training that targets all major muscle groups at least twice per week.[68]

Conclusion

In summary, the existing evidence suggests that resistance training interventions are safe and effectively increase BMD in men with low bone mass. These results have clinical implications, as exercise may be the appropriate "prescription" for some individuals with low bone mass. ler

Pamela S. Hinton, PhD, earned in her doctorate in nutrition sciences from the University of Wisconsin-Madison and is currently an associate professor in the Department of Nutrition & Exercise Physiology at the University of Missouri-Columbia.

References are available at lermagazine.com.

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

Ankle instability rehab emphasizes individuality

Research presented at the most recent International Ankle Symposium indicates that rehabilitation for chronic ankle instability is evolving from a one-size-fits-all approach to an increased focus on matching specific interventions to the patients who are most likely to benefit.

By Lori Roniger

The future of rehabilitation interventions for chronic ankle instability (CAI) could include combining treatments and personalizing rehab programs for individual patients and their specific deficits, according to new research presented at the 6th International Ankle Symposium in Dublin, Ireland.

"I think the key to successful rehab in people with chronic ankle instability is matching the treatment to the individual patient, not having a protocol applied to all patients," said Jay Hertel, PhD, ATC, the Joe H. Gieck professor of sports medicine and codirector of the exercise and sports injury lab at the University of Virginia in Charlottesville. "Matching up the impairments identified in the evaluation should lead to the treatment they get."

Hertel gave a keynote lecture on treatment strategies for CAI at the October 2015 symposium and emphasized in a phone interview after the event that, while CAI is multifactorial in nature, this doesn't mean every patient is influenced by all the possible factors. In particular, he said, it is important to address those that contribute to a patient's specific limitations, such as range of motion, mobility, strength, balance, or more functional issues involving gait or cutting and landing in athletes.

"We need to be treating everyone as an individual," said Erik Wikstrom, PhD, assistant professor of sports medicine at the University of North Carolina at Chapel Hill, whose research on CAI rehab was presented at the conference.

Performing a baseline assessment of each patient and his or her impairments is particularly important in patients with CAI as that population is more heterogeneous than others, Wikstrom said.

A growing body of research suggests that ankle instability threatens quality of life and leads to decreased activity levels, which could have long-term implications.

Matching the treatment to the patient

Patrick McKeon, PhD, ATC, FACSM, assistant professor of exercise and sports sciences at Ithaca College in New York, has been working with Wikstrom and other researchers to determine which CAI patients will benefit most from specific interventions that have already been shown to be effective for improving CAI. The result has

Continued from page 43

been what the researchers call a sensory-targeted ankle rehabilitation strategies (STARS) treatment paradigm.[1,2]

Their research has examined plantar massage, ankle joint mobilization, or calf stretching in CAI patients, and the effect on outcomes such as postural control, ankle joint range of motion, and self-assessed function.[1]

"All of those interventions improved more or less all of those outcomes," Wikstrom said.

They found that response to treatment varied for each intervention—some individuals had large improvements while some had only small improvements—and they sought to determine if they could predict which interventions were best for which patients, starting with plantar massage and ankle joint mobilization.

> "If we don't specifically address the gait mechanics through rehab, we don't actually change the gait patterns."
> — Jay Hertel, PhD, ATC

They found that a baseline Foot and Ankle Ability Measure (FAAM) Sport score greater than 70.31% and a single-limb balance test improvement of at least 1.67 errors after one five-minute plantar massage treatment predicted which patients with CAI would improve their postural control after six such sessions over a two-week period, according to preliminary results presented at the ankle symposium.[3]

"Plantar massage really seems to be beneficial if there is a single-limb balance deficit," Wikstrom said.

In another pilot study, CAI patients who were responsive to joint mobilization treatment had lower FAAM-ADL (activities of daily living) scores and higher anterior Star Excursion Balance Test scores prior to undergoing this intervention than those who did not respond.[4] The treatment involved six sessions over two weeks; each session involved two two-minute sets of Maitland grade-II talocrural traction and four two-minute sets of Maitland grade-III anterior-to-posterior talocrural joint mobilization.

Mix and match

McKeon, who has both research and clinical responsibilities at Ithaca College, said he enjoys seeing the clinical improvements associated with such interventions; ankle joint mobilization, for example, can help increase dorsiflexion and self-reported function. He has also been developing protocols that he hopes will be practical in the real world.

While randomized controlled trials conducted for STARS interventions used only one form of treatment on each patient, McKeon and colleagues are now studying a multimodal approach in which CAI patients receive five minutes of joint mobilization, five minutes of plantar massage, and five minutes of foot core work three times a week for two weeks.

"After that, I typically introduce some balance activities like standing on one leg and hopping on one leg," he said.

Another study[5] presented at the International Ankle Symposium by Wikstrom and colleagues examined whether combining balance training with multimodal STARS treatment in CAI patients improved static postural control more than balance training alone. While this preliminary research did not find a significant difference in static postural control between the treatment groups, Wikstrom said the results, which were based on a relatively small group of 24 patients, suggest that combining the treatments could be effective. He hopes to study this combination treatment in a larger group of patients and determine if any variables can predict a positive response to this intervention.

Impairment-based model

Luke Donovan, PhD, ATC, an assistant professor of kinesiology at the University of Toledo in Ohio, presented research at the ankle symposium on an impairment-based approach to CAI rehab. In this model, patients are prescribed interventions to address specific impairments (such as sensory issues, decreased proprioception, or altered gait kinematics) starting at levels that are challenging for the individual, instead of giving everyone the same tasks.

A study of his that was epublished in March by the *Journal of Athletic Training* examines the effectiveness of a four-week rehabilitation program in which CAI patients performed exercises while wearing an ankle destabilization shoe or while on traditional unstable surfaces. The study's protocol provided patients with challenging exercises throughout the study and focused on range of motion, strength, balance, and functional exercises. After patients were assessed, they started exercises at a level that was difficult for them.

"What we found more or less was that both groups progressed similarly with clinical measures," Donovan said. "Everyone's strength improved on average. I would say that these [ankle destabilization] devices are just as effective as unstable surfaces."

At the symposium he presented the results of a second manuscript stemming from the same data that found impairment-based rehabilitation incorporating an ankle destabilization device was associated with improvements in dorsiflexion range of motion during the stance phase of gait—which is often limited in patients with CAI. The same protocol without the destabilization device had no effect on ankle dorsiflexion.[6]

He said the patients anecdotally enjoyed participating in the study and found the exercises challenging. These studies did not follow patients over the long term, although Donovan is replicating the study using different gait training devices and plans to follow patients over a longer period.

Hertel, one of the study's authors, emphasized the importance of using specific interventions to address the altered gait patterns seen in CAI patients.

"If we don't specifically address the gait mechanics through rehab, we don't actually change the gait patterns," he said. "Patients report feeling better but don't see change in gait without doing specific gait interventions."

Walk this way

Like other researchers, Donovan is trying to figure out how to best bring his research into the clinic. He's been investigating the use of off-the-shelf video cameras to look for visual cues that differentiate between CAI patients and those who have never sprained their ankles, and the potential value of this information for CAI rehabilitation.

Donovan has also been studying the effects of an auditory biofeedback device, worn in a shoe, on gait in CAI patients. Recently

Continued on page 46

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 **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

Continued from page 44

published research reported that wearing the device was associated with decreased plantar pressure in the lateral column of the foot while walking on a treadmill.[7] Since patients walk differently when using the device, he'd like to see if incorporating it into a rehab program causes lasting and long-term changes, such as altering gait, self-reported function, or incidence of giving way.

"There are pretty effective ways clinicians can measure strength, balance, or range of motion, but when it comes to functional movement patterns, it's tough to assess," Donovan said.

He also noted that CAI rehab studies typically have not reported long-term results.

Having a vision

A new area of research on which Wikstrom, McKeon, Hertel, and others are collaborating is examining whether CAI patients have an increased reliance on visual information. Some of them presented an abstract at the ankle symposium on their systematic review of the use of visual information in CAI patients compared with uninjured controls.[8]

Assessing 11 studies of single-limb stance under eyes-open and eyes-closed conditions in CAI patients, healthy individuals, or both, they found CAI patients rely more heavily on visual information during that task than controls. These sensory weighting differences suggest there may be a neurophysiological component to the balance deficits associated with CAI, Wikstrom said.

"We want to get a better understanding of the full spectrum of deficits associated with sensory reweighting," he said.

The next step is to determine whether this outcome is treatable; however, he said, preliminary data from a few of his group's ongoing investigations suggest existing interventions may not treat this issue. If existing interventions don't adequately address the way patients use somatosensory versus visual information, that could explain why patients with CAI often continue to experience episodes of ankle sprain or giving way despite having gone through a full balance training protocol.

Changes in the brain

Phillip Gribble, PhD, ATC, FNATA, who spoke at the conference about CAI as the next injury epidemic, has been trying to document changes that CAI may cause in the brain and spinal cord pathways and how they may manifest into clinical functional deficits.

"There is a rise in understanding that chronic ankle instability creates some adaptations in the nervous system," he said.

A study conducted by Gribble and colleagues published earlier this year found that fibularis longus corticospinal excitability was greater in controls than in CAI patients.[9] He is currently using transcranial magnetic stimulation (TMS), which was used in the previous study, to detect differences in the corticospinal excitability of the peripheral muscles between CAI patients and ankle sprain copers (those who have a history of ankle sprain but don't develop CAI).

"These results may lead to the development of novel rehab techniques," he said.

Long-term consequences

Gribble noted that a growing body of research, some of it presented at the ankle symposium, has been finding that CAI threatens quality of life and leads to a decline in physical activity levels, which could have long-term implications.

A 2015 study by Hubbard-Turner et al found that physical activity levels were reduced in college students with CAI compared with healthy students,[10] and another by Houston et al found that quality of life is reduced in individuals with CAI.[11]

"Something we all recognize that's on the horizon is how to mitigate problems for CAI patients on this path toward long-term consequences and ultimately promote a physically active lifestyle in these patients," Gribble said.

People are recognizing the long-term consequences of CAI and ankle instability, which include ankle osteoarthritis,[12-15] as they have previously for anterior cruciate ligament (ACL) injuries.

"What we're seeing with the ankle is clearly mirrored in the knee patient population," he said.

Future research may investigate how interventions may help to turn CAI patients into copers.

"There has been, to my knowledge, no studies on how any interventions impact physical activity levels," Wikstrom said. "That's the next step."

One challenge is that many patients with CAI come in for treatment only when they experience a recurrent ankle sprain or an episode of giving way and want treatment for acute symptoms, he noted.

"Generally, those get resolved and those patients disappear," Wikstrom said.

These patients often don't think they need rehab and don't understand they may have residual impairments, he said.

"People don't respect ankle injuries," McKeon said.

Compliance and communication

McKeon talked about the importance of a maintenance program for CAI patients after they have undergone some form of rehabilitation, such as balance training.

"I think it's really important for them to continue with those types of activities," McKeon said. "If you don't use it, you lose it."

Such maintenance programs could include performing foot core exercises, foot massage, and trying to balance on one leg. McKeon also recommends that CAI patients get involved an activity that promotes balance and dynamic movement, such as yoga, Pilates, tai chi, or hiking.

"There's a reason that CAI is such a recalcitrant condition," McKeon said. "I think compliance seems to be the biggest issue."

He said he emphasizes to his CAI patients the outcomes and improvements they're seeing while working with him. He likes to use self-reported functional scales, such as the FAAM, to show them where they have difficulties and where their abilities are improving through rehabilitation.

"Having the patients fill out the form initially is a good way for me to show them what their problems are and then to work through goal-setting with them to address those problems," McKeon said. "I can then come back to how each intervention we include in their rehab ties back to the problem they reported. Then as we progress through rehabilitation, I have them revisit the FAAM and show them how they're shifting their perception of difficulty based on the rehab. It definitely helps with the patients' perception of why we're doing what we're doing."

This approach also makes it easier to link changes in clinical outcomes—such as strength, range of motion, limb girth, and balance—to the subjective outcomes identified on the FAAM, he said.

Lori Roniger is a freelance writer based in San Francisco, CA.

References are available at lermagazine.com.

VIONIC®

WALK. MOVE. LIVE.™

*Clinically proven to relieve heel pain**

A recently released peer-reviewed study reveals that Vionic® contoured sandals are comparable in effectiveness to our best-selling pre-fabricated orthotics in the short-term treatment of heel pain. The same study also shows that Vionic® contoured sandals offer more effective relief for heel pain sufferers than standard flat flip flops. These results make Vionic® the first and only sandal brand proven to effectively alleviate heel pain.

IMPROVE OUTCOMES WITH OUR COMPREHENSIVE RETAIL OPPORTUNITIES.

Contact us to learn about our comprehensive in-store retail opportunities and our slatwall display program.
Contact: Deena Rudden at: **415-755-2783** or email: **drudden@vionicgroup.com**
www.VionicShoes.com

To read the full study, visit: **www.vionicshoes.com/heel-pain-relief-study**
*Based on a peer-reviewed clinical study partially funded by Vionic on patients experiencing moderate, non-traumatic heel pain.

POWERED BY VASYLI® MEDICAL

Flexible flat foot: Effects of orthoses during gait

In this original investigation, researchers analyzed the biomechanical effects of a foot orthosis in patients with flexible flat foot during walking and the extent to which those functional effects are consistent with proposed theories about the device's mechanism of action.

By Bruce Elliott, PT, DPT, COMT, and Juan Garbalosa, PhD, PT

Low arches, or flat feet, are associated with an increased risk of injury among physically active people, and it is widely believed that this type of foot tends to be more flexible than other foot types, allowing a disproportionate amount of pronation during the gait cycle.[1,2] Researchers have theorized that flexible flat feet affect the movement and muscular activity patterns of the lower leg, predisposing such individuals to lower extremity musculoskeletal injuries.[3-5]

Excessive pronation at the subtalar joint and the transverse tarsal joint is associated with a flexible flat foot.[6,7] It has been suggested that this foot type will contribute to a loss of ligamentous and osseous stability, necessitating increased muscular activity in the lower leg and foot to maintain that stability.[8] Additionally, the lack of stability may cause an increase in the magnitude of the stress and shear forces that are transmitted to the soft connective tissues. Excessive pronation is the etiological variable most commonly linked to overuse injuries, and the subsequent increase in muscular activity and transmitted forces can ultimately lead to muscular fatigue, which is associated with a variety of overuse injuries.[5,9]

A biomechanical foot orthosis is commonly used for the management of lower extremity injuries that are related to overpronation or flexible flat feet.[8,10] According to Root, realigning the posture of the foot is considered an effective intervention because abnormal foot posture is generally considered the cause of a wide variety of pathological conditions,[11] and the flexible flat foot is managed with orthosis intervention more often than other foot types.[4,5,9,12-14]

Increasingly, foot orthoses have been successfully used as an adjunct treatment for symptoms that are secondary to increased flexibility. Of 465 podiatric patients reporting various maladies, 62% acknowledged complete resolution of their chief complaint after orthotic treatment, and an additional 33% gained partial resolution. Similarly, in a retrospective study with both temporary soft orthoses and permanent rigid orthoses, 96% of patients experienced pain relief, while 70% were able to return to previous levels of activity.[15,16]

Additionally, Nigg et al[17] reported that at least 70% of runners

The orthosis did not affect most of the kinematics of the forefoot, first ray, and medial longitudinal arch, but did affect transverse movement at the forefoot.

Continued from page 49

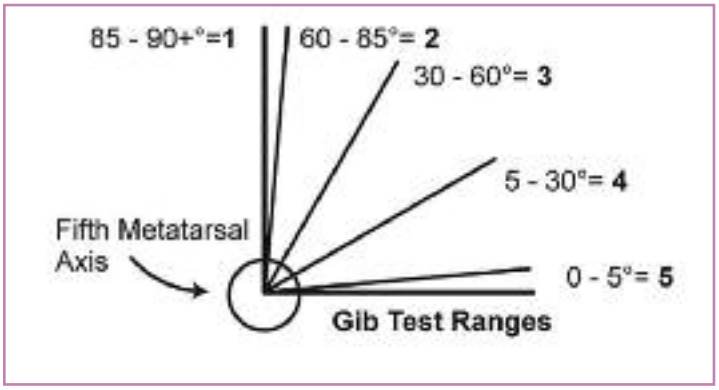


Figure 1. Modified Gib test ranges.

who experience lower extremity musculoskeletal exertional pain will have a reduction in their symptoms with the use of a biomechanical orthosis. Based on static radiologic data, Bleck and Berzins,[18] and later Bordelon and Lusskin,[19] reported that significant correction of flexible flat foot deformity could be achieved by the use of orthoses. In contrast, Penneau et al[20] and Wenger et al[21] suggested the use of an orthotic device could not make permanent changes to a flat foot.

The use of foot orthoses in the treatment of abnormal foot biomechanics has been extensively described in the literature, and those interventions can be grouped into two categories—accommodative or corrective. Regardless of the orthotic prescription, it is difficult to judge the scientific merit of the recommendations that have been generated by these studies because of the conflicting opinions regarding the effectiveness of different orthoses.[1,7,14,22]

We conducted a study comparing the stance phase mechanics of symptomatic individuals with flexible flat feet during normal walking in a conventional sandal and in the same sandal with a maximal arch supination stabilization orthosis. The purpose of the study was to document the effect of the orthosis on the forefoot, medial longitudinal arch, and first ray mechanics of flexible flat feet during normal overland walking at a self-selected speed.

Methods and materials

We screened a convenience sample of 20 individuals for participation in this study. Thirteen met the inclusion criteria; two were lost to follow-up, and one participant's data file became unusable. The 10 individuals (six women) who completed the study ranged in age from 20 to 54 years and reported various complaints of foot, heel, leg, and knee pain. Informed consent and a medical history were obtained from each participant prior to taking any measurements. Individuals were excluded if they had sustained any lower extremity fractures or injury to the capsular or ligamentous structures of the lower leg or foot within the past 12 months.

The inclusion criteria for the experiment were defined by the navicular drop test and the modified Gib test. Individuals were included in the study if they had a navicular drop greater than or equal to 10 mm bilaterally, and if they had at least 60° of frontal forefoot or rearfoot passive range of motion (as determined by the modified Gib test, illustrated in Figure 1)[23] in both feet. The modified Gib test is recommended for orthosis prescription by the manufacturer; however, because of the subjective nature and less-than-adequate

Figure 2. Study participant's foot in the final stage of casting.

reliability of this test, we also used the navicular drop test to define an individual's inclusion in the study.

Upon completion of the structural evaluation, participants were casted for a custom pair of orthoses according to standardized casting procedures of the orthosis manufacturer. One investigator performed all of the casting tasks. This sequential process entailed a gait-referenced weightbearing foam box casting, which captures the maximal amount of arch that one can comfortably achieve at midstance with the heel and forefoot in full contact with the ground (Figure 2). Once accomplished, the casts and orthosis prescription were shipped to the manufacturer.

At the second visit, approximately two weeks later, proper fit of the orthosis was verified and study participants were instructed on their break-in and use. The orthosis featured a semirigid thermoplastic heel cup extending to the base of the metatarsals with a full-length, 1/8-in thick, perforated ethylene vinyl acetate top cover (Figure 3). The individuals used their own footwear during the six-week break-in period and were allowed to take part in normal activities. The only activity that was restricted prior to the actual data collection was recreational running with the orthosis in the shoe.

At the end of the accommodation period, all participants attended a data collection session. At this session, retro-reflective markers were placed on the pelvis, lower extremities, and feet over specific bony landmarks (Figure 4). Using an eight-camera video system sampling at a rate of 120 Hz, the 3D displacements of the retro-reflective markers were recorded while the participants walked over level ground at a self-selected walking speed under one of two

Figure 3. Maximal arch supination stabilization orthosis with perforated EVA top cover.

Continued on page 52

Continued from page 51

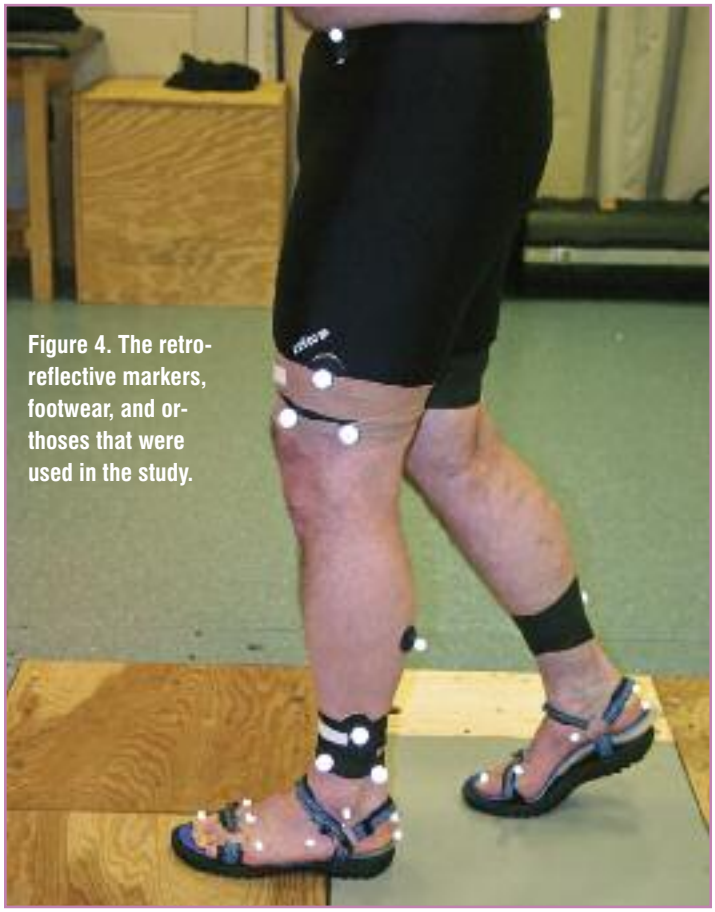


Figure 4. The retro-reflective markers, footwear, and orthoses that were used in the study.

footwear conditions. The footwear conditions consisted of walking in a sandal and walking in a sandal with the orthosis, which was secured to the sandal with two-sided tape. A modified Teva sandal was used for the walking trials (Figure 5). To allow for full visibility of the foot markers, the sandals were modified by removing the straps (with the exception of the anchoring straps) and replacing them with half-inch Velcro straps.

A walking trial consisted of the participant walking continuously at a self-selected walking speed within the laboratory setting, making wide-angle turns at each end of the room. Twelve trials of video data were collected for each participant (six trials in each footwear condition). Each individual walked in the sandal-only condition first, followed by walking in the sandal with orthosis.

Data analysis

We used marker displacement data to obtain the 3D angular displacements of the rearfoot, forefoot, and first ray, as well as the dynamic arch index, during the walking trials. We defined dynamic arch index as the vertical distance to the navicular marker from the floor, divided by the distance from the inferior calcaneal to the first metatarsal marker. The stance phase of the walking trials was extracted and time normalized to 100 frames (1 and 100 representing heel strike and toe off, respectively). We obtained maximum, minimum, and range (maximum minus minimum) of the rearfoot, forefoot, and first ray angles and dynamic arch index of five stance phases for each footwear condition.

To determine the effect of condition (orthosis vs no orthosis) we analyzed six dependent variables simultaneously: forefoot kinematic movement in the sagittal, frontal, and transverse planes; first

ray kinematic movement in the sagittal and transverse planes; and kinematic movement of the medial longitudinal arch (arch index). The level of statistical significance was set at $p<.10$.

Results

We found a significant difference between conditions for maximum forefoot movement in the transverse plane, for both left and right feet. There was also a significant difference between conditions for minimum forefoot movement in the transverse plane for right feet. However, we found no range of motion differences between conditions for any of the other dependent variables, including the arch index, in either lower extremity.

Discussion

The orthosis used in this study is typically prescribed for patients with symptoms associated with flexible flat feet and abnormal pronation. The manufacturer states that the orthosis attempts to control the subtalar joint indirectly by controlling the amount of medial longitudinal arch deformation through direct and total contact of the arch.[23] This is based on the theory that a direct relationship exists between arch height and subtalar pronation; therefore, if arch height is controlled, pronation is also effectively controlled.

An additional claim of the manufacturer is that the orthosis will hypothetically increase first metatarsal plantar flexion by directing a mechanical control over the tarsus of the foot, theoretically creating an indirect force on the calcaneus and talus.[23] The purpose of this is to increase first metatarsophalangeal (MTP) joint dorsiflexion in an effort to create a more rigid lever through the stance phase of the gait cycle.[23] The results of this study do not show significant

Figure 5. The modified Teva sandal (top) and the modified Teva sandal with orthosis (bottom).

Continued on page 55

READY-TO-WEAR PROFESSIONAL INSOLES

MatPLUS® professional insoles are the ultimate ready-to-wear insoles. Designed by professionals for professionals.

Our PRO Series insoles and SoleAid® insoles utilize shells and premium cushioning materials for top shelf performance.

For the ladies, our Heaven Steps® insoles provide professional foot protection for fashion-first footwear.

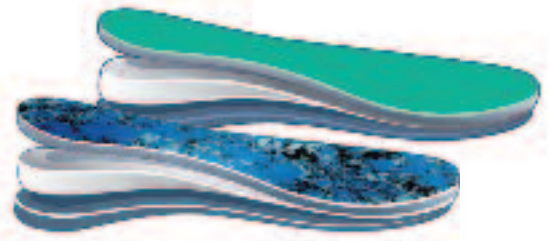
Professionals and resellers: Call us to explore private labeling opportunities, material substitutions and custom insole services.

Call
1.440.352.7201

PRO Series

Our PRO series insoles combine our most efficient materials for discreet support and cushioning. Finished with top and bottom covers that are elegant and protective. Their sophisticated appearance will compliment the finest footwear. Choose from full length or three-quarter length insoles.

- Neoprene or EVA blend top layer
- ORTHO CP™ Rigid shell
- Bottom cover



SoleAid®

SoleAid® ready-to-wear insoles are a premium point-of-sale product offering professional features and detailing. Convenient clam shell packaging.

- Urethane or EVA top layer
- ORTHO CP™ Flex shell
- M-Sole bottom cover or EVA foam

Heaven Steps®

Heaven Steps® insoles utilize a cleverly shaped *cobra* shell, so called because of its resemblance to the snake. The minimalist design provides arch support without bulk, allowing it to fit in ladies dress shoes or heels. Lined with foot-protecting synthetic leather.

- Faux leather top cover
- Cobra shell
- M-Sole or suede bottom cover

MatPLUS™
www.matplusinc.com

Continued from page 53

differences in the maximum and minimum positions of the first ray with the use of the orthosis and do not support this claim. The lack of an effect on first ray motion agrees with the results of Nawoczenski and Ludewig,[24] who also failed to identify any significant change in movement of the first ray during the weightbearing phase of the gait cycle with orthosis use.

During normal walking, first metatarsal plantar flexion is needed to allow unrestricted first MTP joint dorsiflexion during the push-off phase of gait. Nawoczenski and Ludewig compared a forefoot posted orthosis with a maximal arch supination stabilization orthosis and assessed the ability of each to alter motion at the first metatarsal and hallux.[24] Neither orthotic design was associated with significant effects on first MTP joint dorsiflexion, either at midstance or at push-off. Individual participant responses to the maximal arch supination stabilization orthosis revealed that 83% of the participants experienced no change in first MTP joint dorsiflexion; the remaining participants were split between having increased dorsiflexion and decreased dorsiflexion of the first MTP joint.[24]

The maximal arch supination stabilization orthosis is calibrated to deliver a range of forces that overlap the range of downward forces exerted on the device by the human body.[25] The orthosis, which is fabricated from thermoplastic, applies a corrective force to the plantar surface of the foot. Depending on the relative flexibility of the orthosis, there will be a certain amount of movement observed in the transverse plane of the forefoot, a finding we saw in our study.

Anecdotally, all but one participant in our study continued to wear the orthoses after the study's completion, and six of the 10 participants reported either a decrease or complete resolution of their symptoms after several weeks of orthosis use. These phenomena may be attributed to the proprioceptive change the orthosis provides within the shoe.

The major limitation associated with this study was the use of a sandal instead of a shoe for the data collection. The heel counter and upper of a shoe have the ability to improve the fit of the orthosis, prevent movement of the orthosis with respect to the plantar surface of the foot, and potentially enhance the overall effectiveness of the orthosis.

Conclusions

This experiment examined the effectiveness of a clinically recommended orthosis on the joint kinematics of flexible flat feet during normal self-paced overland walking. Although the orthosis did not have an effect on most of the joint kinematics of the forefoot, medial longitudinal arch, and first ray, it did have a significant and consistent effect on transverse movement at the forefoot.

Bruce Elliott, PT, DPT, COMT, is an assistant professor in the School of Physical Therapy at MCPHS University in Worcester, MA. Juan Garbalosa, PhD, PT, is a clinical professor of physical therapy and the director of the Motion Analysis Laboratory at Quinnipiac University in Hamden, CT.

References are available at lermagazine.com.

You provide braces to help him up; we provide the support to lift him up.

If you have patients with Charcot-Marie-Tooth, the CMTA gives them the support they & their loved ones deserve.

CMTA
Charcot-Marie-Tooth Association

One Disease, One Mission, One Family...We Are The CMTA

cmtausa.org • 800-606-2682

ad index

Please Support our Advertisers...

Because of them, we are able to provide you with this unique, informative and invaluable magazine!

lermagazine.com

ler new p

Bunionette Bootie

New from Bunion Bootie, a comfortable and practical treatment option is available for patients with tailor's bunions (otherwise known as bunionettes). The Bunionette Bootie soothes and restores feet by helping to separate and support the first and fifth toes, which in turn can improve standing balance and dynamic stability. A soft, thin, dual-layer barrier helps protect against blisters, rubbing, and tenderness. The Bunionette Bootie provides longitudinal and transverse arch support to help reduce fatigue while walking and standing for long periods. It is available in small, medium, and large sizes.

Bunion Bootie
877/208-4540
bunionbootie.com

SuperFlex Ankle Foot Orthosis

New York OMC introduces SuperFlex, a new flexible, molded, integrated ankle foot orthosis designed to promote dynamic biomechanical function. Features include an outer layer of durable vegetable-dyed leather, a full-interface lining to protect fragile skin, a pretibial leather lace closure, a medial arch balanced with 30-shore durometer EVA (ethylene vinyl acetate) for extra stability, and extra Poron padding at both ankles. A choice of closures—lace, Velcro, boot hooks, or a combination—facilitates easy donning and doffing. Available in black or natural color with a choice of three foot-plate lengths.

New York OMC
718/618-7292
newyorkomc.com

Compression Hose In Larger Sizes

Based on requests from patients and physicians, Sigvaris has introduced six new calf-length sizes and two new thigh-high sizes to its Select Comfort line of compression hosiery to accommodate patients with larger legs (calf circumferences up to 24 inches, and thigh circumferences up to 32 inches). The durable Select Comfort line, designed for easy donning and doffing, comes in closed-toe styles for women and in open-toe styles for both men and women. The hosiery is available in 20-30 mm Hg and 30-40 mm Hg of compression. Colors vary by style and include natural, suntan, crispa, and black.

Sigvaris
800/322-7744
sigvarisusa.com

Nomad Lite Outdoor Shoe

In response to customer demand, Spenco is unveiling a lightweight performance version of its Nomad Moc, the company's most rugged outdoor shoe. Offered in an expanded color palette, the Nomad Lite features a combination of water-resistant fabric and lightweight, water-resistant nubuck leather, soft shell fabric and technical mesh lining for better breathability, a molded rubber toe, and a lug outsole of rubber and EVA (ethylene vinyl acetate) for traction. Like its predecessor, the Nomad Lite comes with a removable Spenco Total Support Insole designed for foot alignment, motion control, and cushioning.

Spenco Medical Corporation
800/877-3626
spenco.com

roducts

Sharp Shape Scanning Package

The newest addition to the AOMS (Automated Orthotic Manufacturing System) family of products from Sharp Shape is the TOT (Transformation of Technology) package, designed to lower practitioner scanner costs. The AOMS TOT package includes an iPad, a small 3D sensor called the Structure Sensor, a Sharp Shape customized iPad app, and a specially designed Windows processing program. The AOMS TOT app allows practitioners to take 3D images of the plantar surface of the foot, positive and negative plaster-casts, and foam boxes. The images can then be sent to participating labs to create orthotic devices.

Sharp Shape
408/871-1798
sharpshape.com

Rebound Dual Knee Brace

Össur has launched the Rebound Dual, a malleable, comfortable knee brace for people with ligament issues, including ligament instabilities, and knee osteoarthritis. The Rebound Dual brace is suitable for people who participate in low-to-high impact activities, including sliding sports. Its lightweight aluminum frame can be easily adjusted for varus/valgus alignment and patient height. The easy off-and-on adjustable strapping allows patients to avoid the cumbersome "step-through" approach. A doeskin thigh liner helps enhance comfort, while a breathable ActiveGrip calf liner helps the brace remain in place.

Össur
800/233-6263
ossur.com

Strap Pilates Book, 2nd Ed

A second edition of *Stretch Out Strap Pilates Essentials* has been published by OPTP and certified Stott Pilates instructor Angela Kneale. The book shows participants how to enhance Pilates movements by effectively using the Stretch Out Strap, a tool that features multiple loops for deep, personalized self-stretching. Readers learn dynamic exercises for use with the strap, including exercises for the lower extremities, that both lengthen and strengthen while challenging core stability and control. Additional benefits of the exercises include increased flexibility, improved range of motion, and injury prevention.

OPTP
800/367-7393
optp.com

Reformulated Relief Cream

Relief topical analgesic from Corganics has a new and improved formulation, with more menthol than in the original (3% vs 2.5%) for increased effectiveness and an improved preservative system designed to ensure a three-year shelf life. The analgesic cream features a synergistic blend of essential oils (menthol, peppermint, eucalyptus, lavender, palmarosa, and sweet orange) along with aloe, vitamin E, and L-arginine. Relief has a refreshing scent, is nonsticky, absorbs quickly, and does not burn or dry skin or stain skin or clothing. Available in a 4-oz tube, 3-oz roll-on, 16-oz pump, or one-gallon pump.

Corganics
866/939-9541
reliefcream.com

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

ler new products

College Park Sidekicks

Introducing College Park's Sidekicks, the first multi-axial stubbie feet for foreshortened prostheses. Used in pairs, the feet encourage muscle activity to assist bilateral transfemoral amputees with rehabilitation, especially when the goal is a transition to microprocessor knees. The flexible platform and anatomical ankle motion promote ground compliance for stability and balance, and the molded tread provides traction and durability. The gait-matched, natural ankle motion also helps reduce socket forces and unwanted torque. Sidekicks are also sold singly for unilateral amputees involved in adaptive sports.

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

Mephisto Maryse Sandal

New to the Mobils by Mephisto line of comfort footwear is the Maryse sandal for women, a slingback wedge sandal with a polyurethane outsole, nubuck upper, and three adjustable Velcro straps. A key feature of all Mobils footwear is the all-over soft padding—cushioning between the lining and the soft leather upper that is designed to pillow the feet. Mobils footwear also features soft-air technology in the midsole to minimize shock, which has benefits for the more proximal musculoskeletal structures in addition to the feet. The Maryse sandal is available in dark taupe, in sizes 5-12 (whole sizes only).

Mephisto USA
800/775-7852
mephistousa.com

Exercise Plan Software

PhysioTools software makes creating exercise programs quick and easy. Select exercises, customize the text, and then email or print the resulting handout. The new app can be used to send exercise plans to a smartphone or tablet. Each exercise includes clearly written instructions, color photographs and/or drawings, and often videos. Modules of interest to lower extremity practitioners include Lower Extremity Basic Exercises, JEMS (Joanne Elphinston Movement Systems) Dynamic Movement Progressions for Trunk and Lower Body, and Corrective Exercises for Movement System Impairment.

PhysioTools
888/449-2338
physiotools.com

Coral Mag Fizz Supplement

Coral Mag Fizz is a beverage enhancer designed to boost the body's ability to perform and recover by utilizing magnesium and potassium, an essential mineral duo reported to help relieve muscle cramps by improving muscle and nerve function and regulating the body's water balance. When added to drinking water, the effervescent, lemon-lime flavored supplement delivers 300 mg of magnesium and 500 mg of potassium. The recommended dose is 6 g of Coral Mag Fizz per 4-6 oz of water, once or twice daily. The beverage supplement has a suggested retail price of $19.95 for a 6.4-oz container.

Coral
800/882-9577
coralcalcium.com

market mechanics

By Emily Delzell

DJO brace addresses lateral knee OA

Research on Vista, CA-based DJO Global's varus unloader brace published in February suggests the device may improve abnormal knee joint mechanics associated with the development and progression of lateral knee osteoarthritis (OA) after anterior cruciate ligament reconstruction (ACLR).

Investigators conducted 3D gait analysis on 19 participants who had undergone primary ACLR five to 20 years previously and had symptomatic and radiographic lateral knee OA and valgus malalignment.

Participants walked under three conditions: no brace; unadjusted brace (sagittal plane support with neutral frontal plane adjustment); and adjusted brace (sagittal plane support with varus adjustment). Compared with no brace, the adjusted brace significantly increased peak knee flexion angle and adduction angle and reduced peak internal rotation angle, as well as peak knee flexion moment, adduction moment, and external rotation moment. It also significantly reduced peak hip adduction angle and increased peak hip adduction and external rotation moments compared with no brace.

There were no significant differences between the adjusted and unadjusted brace conditions except for knee internal rotation angle, which was significantly reduced with the adjusted brace.

The American Journal of Sports Medicine epublished the findings on February 3. ler

Flexion releases data for new OA injectable

Burlington, MA-based Flexion Therapeutics in February released phase 3 data for its lead product candidate Zilretta, a novel nonopioid injectable for knee osteoarthritis (OA).

The sustained-release corticosteroid achieved the study's primary endpoints, reducing pain 50% from baseline at 12 weeks in patients with moderate to severe knee OA pain, and reducing pain significantly at weeks one through 16 compared with placebo. It also achieved a secondary measure, statistical significance against placebo and immediate-release triamcinolone acetonide for pain, stiffness, and function through week 12.

Flexion plans to present detailed results from the phase 3 trial at an upcoming scientific meeting, according to the company.

The Food and Drug Administration fast tracked Zilretta last year, and the company's planned NDA (new drug application) submission is on track for 2016. If approved, the therapy would be the first sustained-release corticosteroid injection for knee OA and the first new injectable approved for the condition in more than a decade. ler

M.J. Markell sells Quikiks Hands-Free shoes

New York, NY-based Quikiks Hands-Free Shoes in February signed its first US distribution agreement within the O&P industry with M.J. Markell Shoe Company.

M.J. Markell, headquartered in Yonkers, NY, will distribute Quikiks shoes, which feature hands-free technology called Step-in-Go that allows wearers to step easily into and fasten their shoes without bending or using their hands.

In December *Entrepreneur* and Canon USA named Quikiks founder Steve Kaufman the grand prize winner of the Project Grow Challenge, a small business owner competition. Kaufman said he will use the $25,000 award to invest in product improvements and marketing. ler

Medicare adopts HSS joint surveys

Investigators from the Manhattan, NY-based Hospital for Special Surgery on February 29 epublished data in *Clinical Orthopaedics and Related Research* validating two new shortened questionnaires that will reduce time spent collecting patient-reported outcome data for hip and knee replacement surgeries.

Beginning in April, Medicare will incentivize hospitals participating in the Comprehensive Care for Joint Replacement model, an initiative supporting higher-quality care for hip and knee replacement patients, to voluntarily submit patient-reported outcome data. Consumers will be able to access survey results on healthcare.gov, the first time treatment-specific, patient-reported outcomes data will be publicly available.

The Hip disability and Osteoarthritis Outcome Score (HOOS) JR—a six-question hip survey—and the Knee injury and Osteoarthritis Outcome Score (KOOS) JR—a seven-question knee survey—are abbreviated versions of the existing HOOS and KOOS surveys. In addition to saving patient and practitioner time, HSS investigators designed the new questionnaires to help orthopedic surgeons better identify optimal surgery candidates, improve rehab services, and more effectively evaluate implant devices.

The surveys are available at hss.com. ler

OHI funds $120K podiatric ed grant

Ronkonkoma, NY-based OHI (Orthotic Holdings Inc.) and the American College of Foot & Ankle Orthopedics & Medicine (ACFAOM) on February 10 announced a joint educational partnership to support the podiatric profession and advise on the impact of shifts in the healthcare industry.

The partnership is built around a $120,000 education and advocacy grant from OHI for programs that over a four-year period will support biomechanics and the podiatric profession.

The alliance will enable the development of consequential educational programs and resources that will help ACFAOM members and all podiatrists prepare for the myriad of challenges and opportunities facing them in a fast-evolving healthcare environment, according to an OHI release. ler

AOPA calls for O&P pilot grant RFPs

The Alexandria, VA-based American Orthotic & Prosthetic Association (AOPA) in late February invited requests for proposals (RFPs) for 2016 O&P research grants. This year AOPA will fund up to four pilot grants for up to $15,000 each.

View the 2016 research topics available for funding and full RFP and application online at aopanet.org. ler

ProtoKinetics launches gait screen at CSM

Havertown, PA-based ProtoKinetics launched its Movement Analysis Software (PKMAS) Primary Gait Screen on February 17 at the Combined Sections Meeting of the American Physical Therapy Association in Anaheim, CA.

The PKMAS Primary Gait Screen (PGS) addresses transitional movements in a single test (typically performed in less than one minute) that requires no editing and is easy to administer, according to a company release. Data are available immediately. Key gait metrics include efficiency, symmetry, and speed. ler

Continued on page 62

Continued from page 61

APTA names outcomes registry panel

The Alexandria, VA-based American Physical Therapy Association (APTA) on February 10 announced the members of a Scientific Advisory Panel to oversee its Physical Therapy Outcomes Registry.

The panel members are: James Irrgang, PT, PhD, ATC, FAPTA (director); Kristin Archer, PT, DPT, PhD; Linda Arslanian, PT, DPT, MS; Janet Freburger, PT, PhD; Christopher Hoekstra, PT, DPT, OCS, FAAOMPT; Stephen Hunter, PT, DPT, OCS; Michael Johnson, PT, PhD, OCS; Christine McDonough, PT, PhD; and Linda Woodhouse, PT, PhD.

The panel will provide direction for the registry on scientific integrity, clinical application, quality, public policy, and research. It will also oversee the registry's research agenda, data management and analysis strategies, clinical application, content development, and scholarly publications.

Data will guide best practices, help providers meet regulatory reporting requirements, generate benchmarking reports, and help shape payment policy and support the physical therapists in current and future quality and compliance programs required by payers, such as the Physician Quality Reporting System. ler

Justin Blair, ING finalize distribution deal

Chicago-based Justin Blair in February completed an exclusive distribution agreement with Hickory, NC-based ING Source, manufacturer of the Foot Gym and orthopedic compression products, including the Orthosleeve.

Justin Blair is ING Source's leading distribution partner for the Midwest, and the agreement covers independent pharmacy, home and durable medical equipment, and foot care retail channels in 11 states across the region. Justin Blair has offered the full range of the Orthosleeve brand as a standard distributor for more than four years.

In January, Teaneck, NJ-based Apex Foot Health and Justin Blair finalized an exclusive distribution agreement allowing the Chicago-based company to sell Apex footwear to its pharmacy, home medical equipment, and pedorthic shoe store customers across 17 states. ler

Fitness orgs join to check chronic disease

The American College of Sports Medicine (ACSM), Medical Fitness Association (MFA), and American Council on Exercise (ACE) on February 23 announced a major new effort called the Exercise is Medicine (EIM) Solution at National Press Club in Washington DC. The effort is part of the ongoing EIM global initiative the ACSM launched in 2008.

With the MFA and the ACE joining the ACSM, the new program represents nearly half the fitness professional industry in the US.

"Much of the illness and early death related to [many] chronic diseases can be prevented by increased physical activity. The EIM Solution is an innovative approach that, through a prescription, links the medical profession with physical activity professionals and community resources" said US Surgeon General Regina Benjamin, MD, who delivered a keynote talk during the announcement.

The EIM Solution will include physical activity counseling, as well as prescription and referral strategies, particularly the involvement of health and fitness professionals, an often-missing component of physician-prescribed treatment plans, according to the ACSM.

Go to exerciseismedicine.org for more information. ler

ConforMis introduces knee system

Bedford, MA-based ConforMis undertook the full commercial launch of its customized posterior-stabilized (PS) knee replacement system on March 2 at the American Academy of Orthopaedic Surgeons annual meeting in Orlando, FL.

The customized iTotal PS implant is customized for each patient to avoid overhang, rotation, and sizing compromises.

The system also helps restores knee curvature and has a customized cam and spine to provide stability throughout the full range of motion.

Primary total knee implants either retain the patient's own posterior cruciate ligament (CR), or substitute for it (PS). PS implants use a cam and spine feature that functions as the posterior cruciate ligament.

US surgeons in the US market show a heavy preference for the PS, which accounts for 72% by revenue of all primary total knee replacements, according to a ConforMis release.

The iTotal PS nearly triples the available market for ConforMis, said Philipp Lang, MD, MBA, the company's CEO and president. ler

AAOS supports local playground build

The American Academy of Orthopaedic Surgeons (AAOS) on March 1 joined the City of Kissimmee, FL, Central Avenue Elementary School, local residents, and organizers from Community Vision and KaBoom! to build a new community playground at Central Avenue Elementary.

Last December children from the neighborhood drew their dream playgrounds, and more than 200 volunteers used a plan based on those drawings to finish the construction in less than six hours.

The new space provides a place to play for more than 2678 Kissimmee children.

Since 2000, the AAOS has sponsored a one-day volunteer build to kick-off its annual meeting, which was held this year at the Orange County Convention Center in Orlando March 1-5. The playground is the 17th built by AAOS and KaBoom! ler

BOC gives $100K for pedorthic research

The American Board for Certification on Orthotics, Prosthetics, and Pedorthics (BOC) in December gave the Pedorthic Foundation $100,000.

The foundation will use the funds to support grants for clinical or laboratory research in prescription footwear and orthotic and pedorthic modifications. For more information on the grants, go to pedorthicfoundation.org. ler

Ottobock opens orthotic business unit

Austin, TX-based Ottobock's customers in January began getting support from the company's new business unit and sales organization dedicated to orthotics.

Ottobock's new orthotic business unit and sales representatives (formerly called activity and sports medicine [ASM] representatives) support the full line of its orthotics product and services, including the C-Brace, Stance Control, WalkOn, modular components, and the full line of Ottobock off-the-shelf bracing products.

Ottobock's prosthetics business unit (formerly the technical orthopedics business unit) is supported by the North American prosthetics sales organization. ler

Stop wasting time and money with plaster.

New Technology, Same Product

Get the same result from a 3-D scan

Non-Semi Full Weight Bearing 3-D Scanning

We will always accept traditional orthotic casting methods as well.

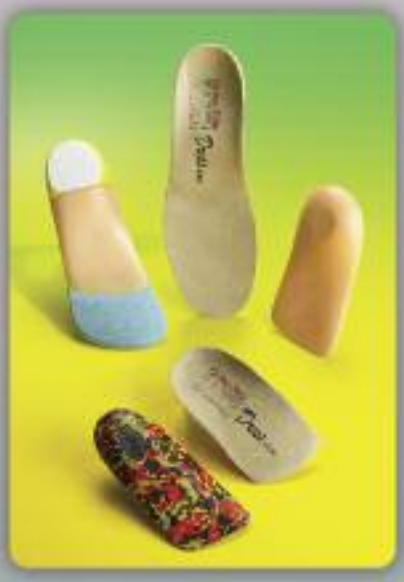
Call Us

Never hang up unhappy

800-473-6682

www.ortho-rite.com

Here are some of our orthotic products:



Ortho-Rite
INCORPORATED

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

THE LANGER SPORTHOTICS LINE

FINE TUNING ATHLETES, ONE SPORT AT A TIME

The Langer Sporthotics Line

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 · The Orthotic Group