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LOWER EXTREMITY REVIEW

February 22 / volume 14 / number 2

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NATIONAL BIOMECHANICS DAY

9 NATIONAL BIOMECHANICS DAY IS APRIL 6, 2022

Introducing biomechanics to high school students broadens community understanding of human movement and encourages the workforce of tomorrow.



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By Keith Loria and Janice T. Radak

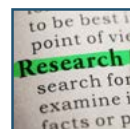
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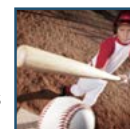


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Richard Dubin

Publisher and Chief Executive Officer

rich@lermagazine.com | 518.221.4042

STAFF

Editor

Janice T. Radak | janice@lermagazine.com

Associate Editor

Laura Fonda Hochnadel | laura@lermagazine.com

Marketing Manager

Glenn Castle | glenn@lermagazine.com

Graphic Design/Production and Website Development

Anthony Palmeri | PopStart Web Dev
webmaster@lermagazine.com

Operations Coordinator

Melissa Rosenthal-Dubin | melissa@lermagazine.com

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LOWER EXTREMITY REVIEW

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Lower Extremity Review Mission

Showcasing evidence and expertise across multiple medical disciplines to build, preserve, and restore function of the lower extremity from pediatrics to geriatrics.

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- Biomechanics matter
- Injury prevention is possible
- Diabetic foot ulcers can be prevented
- Collaborative care leads to better outcomes

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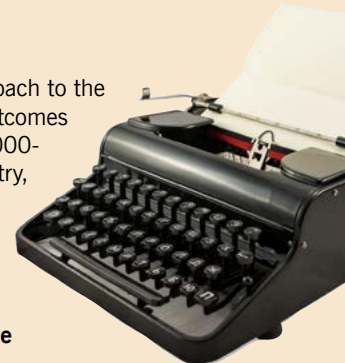
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LER encourages a collaborative multidisciplinary clinical approach to the care of the lower extremity with an emphasis on functional outcomes using evidence-based medicine. We welcome manuscripts (1000-2000 words) that cross the clinical spectrum, including podiatry, orthopedics and sports medicine, physical medicine and rehabilitation, biomechanics, obesity, wound management, physical and occupational therapy, athletic training, orthotics and prosthetics, and pedorthics.

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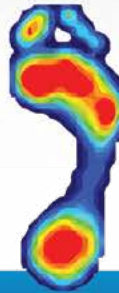


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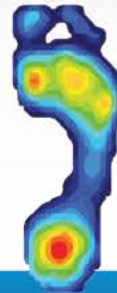
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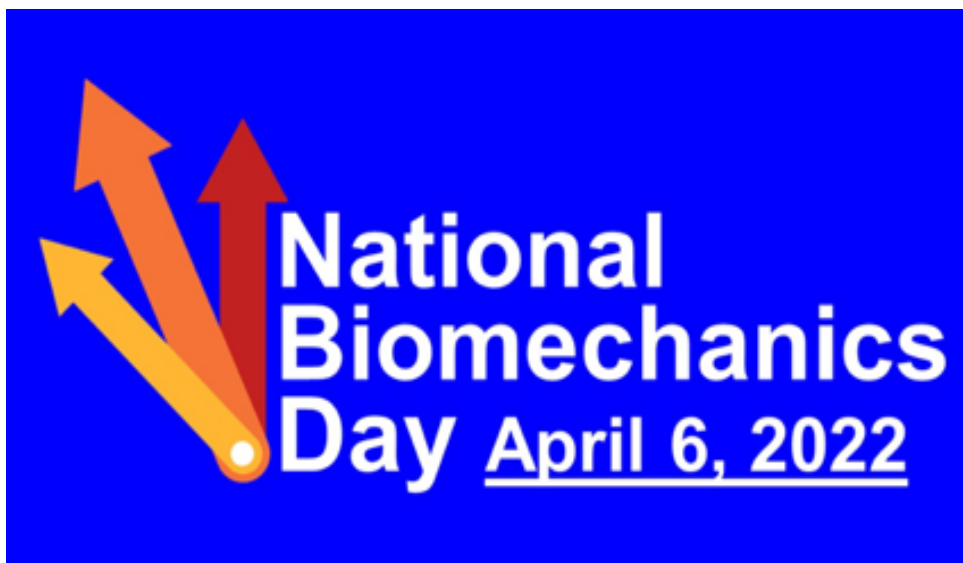
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National Biomechanics Day Is April 6, 2022

BY PAUL DEVITA, PHD, AND FRIENDS

Community engagement, the collaboration between university and community groups, strengthens the connections and the cooperation between these groups. It enables university faculty and students to enhance the quality of life in the community by bringing their knowledge and skills to the general population and it enables community members to enlighten university personnel about the modern directions in which communities are evolving and their current needs to successfully evolve. National Biomechanics Day (NBD) is community engagement that introduces biomechanics to high school students and so broadens the community's perspective about the science of human movement and more importantly, about careers within both biomechanics science and biomechanics application. Noteworthy today for example is the rapidly growing application of biomechanics in professional sports, such as baseball and major league teams hiring biomechanists to work with their players to improve performance and reduce injury risk.

NBD has successfully introduced biomechanics to over 32,000 high school students through 400 biomechanics events around the world over the past 6 years. NBD events involve many people including university faculty and staff, graduate and undergraduate students, as well as high school students, their teachers and parents. All have important roles in a successful NBD and here we present the perspectives of the graduate students who are the heart of NBD events. They demonstrate biomechanics to the visiting high schoolers, relate to the high schoolers because of their similar ages, and inspire the high schoolers to enter college and consider training in biomechanics. Here are biomechanics graduate students from the United States, Australia, Brazil, and New Zealand. In reading these vignettes, we think you'll see the far-ranging passions that drive NBD: Biomechanics, the Breakthrough Science of the 21st Century! And we hope you'll consider joining us.



James Tracy

Doctoral candidate at University of Delaware's interdisciplinary Biomechanics and Movement Science program




Movement is incredibly complex, adaptive, and puzzling. No single scientific focus can explain how everything works, so biomechanics found a way to be more. Biomechanics gathers individuals from different backgrounds—physical therapists, engineers, fashion designers, statisticians, athletic trainers, zoologists, mathematicians, computer scientists, exercise scientists, public policy makers, and more—and helps them work together to find innovative solutions to intricate challenges.

My own academic path highlights some of the range of opportunities biomechanics offers that allow individuals to pursue personal curiosities. I started out analyzing collegiate distance runners' mechanics using laboratory motion-capture equipment. I worked with USA Track and Field for a few years analyzing professional steeplechase performance with high-speed cameras during competitions. I partnered with a group of engineers, statisticians, and exercise scientists doing development and testing for a new product to measure forces in football helmets and athletic shoes. I completed dynamic balance assessments for children with and without cerebral palsy. I explored how adults maintain stability to protect against falling. The only prerequisite to each opportunity was the willingness to learn new things. Biomechanics is inventive and collaborative, and that is what attracted me to biomechanics and keeps me coming back for more.

National Biomechanics Day is an incredible event that showcases the exciting range this field has to offer. NBD is a chance for students to get a glimpse of biomechanics. There is a place within biomechanics for individuals from different backgrounds to chase their interests and flourish. NBD is also an opening for hosts to introduce eager minds to new applications of their

Continued on page 10

intellect. It has been rewarding to interact with NBD participants who start with no prior understanding of biomechanics and see them walk away with personal questions and the beginnings of the tools to answer them. Biomechanics welcomes all to use its tools to answer questions about movement. Whether you're interested in how people walk or athletes perform, how animals climb or catch prey, or how machines adapt to new information or interface with the body, biomechanics is where answers are being sought and found. Someone's path will start at the next National Biomechanics Day. 


Rachel Teater

Doctoral candidate at Vanderbilt University's Center for Rehabilitation and Assistive Technology



My first exposure to biomechanics was in tenth grade when female engineering students from The Ohio State University (OSU) visited my class and presented on their engineering majors. The presentation on biomedical engineering completely captivated me as the student described using math and science to improve healthcare and answer questions about human biology. Later that year, I utilized an assignment to shadow a local professional to ask Ajit Chaudhari, PhD, if I could visit his biomechanics research lab at OSU for a day. This visit exceeded my expectations. I found amazing technology, like force plates and motion-capture cameras, but more importantly, I found people like me—people with an insatiable curiosity to

understand how the human body moves. This early exposure to biomechanics ultimately inspired me to attend OSU, major in Biomedical Engineering, and join Chaudhari's lab as a research assistant. During my undergraduate career, I was able to explore the world of sports biomechanics while contributing to projects studying core stability in runners and ankle instability. This experience confirmed my desire to pursue a career in biomechanics research, but I was curious to learn about other areas in this field. This led me to pursue graduate studies at Vanderbilt University in the Center for Rehabilitation Engineering and Assistive Technology. Here, my focus is lower-limb prosthetics research providing me the opportunity to explore another meaningful area of biomechanics.

Because my introduction to biomechanics came through an event at my high school and then through visiting a local biomechanics research lab, I personally understand the impact that exposure to biomechanics can have on the future trajectory of young students. My personal journey has contributed to my passion and excitement for biomechanics outreach events, such as National Biomechanics Day. Through various interactions with K-12 students across multiple outreach events, I've had the opportunity to enthusiastically explain why I love combining science and math to understand the world around me. These events always reignite my love for this field and improve my ability to explain complicated topics. It is exciting that through outreach events I can perpetuate the early exposure to engineering and biomechanics that I had the privilege of experiencing and, hopefully, also inspire the next generation of innovators to pursue a future in science, math, and maybe even biomechanics! 

Ryan Quarrington

PhD, postdoctoral research fellow at the Adelaide Spinal Research Group, University of Adelaide


Throughout my schooling I enjoyed mathematics and physics, and I had a very keen interest in sports and human movement, so a career related to biomechanics always seemed likely.



However, my university of preference (The University of Adelaide) did not offer a Biomechanical Engineering degree (or similar). So, I enrolled in a brand-new degree that was being offered for only the second year, a Bachelor of Engineering (Mechanical and Sports). This degree comprised all of the core Mechanical Engineering subjects and was supplemented with various health science courses (eg, anatomy, physiology). Toward the end of the third year, I was considering a change in direction, as I wasn't getting enough of a biomechanics fix from this degree. However, during one of the final lectures for the year, we were treated to a guest lecture from Claire Jones, PhD. Jones had recently completed her PhD at the Orthopaedic and Injury Biomechanics Group, University of British Columbia, and had taken a job as the Senior Biomedical Engineer at the Adelaide Centre for Spinal Research. She spoke about the injury biomechanics research projects she had been involved in at UBC, including preclinical models of spinal cord injury and cadaver head-neck impact experiments, as well as the projects she would be assisting with in her new role in Adelaide. I was not previously aware that this area of biomechanics-related work even existed, and I was immediately intrigued! It combined my long-term interest in biomechanics with the design and build, computer programming, and data analysis aspects of Mechanical Engineering that I had thoroughly enjoyed so far in my degree. After that lecture, I contacted Jones to express my interest in doing work placement over the summer, and since then (11 years!) she has supervised my Honours project, my

Continued on page 12



PhD, and now my postdoctoral position. In this time, I have worked across an extremely wide range of biomechanics and biomedical-related projects; from taking real-time measurements of spinal cord CSF pressure in live sheep, to building a drop tower to measure the impact response of human cadaver heads and necks, to designing an instrumented mannequin neck that can provide real-time feedback on head and neck motion during paramedic training, just to name a few. There are so many different aspects of biomechanics that anyone with an interest in the STEM and/or health fields can find a fulfilling area of work! 


Karine JV Stoelben

Doctoral candidate at Federal University of Pampa, Brazil



National Biomechanics Day (NBD) is a fantastic opportunity to bring the attention of high school students to the multidisciplinary pattern of biomechanics. I was inspired by the NBD idea when I received the invitation to join the NBD 2017. My masters' supervisor at that time in the Federal University of Santa Maria in Brazil forwarded an email invitation to organize the event at our laboratory. My instant reply was: "Yes, we must develop this new experiment here." I was so enthusiastic about the NBD event because I only had the opportunity to learn about biomechanics when I was an undergraduate student and was helping a classmate in the development of a biomechanics research project. I subsequently led the organization of 2 NBD events while studying in Santa Maria.

The NBD events helped me realize how much the students love the activities and can understand the wide applicability of biomechanics in their daily lives when they have the opportunity to visit the biomechanics lab. We observed that when students understand the concepts we explained, they quickly understand, connect the examples with their studies, and ask related questions. This experience was gratifying and also helped me to further develop my skills related to public speaking and how to explain complex concepts.

Later, during my PhD program at the Federal University of Pampa in Brazil, I got involved with NBD activities again in 2021. Due to the coronavirus pandemic, we promoted an online event. This new format was challenging for me to provide a biomechanics experience through a screen vision, and not using our lab facilities was tricky. While organizing and managing NBD events, I noticed that anyone can develop a passion for biomechanics. However, what is missing to have more people falling in love with biomechanics is the opportunity to learn about general applications and see biomechanics' daily use, as NBD promotes worldwide. Finally, I realized we can take advantage of NBD to successfully provide real biomechanics experiences for students attending our events. Even though they may not come to the biomechanics area, they certainly will look at daily applications differently and will better understand the importance of science and the importance of Biomechanics, the Breakthrough Science of the 21st Century! 


Roxanne Fernandez

Doctoral candidate at University of Waikato, Te Huataki Waioira School of Health, New Zealand

"Grateful" is how I described my experience in the "National Biomechanics Day" event. As an international PhD student at the University of Waikato, New Zealand, this is one of the highlights of my student life. Despite the current health concerns that we are experiencing, our team was able to execute what we had planned for the event. I was fortunate to be part of the



working committee and be mentored by one of the best in the field, Kim Hébert-Losier, BSC, PT, PhD. It was a learning experience as I was able to see how they (the working committee) work and be inspired by each team member's dedication, commitment, and passion. The event was a fun-filled and informative experience for all the student participants, and they were enthusiastic and curious to try all the activities. For us, it was a great feeling, and we were happy to achieve our goal of at least 50% of women participation supported through a NBD outreach grant.

NBD, by its vision and mission, helps me understand and appreciate my role and purpose as an educator, clinician, and aspiring researcher. It is a reminder of my commitment to the field—to support and convey the importance of biomechanics, especially to the younger generation. As part of my long-term plan, I hope to see the Philippines be part of this worldwide event and help achieve the purpose of National Biomechanics Day and become active synergists in this chain of human movement advocacy. 

Paul DeVita, PhD, is director of the Biomechanics Laboratory and professor of kinesiology at East Carolina University in Greenville, North Carolina. He is past-president of the American Society of Biomechanics and a leader in The Biomechanics Initiative which hosts National Biomechanics Day.

Don't bury your head in the past

The future is far too bright





3D Printing Is Transformative

BY RICH DUBIN, PUBLISHER AND CEO

Three-dimensional (3D) printing is revolutionizing every field it has touched, and orthotics and prosthetics (O&P) is no different. From a business perspective, adjusting a long-standing workflow to incorporate new technology is always daunting. It can be difficult to imagine how it will change things and when the workflow is clinical, understanding how new technology will impact patient outcomes is critical. Doing your homework is invaluable—and you may not have to go far.

Tech manufacturers from around the globe are forging new partnerships with local businesses—and may be closer than you think.

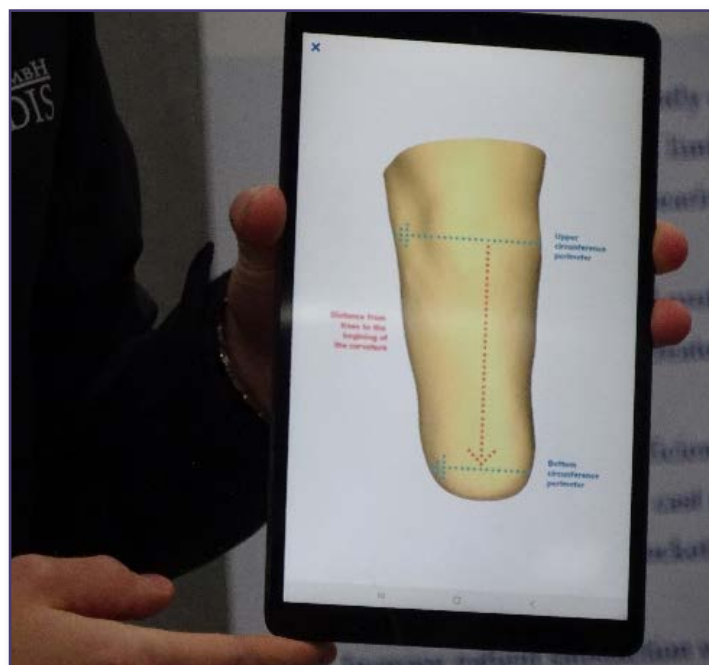
I was recently asked to speak at a local event sponsored by PVA Med in Halfmoon, New York (population 24,500). PVA Med has a system for check socket fabrication that is easy and efficient. Check sockets for prosthetics are

critical to successful patient outcomes. They allow prosthetists to make minute adjustments in the materials and fit of the prosthetic to ensure the safety and comfort of the patient. In the old days, it could take multiple tries to get all of the adjustments made correctly so the fit could be accurate to the residual limb and comfortable for the patient. This often took months. 3D printing is shortening that timeline to mere weeks. And that's a better outcome—for both patients and your bottom line.

The Digital Scan to O-Ply Educational and Networking Event showcased new transformative digital solutions for prosthetic patient care in action. After being welcomed by Tony Hynes, Founder and CEO, PVA Med, and Cissi Schaffer, Director of 3D Printing, PVA Med, event attendees were treated to a captivating presentation from Andreas and Simone Radspieler (the entrepreneurial couple behind

Romedis GMBH) and Matt Doering of Cypress Adaptive (Navesink, New Jersey) on scanning and acquiring the shape with the Symphonie Aqua Digital solution [Romedis GMBH, Neu-beuern, Germany].

The live demonstration of the Symphonie Aqua System in action—scanning a patient and integrated with the PVA Med Rapid Plaster and Emergence PRO 3D printer to create a check socket during the presentation—was the highlight of the event. The Symphonie Aqua System is a hydrostatic system, which utilizes magnetic field tracking (MFT), scans the residual limb in 3D under actual conditions bearing full weight to produce a properly fitting product. The Symphonie Aqua System does not require any external water or power to operate. The demonstration showed how simple the system is to operate and how the model can be modified for a better and more accurate fit



Patient Jim Drzymala (left) stands with his residual limb in the Symphonie Aqua System as the machine creates the digital scan (scan on the right).

Continued on page 10

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Samples of the Symphonie check socket product. Check sockets can be 3D printed in as little as 3–6 hours.




The event was hosted by PVA Med at its state-of-the-art facility in Halfmoon, New York.

using the Rapid Plaster software on a mobile tablet. Local clinicians who attended the event spoke to their experience with the system at their practice and how it greatly improved their efficiency and how they were impressed with the strength and reliability of the 3D printed check socket.

In addition to the demonstration, Hynes led a tour of PVA's new state-of-the-art manufacturing facility, the heart of which served as the stage for the demonstration. When the

tour was complete, we were able to examine the finished WalkStrong Design product (PVA Med's trademarked design). The newly printed check socket was then fitted and demonstrated by Jim Drzymala, a local patient volunteer. He demonstrated how flexible yet strong the socket was and described what he called the incredible fit and comfort of the 3D printed socket compared to casted products he had used in the past. After a brief Q and A, a networking event and dinner was held for all attendees.

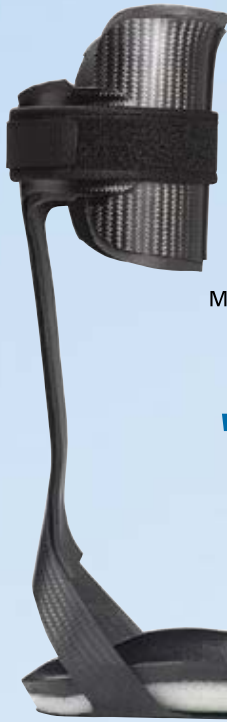
Networking with this group of innovators, clinicians, and tech enthusiasts showed that 3D printing technologies keep improving and these types of events help to take the fear of adoption of these technologies out of the equation. These 3D digital scanning and printing technologies really are transformative: They do truly provide same-day accurate scanning, printing, and properly fitting check sockets. The transformation has arrived. 

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EPSTEIN-BARR VIRUS MAY CAUSE MULTIPLE SCLEROSIS

Multiple sclerosis (MS) is an autoimmune disease that affects the central nervous system. In people with MS, the body's immune system attacks the insulating layer that surrounds nerve cells, often killing the cells.

The underlying cause of MS remains unknown. One possibility is that it's triggered by a viral infection. Epstein-Barr virus (EBV) has been among the top suspects. EBV is a herpes virus that often causes no symptoms. However, in some people it can cause infectious mononucleosis, or mono. After an EBV infection, the virus remains in a latent state within cells and, in some cases, may reactivate. EBV eventually infects about 95% of adults, but very few will develop MS.

To explore whether there is a link between MS and EBV, a team of researchers studied more than 10 million active-duty US military personnel between 1993 and 2013. Active-duty soldiers have blood samples taken every 2 years as part of routine medical screenings. The Department of Defense Serum Repository contains serum left over from these screenings. From these samples, the researchers determined whether—and when—donors were infected with EBV. They tested samples from 801 people who developed MS. They then compared these to samples from more than 1,500 matched controls.

The team found a much higher rate of EBV infection among people who developed MS than among controls. Out of the 801 MS cases, only 1 person tested negative for EBV in their last sample collected before MS onset. The team calculated that people infected with EBV were 32 times as likely to develop MS as uninfected people. The results were published in the journal *Science*.

The researchers found no such association between MS and any other human viruses. This included cytomegalovirus, a virus distantly related to EBV that is transmitted similarly—through bodily fluids.

The team also measured blood levels of neurofilament light chain (NfL), a biomarker for nerve degeneration (see figure). NfL levels increased in people who developed MS compared to those who did not. The increase occurred only after EBV infection and usually before MS diagnosis. This finding shows that the nerve degeneration that accompanied MS did not start before infection with EBV.

The research team, led by Alberto Ascherio, MD, DrPH, from the Harvard T.H. Chan School of Public Health, says that the association between EBV and MS risk was too strong to be explained by any other known MS risk factors. The findings strongly suggest that EBV is part of the chain of events that leads to most cases of MS. However, EBV in itself is not sufficient to trigger MS. Other unknown factors certainly play a role.

“The hypothesis that EBV causes MS has been investigated by our

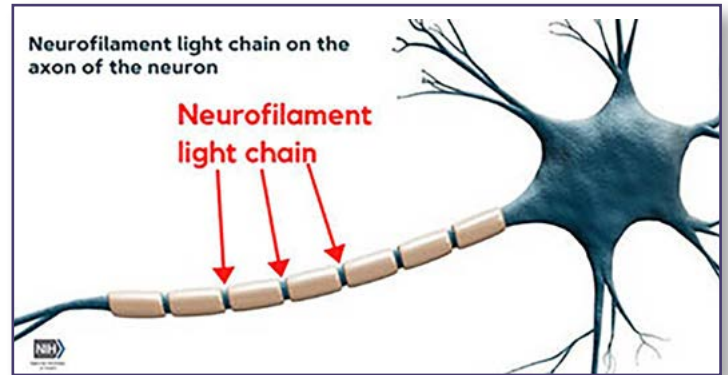


Figure shows location of neurofilament light chain (NfL) on the non-myelinated section of the neuron's axon. NfLs were recently identified as a blood biomarker for nerve degeneration. In the study—“Neurofilament Light as a Biomarker in Traumatic Brain Injury” which was published in *Neurology*—researchers found that serum NfL concentrations highly correlated with cerebral spinal fluid NfL levels, showing that serum NfL reflects CSF NfL. The researchers also observed that NfL concentrations were associated with more concussions and greater severity of post-concussion symptoms after a year. Illustration by Pashtun Shahim, NIH Clinical Center.

group and others for several years, but this is the first study providing compelling evidence of causality,” Ascherio says. “This is a big step because it suggests that most MS cases could be prevented by stopping EBV infection.” [\(ler\)](#)

Written by Brian Doctrow, PhD.

Source: Bjornevik K, Cortese M, Healy BC, et al. Longitudinal analysis reveals high prevalence of Epstein-Barr virus associated with multiple sclerosis. *Science*. 2022;375(6578):296-301.

IMMEDIATE EFFECTS OF FOOT ORTHOSIS GEOMETRY

Foot orthoses (FOs) are used to treat clinical conditions by altering the external forces applied to the foot and thereafter the forces of muscles and tendons. However, whether specific geometric design features of FOs affect muscle activation is unknown. The aim of this study was to investigate if medial heel wedging and increased medial arch height have different effects on the electromyography (EMG) amplitude of tibialis posterior, other muscles of the lower limb, and the kinematics and kinetics at the rearfoot and ankle. Healthy participants ($n = 19$) walked in standardized shoes with i) a flat inlay; ii) standard shape FOs [Salfordinsole], iii) standard FOs adjusted to incorporate a 6mm increase in arch height, iv) and standard FOs adjusted to incorporate an 8-degree medial heel wedging, and v) both the 6mm increase in arch height and

Continued on page 20

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Continued from page 19

8-degree increase in medial wedging. EMG was recorded from medial gastrocnemius, peroneus longus, tibialis anterior, and in-dwelling tibialis posterior muscles. Motion and ground reaction force data were collected concurrently. Tibialis posterior EMG amplitude reduced in early stance with all FOs ($\eta^2 = 0.23-1.16$). Tibialis posterior (TP) EMG amplitude and external ankle eversion moment significantly reduced with FOs incorporating medial wedging. The concurrent reduction in external eversion moment and peak TP EMG amplitude in early stance with medial heel wedging demonstrates the potential for this specific FOs geometric feature to alter TP activation. Medial wedged FOs could facilitate tendon healing in tibialis posterior tendon dysfunction by reducing force going through the TP muscle tendon unit. 

Abstract from: Reeves J, Jone, R, Liu A, Bent L, Nester C. The immediate effects of foot orthosis geometry on lower limb muscle. *J Biomech.* 2021;128:110716. Use is per CC BY 4.0.

AOPA 2022 CALL FOR PRESENTATIONS




The 105th American Orthotic & Prosthetic Association National Assembly is set to take place Sept. 28 – Oct. 1, 2022, in San Antonio, TX. Virtual sessions will follow. The Call for Presentations, which are submitted to pre-identified Workgroups, is now open. Deadline for submission is April 1, 2022. To learn more, visit aopanet.org. 

LER BOARD MEMBER HITS PUBLISHING MILESTONE


David G. Armstrong, DPM, MD, PhD, professor of surgery and director of the Southwestern Academic Limb Salvage Alliance (SALSA),

published his 600th peer-reviewed manuscript in January 2022, at age 52. He becomes the first podiatric surgeon in the history of the specialty to reach this landmark. He reached 500 peer-reviewed manuscripts at age 50. His work has been cited more than 55,000 times. He and his colleagues have become the first podiatric surgeons to publish in a multitude of high impact peer-reviewed journals.



This includes the *New England Journal of Medicine*, *Nature* journals, *The Lancet*, *JAMA*, *Journal of Vascular Surgery*, and *Journal of Bone and Joint Surgery* among many others. *Lower Extremity Review* congratulates Dr. Armstrong for this accomplishment and is grateful for his service as an Editorial Advisory Board member. 

ALTERED GAIT INITIATION FOUND IN EARLY MS

In a study of patients with early-stage multiple sclerosis (MS), French researchers found that early-stage MS strongly affects the motor modulation of stance limb kinetics during the anticipatory postural adjustment of gait initiation, without altering the execution phase. The net muscular moments are sensitive in detecting unobservable balance impairments and can be used to assess disease progression at the early stage. These results suggest that early rehabilitation programs aimed at improving motor modulation and flexibility in gait initiation should be implemented. 

Excerpted from: Massot C, Simoneau E, Peron D, et al. Simplified stance limb kinetics patterns revealed during gait initiation in early stage of multiple sclerosis. Clin Biomech (Bristol, Avon). 2022 Jan;91:105549.

USE OF VISCOSUPPLEMENTATION WITH HYALURONIC ACID IN OA

Osteoarthritis (OA) is a significant cause of disability. Considering the increasing diffusion of the viscosupplementation (VS) with hyaluronic acid (HA), the International Symposium Intra Articular Treatment (ISIAT) appointed a Technical Expert Panel (TEP) to identify the criteria for successful VS with a specific HA in OA; this through a systematic literature review (SLR), performed following the PRISMA guidelines interrogating Medline, Embase, Cochrane Library, Cumulative Index to Nursing and Allied Health Literature (CINAHL), Grey Matters, and American College of Rheumatology (ACR/EULAR) databases and the opinion of international experts. The research included only studies on adults and humans without limitations of language or time of publication. Researchers

Continued on page 23



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extracted both quantitative and qualitative data from each study. Mixed Methods Appraisal Tool (MMAT) was used to perform quality analysis for the level of evidence. The SLR retrieved 385 papers, 25 of which were suitable for the analysis. The TEP focused on the different formulations of the product Sinovial® [HA 0.8%, HA 1.6%, HA 2%, 800–1200 kDa, HA 3.2% (1400–2100 kDa/65–110 kDa)]. The choice was due to the amount of evidence available. The TEP weighed the evidence in 2 rounds of a Delphi survey; the results, and any disagreement, were discussed in a final session. Three domains were considered: 1) the patients' characteristics associated with the best results; 2) the contraindications and the conditions linked to increased risk of failure; 3) the clinical conditions in which VS is considered appropriate. The TEP concluded that VS with HA is safe and effective in the treatment of knee and hip OA of grades I to III and that it is possible to undertake VS in other situations (eg, grade IV Kellgren-Lawrence – KL); a comprehensive examination of the patient should be performed before the procedure. 


Abstract from: Migliore A, Gigliucci G, Alekseeva L, et al. Systematic literature review and expert opinion for the use of viscosupplementation with hyaluronic acid in different localizations of osteoarthritis. *Orthop Res Rev.* 2021;13:255-273. Use is per CC BY 4.0.

OBESITY-RELATED BURDEN OF OSTEOARTHRITIS OF KNEE AND HIP

Osteoarthritis (OA) is a leading cause of disability and a source of societal costs among older adults, especially with an increasingly obese population. Few studies have investigated the burden of knee and hip OA due to high body mass index (BMI). Therefore, this study aimed to systematically summarize the trends of knee and hip OA due to high BMI in China and the USA 1990–2019.

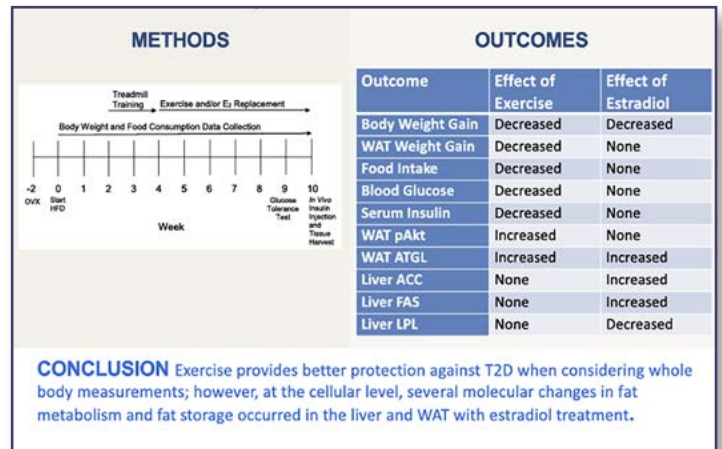
Methods: Global Burden of Disease Study 2019 data were used to estimate age-standardized prevalence, disability-adjusted life years (DALYs) rates of knee and hip OA, and burden of knee and hip OA due to high BMI by sex. Joinpoint regression analysis was used to determine temporal trend changes.


Results: Trends in DALYs rates of knee OA due to high BMI have shown a steady and large increase in China, while USA trends first showed an increase followed by a large decrease 200–2005 and finally a steady increase. Trends in DALYs rates of hip OA due to high BMI have shown a steady and large increase in both men and women in both countries 1990–2019. Age comparison data are also available for both countries.

Conclusions: The burden of knee and hip OA due to high BMI is substantially increasing in China and the USA in recent years. Researchers and health policy makers should assess changing patterns of high BMI on the burden of OA and devise corresponding weight-control strategies. 

Abstract from: Liu M, Jin F, Yao X, Zhu Z. Disease burden of osteoarthritis of the knee and hip due to a high body mass index in China and the USA: 1990–2019 findings from the global burden of disease study 2019. *BMC Musculoskeletal Disorders.* 2022;23:63. Use is per CC BY 4.0.


EXERCISE BEATS ESTRADIOL AT PREVENTING TYPE 2 DIABETES IN RATS



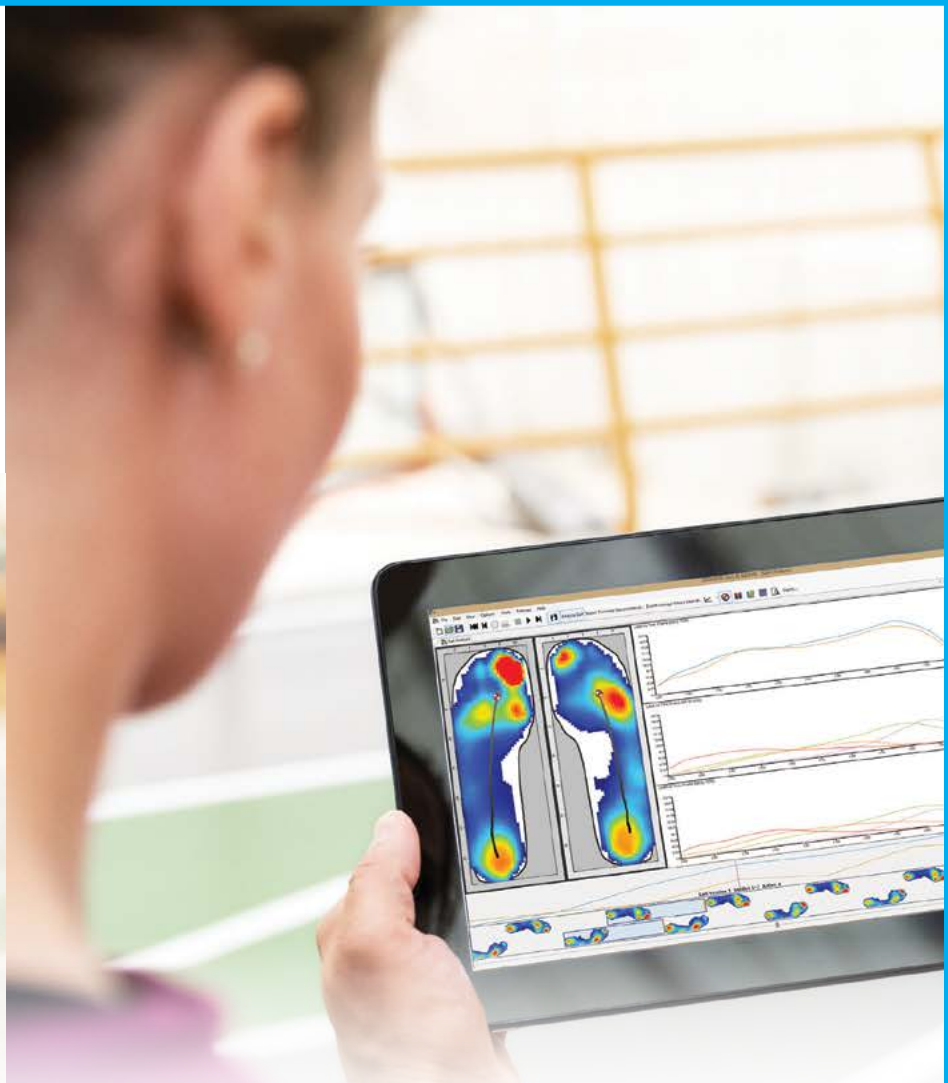
Researchers from Augustana University in South Dakota sought to understand the molecular mechanisms by which estradiol and exercise induce beneficial effects by assessing whole body and cellular changes. They divided a group of female rats into groups—control, exercise (Ex), estradiol replacement, and Ex + estradiol. Only exercise effectively reduced white adipose tissue (WAT) weight gain, food intake, blood glucose levels, and serum insulin levels. 

Used with permission from: Fritsch LJ, McCauley SJ, Johnson CR, Lawson NJ, Gorres-Martens BK. Exercise prevents whole body type 2 diabetes risk factors better than estradiol replacement in rats *J App Physiol.* 2021;131:5:1520-1531.

EXERCISE BENEFICIAL FOR MOVEMENT-EVOKED PAIN

European researchers have published a systematic review and meta-analysis looking at the effects of musculoskeletal rehabilitation intervention on movement-evoked pain. They looked at 38 trials which assessed 60 different interventions. There was moderate-certainty evidence of a beneficial effect of exercise therapy compared to no treatment (SMD=-0.65; 95%CI -0.83,-0.47; $p < 0.001$) on movement-evoked pain in adults with musculoskeletal pain. There was low-certainty evidence of a beneficial effect of transcutaneous electrical nerve stimulation compared to no treatment (SMD=-0.46; 95%CI -0.71,-0.21; $p = 0.0004$). There was no benefit of transcutaneous electrical nerve stimulation when compared to sham transcutaneous electrical nerve stimulation (SMD=-0.28; 95%CI: -0.60,0.05; $p = 0.09$; moderate-certainty evidence). 

Excerpted from: Leemans, L, Poli A, Nijs J, Wideeman T, den Bandt H, Beckwee D. It hurts to move! Assessing and Treating movement-evoked pain in patients with musculoskeletal pain: a systematic review with meta-analysis. *J Orthop Sports Phys Ther.* Epub 5 Feb 2022. doi:10.2519/jospt.2022.10527.



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Obesity Impacts Clinical/Functional Consequences of Knee Osteoarthritis

BY BENJAMIN RAUD, CHLOÉ GAY, CANDY GUIGUET-AUCLAIR, ARMAND BONNIN, LAURENT GERBAUD, BRUNO PEREIRA, MARTINE DUCLOS, YVES BOIRIE, AND EMMANUEL COUDEYRE

These authors found a dose-response relation between body mass index and the clinical consequences of knee osteoarthritis. High physical activity level was associated with low BMI and contributes to preventing the clinical consequences of KOA.

Osteoarthritis (OA) is the most common joint disease and one of the most prevalent symptomatic health problems. Knee osteoarthritis (KOA) leads to knee pain and altered joint function, with socioeconomic consequences. It generates a high proportion of health costs in many countries and has become a major public health issue. The health costs are directly related to KOA, such as knee replacement, or substantially by medication consumption.

In the many studies investigating the risk factors of KOA, overweight and obesity remain the most determinant even though they are considered modifiable. A recent meta-analysis showed a 5-unit increase in body mass index (BMI) associated with a 35% increased risk of KOA (relative risk [RR]: 1.35; 95% confidence



interval [CI]: 1.21–1.51). BMI was positively associated with increased risk of KOA defined by plain radiography and/or clinical symptoms (RR: 1.25, 95% CI: 1.17–1.35) and clinical surgery (RR: 1.54, 95% CI: 1.29–1.83). Another study suggested a longitudinal association between weight gain and increased risk of symptomatic OA. The Framingham study showed an association of decreased BMI by ≥ 2 units at 10 years before examination and 50% decreased risk of OA for women. In another cohort study, a weight loss of $>10\%$ could reduce the clinical consequences of OA, finding a dose–response association between weight loss and pain or articular function.

Overweight and obesity are well known to increase the risk of KOA by mechanical load on weight-bearing joints. However, obesity or metabolic syndrome also increase the risk of hand

OA. Hence, metabolic diseases, such as diabetes or metabolic syndrome, could have systemic effects on joints. A recent meta-analysis reported that type 2 diabetes mellitus may be a risk factor for OA whatever the location. Few studies have explored the association between obesity stage and KOA consequences on disability. A recent study showed that waist circumference could be one of the main risk factors for limiting ambulation speed in adults with KOA.

Regular physical activity (PA) as well as caloric restriction can reduce the clinical consequences of KOA and potentially contribute to weight loss. However, the impact of BMI on level of PA in people with OA is unknown. A recent study measured the level of PA in a normal-weight population versus unhealthy and healthy overweight and obese participants. PA was lower for unhealthy overweight and healthy

This article has been excerpted from “Level of obesity is directly associated with the clinical and functional consequences of knee osteoarthritis” by the same authors, which was published online Feb. 27, 2020, in the journal *Scientific Reports*. <https://www.nature.com/articles/s41598-020-60587-1>. Editing has occurred, including the renumbering of figures, and references have been removed for brevity. Use is per CC BY 4.0.

Continued on page 26

| | Overweight | Stage I | Stage II/III | Total | P value* | | |
|--|-------------|------------|--------------|-------------|-----------------------|----------------------------|-------------------------|
| | | | | | Stage I vs Overweight | Stage II/III vs Overweight | Stage II/III vs Stage I |
| Pain during the last 24 hours (VAS† 0–10), mean (SD) | 4.3 (2.4) | 5.0 (2.6) | 5.2 (2.3) | 4.7 (2.5) | 0.0356 | 0.0462 | 0.7454 |
| Most intense pain during the last month (VAS 0–10), mean (SD) | 6.4 (2.3) | 6.8 (2.4) | 7.4 (1.9) | 6.7 (2.3) | 0.2973 | 0.0329 | 0.2241 |
| Treatment for pain due to OA, n (%) | 139 (65.6%) | 71 (68.3%) | 43 (79.6%) | 253 (68.4%) | 0.9807 | 0.2034 | 0.2286 |
| Other painful joint, n (%) | | | | | | | |
| Lumbar spine | 154 (69.1%) | 80 (72.1%) | 38 (66.7%) | 272 (69.6%) | 0.8967 | 0.4596 | 0.4386 |
| Cervical spine | 129 (57.8%) | 57 (51.4%) | 36 (63.2%) | 222 (56.8%) | 0.1518 | 0.4619 | 0.0939 |
| Hands | 109 (48.9%) | 44 (39.6%) | 29 (50.9%) | 182 (46.5%) | 0.0673 | 0.8041 | 0.2804 |
| Shoulders | 107 (48%) | 60 (54.1%) | 29 (50.9%) | 196 (50.1%) | 0.4979 | 0.9994 | 0.6333 |
| Hips | 68 (40.5%) | 43 (38.7%) | 23 (40.4%) | 134 (34.3%) | 0.1924 | 0.2628 | 0.9281 |

Table 1. Description of pain reported by participants. *Generalized linear mixed models with resorts as a random effect and adjusted for sex, age and number of comorbidities. †VAS: visual (0, no pain; 10, very severe pain).

and unhealthy obese participants than healthy overweight and normal-weight participants. More specifically, a recent meta-analysis found that people with KOA were the least active according to PA guidelines. Other studies of KOA suggest that being overweight or obese is associated with lower quality of life and higher risk of disability and may affect knee joint impact rates and cause incremental pain. Also, overweight and obesity are risk factors for pain in the global population.

Despite obesity being a risk factor for KOA, we have few data on the association of obesity severity and its clinical and functional consequences. This study aimed to describe the association between KOA and BMI gradation in terms of pain, physical disability, level of PA, and fears and beliefs concerning KOA.

Methods

This study is part of a larger cross-sectional study of people with KOA older than 18 years of age that took place in France between September and November 2014 in 9 spa therapy resorts dedicated to OA. Every thermal establishment provided identical care for the patients, and procedures were similar for each center. For each patient, OA was the indication that led to

prescribing spa therapy.

Participants were classified according to their BMI in three groups: overweight (BMI 25–30 kg/m²), stage I obesity (BMI 30–35 kg/m²) and stage II/III obesity (BMI ≥ 35 kg/m²). The groups were compared in terms of pain, physical disability, level of physical activity (PA) and fears and beliefs concerning KOA.

For specifics, see full article at <https://www.nature.com/articles/s41598-020-60587-1>.

Results

Participants: We included 391 individuals with BMI ≥ 25 kg/m²: 223 (57.0%) were overweight, 111 (28.4%) had stage I obesity, and 57 (14.6%)

had stage II/III obesity. BMI groups did not differ by sex, age, OA duration and joint replacement. The mean number of comorbidities was 1.1 (SD 1.1) for overweight people as compared with 2.4 (SD 1.2) and 2.6 (SD 1.1) for stage I and stage II/III obesity groups ($p < 0.0001$). The BMI groups significantly differed in terms of comorbidities for diabetes, hypertension, and anxiety or depression:

- 9.4%, 20.7% and 19.3% of the overweight, stage I and stage II/III groups, respectively, were followed up for diabetes ($p = 0.0094$);
- 34.5%, 51.4% and 56.1%, respectively, reported hypertension ($p = 0.0011$);
- and 14.3%, 18% and 29.8%, respectively, reported anxiety or depression ($p = 0.0236$).

The BMI groups did not differ in terms of renal failure, gastrointestinal bleeding, physical impairment limiting activity, or cardiovascular disease.

According to the Osteoarthritis Research Society International (OARSI) phenotypes, 96.5% of stage II/III participants had polyarthritides with comorbidities profiles, as compared

A weight loss of >10% could reduce the clinical consequences of OA, finding a dose–response association between weight loss and pain or articular function.

Continued on page 29

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| | Overweight | Stage 1 | Stage II/III | Total | P value* | | |
|--|-------------------|-------------------|-------------------|-------------------|-----------------------|----------------------------|-------------------------|
| | | | | | Stage I vs Overweight | Stage II/III vs Overweight | Stage II/III vs Stage I |
| WOMAC function score (0–100), mean (SD) | 36.2 (20.1) | 39.5 (21.4) | 45.6 (18.4) | 38.5 (20.4) | 0.4468 | 0.0115 | 0.0703 |
| IPAQ physical activity level, n (%) | | | | | 0.3770 | 0.0058 | 0.0523 |
| Low | 40 (18.5) | 18 (17.3) | 15 (27.3) | 73 (19.5) | | | |
| Moderate | 75 (34.7) | 46 (44.2) | 27 (49.1) | 148 (39.5) | | | |
| High | 101 (46.8) | 40 (38.5) | 13 (23.6) | 154 (41.1) | | | |
| IPAQ score (MET-min/week), mean (SD) | | | | | | | |
| Vigorous activity† | 2 956.8 (2 388.7) | 2 472.0 (1 945.8) | 2 653.3 (2 679.6) | 2 803.7 (2 297.0) | / | / | / |
| Moderate activity | 1703.2 (1338.7) | 1829.1 (1543.6) | 1100.0 (1010.1) | 1645.0 (1368.6) | 0.8521 | 0.0020 | 0.0035 |
| Walking | 1373.4 (1116.5) | 1357.9 (1261.1) | 942.1 (1001.5) | 1312.1 (1149.6) | 0.4067 | 0.0053 | 0.0403 |
| Total activity | 3627.5 (2926.4) | 3249.7 (2602.3) | 2094.6 (1832.1) | 3292.7 (2745.2) | 0.1617 | <0.0001 | 0.0040 |
| IPAQ time spent sitting (min/week), mean (SD) | 276.5 (141.7) | 283.5 (132.7) | 351.4 (186.2) | 289.8 (149.0) | 0.4970 | 0.0006 | 0.0072 |
| KOFBeQ scores, mean (SD) | | | | | | | |
| Total score | 41.5 (22.7) | 45.9 (23.1) | 52.4 (20.6) | 44.4 (22.8) | 0.1843 | 0.0064 | 0.1248 |
| Activities of daily living | 8.8 (7.7) | 9.9 (8.4) | 12.4 (8.5) | 9.6 (8.1) | 0.3694 | 0.0111 | 0.0874 |
| Physician | 17.1 (10.9) | 19.6 (10.6) | 21.3 (10.2) | 18.4 (10.8) | 0.0921 | 0.0226 | 0.3858 |
| Disease | 7.1 (6.4) | 7.6 (5.8) | 8.1 (5.1) | 7.4 (6.1) | 0.6257 | 0.3474 | 0.6084 |
| Sports or leisure activities | 8.5 (6.3) | 9.0 (6.0) | 10.4 (5.5) | 8.9 (6.1) | 0.5725 | 0.0585 | 0.1841 |

Table 2. Description of WOMAC, IPAQ and KOFBeQ scores. *Generalized linear mixed models with spa therapy resorts as a random effect and adjusted for sex, age and number of comorbidities. †Statistical test could not be used because of small numbers in stage II/III obesity group.

with 90.1% of stage I and 57.8% of overweight participants ($p < 0.0001$).

Pain. After adjustment for sex, age and number of comorbidities, pain intensity during the last 24 hours increased significantly with BMI gradation ($p = 0.0367$) (Table 1). For the most intense pain during the last month, only overweight and stage II/III groups differed significantly. Pain intensity during the last 24 hours was $>4/10$ for 46.8% of overweight individuals versus 60% for stage I individuals ($p = 0.0493$) and 65.5% for stage II/III individuals ($p = 0.0343$). Overall, 79.6% of participants with stage II/III obesity reported receiving treatment for pain due to OA versus 68.3% and 65.6% of stage I and overweight participants ($p = 0.4199$).

Participants reported another painful joint (Table 1), with no significant difference between groups.

Multiple-joint OA was reported by 91.5%, 90.1% and 96.5% of participants in overweight, stage I and stage II/III obesity groups, respectively.

Physical disability. [Based on Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) function scores] the BMI groups significantly differed in physical disability ($p = 0.0409$). The stage II/III obesity group was significantly more impaired than the overweight group ($p = 0.0115$).

Physical activity level. Using the short form of the International Physical Activity Questionnaire (IPAQ), we estimated continu-

ous scores in metabolic equivalent minutes per week (MET-min/week) for vigorous, moderate, walking and total activity, as PA level (low, moderate or high). The IPAQ PA level and continuous score are described in Table 2. The PA level significantly differed among BMI groups ($p = 0.0219$). The proportion of participants with low and moderate PA level increased with BMI gradation and the proportion with high PA level decreased with BMI gradation. The BMI groups significantly differed by IPAQ continuous scores in MET-min/week: moderate activity ($p = 0.0051$), walking ($p = 0.0201$), and total activity ($p = 0.0002$). The walking and total activity continuous scores decreased with BMI gradation. Time spent sitting significantly differed

Continued on page 30



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Continued from page 29

among groups ($p = 0.0025$). The IPAQ moderate activity, walking and total activity continuous scores, such as time spent sitting, significantly differed between overweight and stage II/III obesity groups and between stage I and stage II/III obesity groups.

Fear and beliefs concerning KOA. Using the 11-item Knee Osteoarthritis Fears and Beliefs Questionnaire (KOFBeQ), five scores were estimated: a total score and 4 sub-scores for fears and beliefs about activities of daily living, physicians, disease, and sports and leisure activities. Higher scores indicate greater fears and beliefs; these are described in Table 2. The total score, daily activity score and physician score significantly differed among BMI groups ($p = 0.0204$, $p = 0.0389$ and $p = 0.0413$, respectively), with significantly higher scores for the stage II/III obesity group. The disease and sports or leisure activities scores did not differ between groups.

Discussion

This study describes the clinical consequences of KOA severity in a KOA population by level of obesity. We found a graded relation between obesity stages and clinical consequences of KOA. Indeed, the results showed a progressive increase between degree of obesity based on BMI and clinical consequences. Participants with higher BMI had higher pain scores, were more disabled, and reported more often anxiety and depression, which agrees with previous studies. In addition, the higher the obesity stage, the less the participant performed PA, which increases the risk of leading a sedentary lifestyle.

The relationship between obesity severity and OA onset has been largely described in the literature. But to our knowledge, this is the first study to describe the clinical consequences of KOA by degree of obesity. Indeed, most studies have determined these two components in all obese people but not by BMI category. Thus, given the size of our sample, we could distinguish overweight individuals from those with grade I or II obesity and higher. Another strength of this study is the amount of data collected. Indeed, a large number of clinical variables were analyzed, which provided a broader picture when assessing daily life consequences on KOA.

The three obesity groups did not differ in location of pain. These findings agree with the hypothesis of a “chronic micro-inflammatory state” that in conjunction with weight could play a major role in the initiation and perpetuation of OA. Weight loss would be the best way to decrease chronic inflammation by reducing inflammatory mediators and also reduce mechanical load on bearing joints. Individuals with high BMI are at increased risk of metabolic syndrome, which is based on the co-occurrence of multiple risk factors (hypertension, high lipid levels) or type 2 diabetes mellitus or coronary heart disease. Insulin resistance and micro-inflammation play a role in the development of chronic lesions. Micro-inflammation involved in the initiation and perpetuation of KOA is linked to level of insulin resistance, and insulin resistance is associated with the location and proportion of fat mass. Losing fat mass could play a major role in decreasing this micro-inflammation and reducing the

clinical consequences of KOA.

We found the same gradual response between BMI and VAS pain score in the last 24 hours, which suggests higher pain for people with severe obesity and lower pain for overweight people. This finding may explain why weight loss may be directly associated with pain level and that the strategic approach to decrease pain could allow individuals to do more exercise. A recent study showed that in women with OA, disease-related pain was positively associated with cortisol production, particularly with greater pain intensity. Pain is a potential stressor and activator of the hypothalamic-pituitary-adrenal axis, which has been related to increased visceral obesity.

Strategies to control pain is a great part of the therapeutic proposition because it is a barrier to weight loss and PA. The psychological impact of obesity can be a barrier to PA and associated with severity of obesity. It could explain the association between BMI and the frequency of reported anxiety or depression. Strategies to increase the level of PA cannot be the same with different psychological profiles, which emphasizes the need for personalized medicine.

PA or rehabilitation is widely recognized as one of the first non-pharmacological lines of treatment for OA and is recommended for all patients. This study demonstrated that disability in patients with KOA, based on WOMAC function score, was associated with severity of obesity. With increasing obesity stage, OA increasingly led to altered function, thereby reducing the amount of PA performed, even though PA helps to improve function. Proposing PA as the first treatment aims to decrease fat mass, increase insulin sensitivity and decrease pain and micro-inflammation. However, we cannot expect severely obese individuals to do the same amount of PA as other people because they require psychological reinsurance. We found presence of anxiety and depression associated with BMI severity. This mental association with BMI severity should be more explored in future research, using validated instruments such as the Hospital Anxiety and Depression Scale (HADS) that evaluated the severity of anxiety and depression symptomatology. Obesity severity might be a stress factor recognized as a cardiovascular risk.

Concerning the representativeness of our sample, the individuals we studied are representative of samples studied in the literature and because of the high number of participants (n = 391), many different phenotypes of KOA were included. Indeed, the mean age was 67.3 years, and 71% were women. The mean WOMAC function score was 38.5. Our population was close in terms of age, sex and function to the 915 patients in the Tubach et al study.

Conclusion


We found level of obesity directly associated with clinical consequences of KOA, with a gradual dose-response relation by increasing BMI. High PA level was associated with low BMI and contributed to preventing the clinical consequences of KOA. The role of body fat mass in terms of clinical benefits of PA could be studied. (ler)

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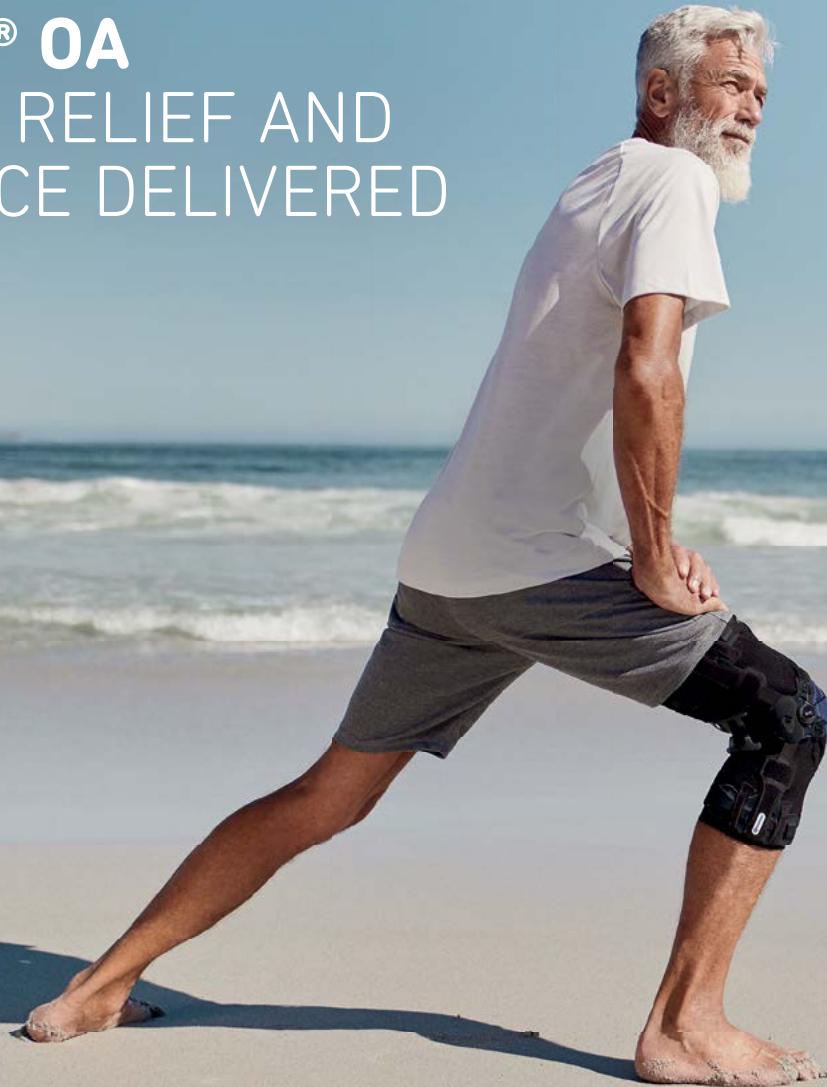
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AGENDA (CHECK BACK FOR UPDATES)

- SURGERY: MIS Bunionectomy
- SURGERY: The Role of Foot Function and Biomechanics After Surgery?
- BIOMECHANICS: Biomechanical Assessment & Orthotic Prescription
- BIOMECHANICS: How Do Foot Orthoses Work
- BIOMECHANICS: Longitudinal Arch Load-Sharing System of the Foot
- BIOMECHANICS: The World of Science is Staring Up at Us
- POD MED: Limb Salvage Expert Panel Discussion
- POD MED: Onychodystrophy Is NOT Always Onychomycosis - Best Practices for Testing and Treatment
- POD MED: How to Manage the “No Option” Patient with PAD
- POD MED: Billing Hurdles for AFOs and Therapeutic Footwear
- POD MED: Gout Arthritis - The Time is Now for Remission and Cure
- POD MED: Oral ABX for Management of Osteomyelitis
- WOUND CARE: Didn't Heal - Recognizing Barriers to Wound Healing
- WOUND CARE: The ABCSS System for Chronic Wound Management: A New Acronym for Lower Extremity Wound Management
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BY KEITH LORIA AND JANICE T. RADAK

Osteoarthritis (OA) of the knee is a progressive disease caused by a breakdown of joint cartilage and ultimately, the underlying bone. The cartilage of a joint can become thin, cracked, and frayed, allowing the bones of the knee to rub together, which can lead to pain, inflammation, and stiffness. Therefore, people diagnosed with knee OA often become less active, which leads to physical deconditioning and loss of strength. So, keeping patients active is a fundamentally important component of managing knee OA.

Today, nearly 24% of the U.S. population has knee OA (more than double the number in 1940), and that is expected to increase to nearly 50% by 2040, making knee OA a major public health burden.

At a recent lerEXPO educational event, “Keeping Knee OA Patients Active,” sponsored by Bauerfeind, a trio of authorities in the field offered a comprehensive overview of relevant modalities that can impact patient care and play a positive role in keeping patients moving, thereby increasing their overall quality of life.

The symposium showed how regular exercise and physical activity can help maintain and increase strength, endurance, and range of motion for OA patients. Selected highlights are presented here.

The Orthopedic Surgeon’s Perspective

Michael Oberlander, MD, FAAOS, chief medical officer at Boston-based FIGUR8, Inc., delivered a talk on the pathology, pathophysiology, diagnosis, evaluation, and myriad treatment options for this common condition. He also discussed both prescription and over-the-counter drug therapies and recent recommendations from the American Academy of Orthopedic Surgeons.

The sports medicine specialist noted that orthopedic surgeons often see patients in the later stages of knee OA, so fewer options are available, and surgical treatment is more the



norm than the exception. Oberlander focused his talk on conservative treatments of knee OA and what can be done before patients get to those end stages.

Emphasizing the conservative treatment, Oberlander added it’s very important to educate patients on the importance of low-impact exercise, weight loss, and biomechanical aids, such as walking sticks.

“Our goal in conservative treatment for our patients is really to keep them active and keep those joints moving,” he said. “You want to keep them limber with low impact exercise, so biking, hiking, sometimes using assisted aids like walking sticks. There’s also Pilates, yoga, and pool exercises, which significantly decrease the stresses on the joint and are really quite therapeutic as well.”

“We really want to individualize our treatment with our patients,” he said. “We want to talk to them about weight loss as that makes a significant difference in terms of joint longevity and preserving the articular cartilage and decreasing their pain level.”

He acknowledged the challenge of talking about weight loss with patients who have a body mass index over 25 and are considered obese. “A lot of our patients are significantly overweight—30 pounds, 50 pounds, even 100 pounds plus,” he said. “You can’t really talk about losing large amounts of weight. So, I like to talk about what does your joint see?”

He tells patients that excess weight can add excess pressure to the knee joint, depending on the activity:

- Contact pressure is 3–7 times non-weight bearing pressure
- Squatting and kneeling add 7 times
- Stairs can add 5 times

“So, a 10-pound weight loss is like taking 30–70 pounds of pressure off your knees. Patients get this message and often report back on what they notice.”

For patients who remain physically active and even athletes, bracing can be an option. Key challenge is they must be worn correctly and consistently. “If [braces] slip and they are not in

Continued on page 36

As clinicians, we need to recommend low to moderate impact loading exercises as well as proper exercise, lower sets, meaning a little bit more repetition, lower weights, and doing more body weight types of activities.

place, they're not going to be helping. But in the right patient population, they are very effective. For patients who want to increase their activity level, that unloader brace can be life saving for them in terms of saving their golf game."

By using patient-reported outcomes, Oberlander noted it's easier to follow patients longitudinally, deciding when the conservative management is no longer helping, and knowing when it's time to send them to orthopedic colleagues for surgical options.

"Start with the simplest [treatments] and least expensive and get more complex as you progress through this disease along with your patient," Oberlander said.

The PT's Perspective

Kevin E. Wilk, PT, DPT, FAPTA, associate clinical director of Champion Sports Medicine in Birmingham, AL, looked at conservative treatment modalities clinicians should consider for short-term symptom relief as well as mid-term management strategies to keep knee OA patients active. In general, he noted that cycling, which loads only 1.2 times body weight (BW), can be a nice alternative. The pool is another option, he said, adding that waist-deep water is only 50% BW and water to the shoulders is only 25% BW, making both options extremely joint friendly.

"There's also a new unloading treadmill," he said, explaining that it was comparable to running in waist-deep water. He also likes the elliptical (2.2x BW) and rowing (0.85 BW).

Wilk compared different patients with articular cartilage defects, detailing how treatments varied for

- a 37-year-old recreational skier who works

in the kitchen of a restaurant and has had anterior cruciate ligament reconstruction, a meniscus debridement twice, and articular cartilage procedures

- a former NFL player who suffers from lateral compartment problems
- an 18-year-old soccer player in college with no previous knee injuries or pain, who was diagnosed with a meniscal tear.

The question becomes, "Is surgery indicated?"

"There are numerous studies that have looked at the long-term effects of articular cartilage defects, and it's a mixed bag," Wilk said. "Some people do very, very well without any type of intervention, and others have some significant problems."

The challenges with articular cartilage procedures, he noted, are myriad: slow healing potential, pain with loading, and a long duration for recovery. Add in that few patients use crutches for the 6 weeks as directed, which leads to more consequences.

"As clinicians, we need to recommend low to moderate impact loading exercises as well as proper exercise, lower sets, meaning a little bit more repetition, lower weights, and doing more body weight types of activities," he said. "Coping skills and strategy to control pain, and a positive attitude—all those have been shown to be very beneficial for the OA patient or the rheumatoid arthritis patient as well."

Of course, he stressed that leading an active lifestyle is paramount to long-term success with knee OA patients.

"People often say, 'I can't do this because my knee hurts,' so we have to find a level of

activity that they can do with minimal to no discomfort," Wilk said. "If running hurts, then walk. If walking hurts, cycle. But we want to keep the joint moving. Motion is lotion for the joint. It helps stimulate articular cartilage over the articular surfaces and low-intensity, long-duration exercise is extremely beneficial."

"We want to promote healing, but we don't want to overload," Wilk said. "We don't want somebody to have a stiff joint as stiff joints don't do very well. So, we want people to stretch and gain motion and get extension and flexion back. We also want to have good hip, foot, and ankle range of motion."

Wilk said he has had success with unloading braces in his patients with articular cartilage issues. Patients have reported improved knee function, reduction of pain, and increased activity. His patients have also found medial

Benefits of Braces For Knee OA

"The benefit of bracing is always higher than the risk score," said International Trainer Torsten Krapf, PT.

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pain symptom relief with lateral heel wedge orthotics—something he noted there is evidence to support.

The challenge with braces, he noted, is that patients don't like to wear them when they don't fit properly, so fit is critical. He noted that you have to work with the patient: "I tell them, 'You don't have to wear it all the time, wear it for long walks or hiking; but when your knee is feeling fine, put the brace aside until the next activity.'"

"I find that braces help keep patients in the zone of function," Wilk said.

Principles in OA bracing

Torsten Krapf, PT, an international trainer for Bauerfeind, offered insights into the use of bracing—as both a rehabilitative and preventive tool for patients with knee OA, because maintaining motion is important for quality of life.

"Braces are an addition, not a replacement," he said, for rehabilitation and muscle strengthening. "Several published studies show

that with the help of corrective forces introduced from the outside, the abduction moment in the knee joint could be reduced. This relieves the knee joint during movement."

The relief from OA braces, he continued, leads to a clinically relevant, "moderate" improvement in pain perception and the functionality of the patient's knee joint. "When you decrease pain, the patient can increase activity."

Once they start wearing a brace, the patient will say, "I can feel it right away, this helps a lot," Krapf said. "For long-term use, braces must provide more comfort without sacrificing the mechanical offloading effort."


Krapf discussed different types of braces (support sleeves, hinged, single upright, double upright) that can provide symptom relief for OA patients, as well as the pros and cons of different technology concepts from a product development standpoint. He also discussed the process used by the international development team that worked on Bauerfeind's GenuTrain, GenuTrain S, and GenuTrain A3, which he not-

ed are proven to relieve OA pain and improve knee stability while their anatomical shape and donning aids make them easy and comfortable to wear.

Krapf, like the prior speakers, emphasized that proper measuring and fit accuracy of the brace is very important for a strong outcome.

"Braces can increase the mobility for patients," Krapf said. "It will increase muscle strength, but only if people do their exercises."

To Learn More...

This article presents only highlights of "Keeping Knee OA Patients Active," a 2-hour, 2.25 CEU educational event. To hear all 3 presentations in full, visit lerEXPO.com; go to EVENTS in the top menu and scroll down to "Keeping Knee OA Patients Active." 

Keith Loria is a freelance writer in Washington, DC. Janice T. Radak is editor of Lower Extremity Review.

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Case reports should be no more than 1500 words (not including references, legends, and author biographies). Photos (≤ 4) are encouraged. Case reports can include a literature review as is appropriate for the topic. (Please note that for HIPPA compliance, photos should be de-identified before sending.)

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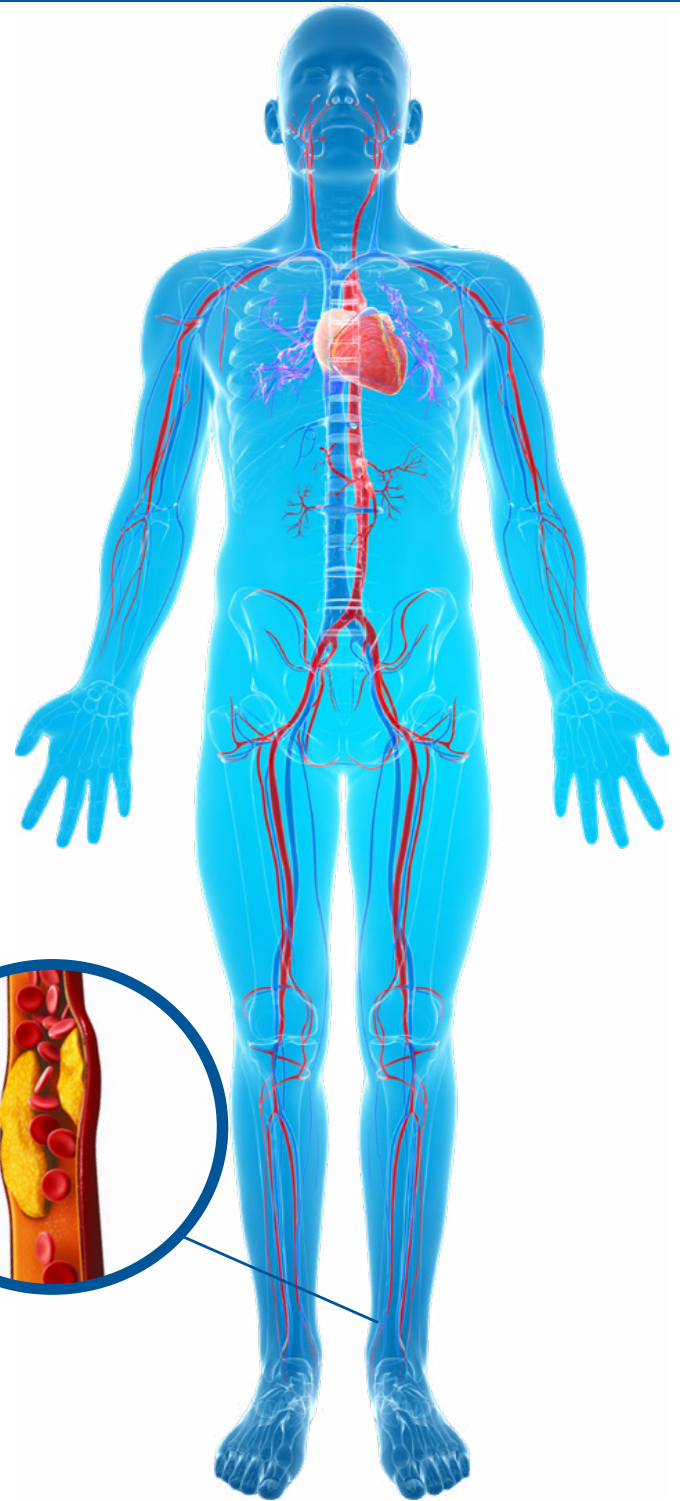
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BY WINDY COLE, DPM, CWSP

“Science is curiosity, testing, and experimenting.”

Venkatraman Ramakrishnan

Wound healing as a clinical specialty has evolved over the past 2 decades. The importance of wound care research in this emerging area of medicine cannot be overstated. Wound care research must continue to be conducted to facilitate the development of effective treatment protocols for patients suffering the numerous sequelae associated with chronic wounds. Wound management remains an area of medicine where advance practitioners play a key role in providing care and making decisions. It is therefore reasonable to believe that wound care clinicians of all backgrounds should also be active participants in wound care research. This article will detail the initial steps in developing a research proposal including determining a hypothesis and selecting the design of the study.

Designing and executing experimental studies requires attention to detail. The process starts with a good research question. The best research questions are those that are simplistic and focused. How do you come up with a good research question? Often research questions arise from a specific clinical problem or unusual patient case. Sometimes questions arise due to an interest in a new product or technique that might add benefit to patient care. All that is needed to begin is curiosity.

Once you have decided on your hypothesis the next step is to determine your study design. In this relatively young clinical specialty, there are a number of patient care needs that require investigation. Various research designs can be considered. Common types of trial designs include case studies, surveys, non-comparative studies, and randomized controlled trials (RCT). When considering the type of trial you would like to perform, it is important to consider the number of potential subjects available to participate and the potential implication of the study. A thorough



literature search should also be conducted prior to determining the study design so that you may familiarize yourself with any previous research conducted on the subject matter.

Case Studies: Case studies are a great way to evaluate new dressings or devices. This type of trial can help determine the product efficacy in a certain patient population or wound type. Collecting data on patient satisfaction, unexpected side effects, and overall ease of use are examples of information that can be collected by means of case studies. While case studies are a good first step, often these trials do not provide enough evidence to make definitive conclusions based solely on the study outcomes.

Surveys: Surveys can be a helpful tool to measure the relationship between clinical intervention and patient behavior, tolerance, or outcomes. Surveys are often part of a larger trial design and can be used to determine product usability or to measure changes in patient quality of life. Information collected from survey data often influences the planning and design of additional studies.

Non-comparative Studies: Non-comparative studies follow a small cohort of patients receiving a specific intervention for a predetermined series of weeks. There is no control group in these types of studies. Often the focus of non-comparative studies is on new treatments or

new indications for established therapies. In the process of developing novel treatments, it is common to perform a series of studies to obtain more information about the proposed new therapy. These studies are performed as a pilot to study a particular hypothesis prior to initiating a larger randomized controlled trial.

Randomized Controlled Trials (RCTs): Widely accepted as the ‘gold standard’ of clinical research, RCTs are a powerful tool to evaluate new wound care treatments or methods. RCTs provide what is commonly referred to as Level 2 evidence. Level 1 evidence is achieved only after multiple RCTs are performed on a particular intervention. RCTs test a large number of patients to determine the effects of a therapy and compare the results to a group of subjects not receiving the treatment (control). Subjects are randomly assigned into either group thus decreasing study bias. Because of their empirical rigor, RCTs are the study design of choice and widely accepted throughout the scientific community.

Start With a Poster Abstract

Participation in wound care research allows clinicians to contribute to robust and meaningful evidence-based treatment algorithms that will drive patient outcomes. I encourage all providers interested in becoming more involved in research to start by submitting a poster abstract for an

Continued on page 42


upcoming scientific symposium. Abstracts are typically due several months (see box) before a meeting to allow time for peer review, so be sure to plan accordingly. Submitting a poster abstract is a great way to get involved with research. Here are some simple tips to keep in mind when preparing your abstracts.

Guidelines for writing an abstract

1. Introduce the topic—what is the focus of the poster?
2. State the problem—what is the question being addressed?
3. Summarize why the problem exists—briefly summarize a review of the literature. Describe any shortcomings in previous research on this topic.
4. Explain how the research question was answered—what experiments or testing was done? What parameters were measured and by what means? How was data collected?
5. What were the findings—how was data compiled and analyzed? State the statistical method if applicable.

Sample Abstract Deadlines

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| American Orthopaedic Foot & Ankle Society | Sept. 14-17, 2022 Quebec City, Canada | March 7, 2022 |
| American Orthotic & Prosthetic Association | Sept. 28-Oct. 1, 2022 San Antonio, TX | April 1, 2022 |

6. What is the impact of the research—why should others care? How can this information influence clinical procedures or algorithms of care? 

Windy Cole, DPM, CWSP, is an adjunct professor and Director of Wound Care Research at Kent State University College of Podiatric Medicine. Dr Cole also serves as the National Director of Professional Development and Clinical Education for Woundtech. She is board certified by the American Board of Foot and Ankle Surgery and the American Board of Wound Management. She has been a dedicated wound care advocate for two decades with interests focused on medical education, diabetic foot care, wound care, limb salvage, and clinical research. Her passion to help others has led her to participate in humanitarian efforts around the world. Dr. Cole has published

numerous peer-reviewed and industry articles on these topics and is a sought-after speaker both nationally and internationally. She is an Editorial Board member of Wound Management and Prevention, Podiatry Today, The Foot Journal, and Lower Extremity Review. She is also the Podiatry Section Editor for the ePlasty Journal. She is a wound care advocate on the forefront of wound research and was the 2020 World Union of Wound Healing Silver Medal Award recipient for her work in Technology-driven Research. She sits on the advisory board of multiple emerging biotech companies and has been integral in collaborating on innovative research protocols in the space.

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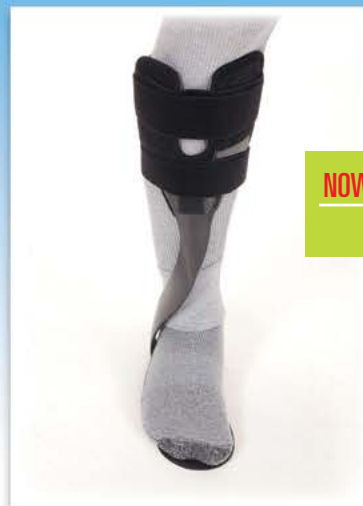


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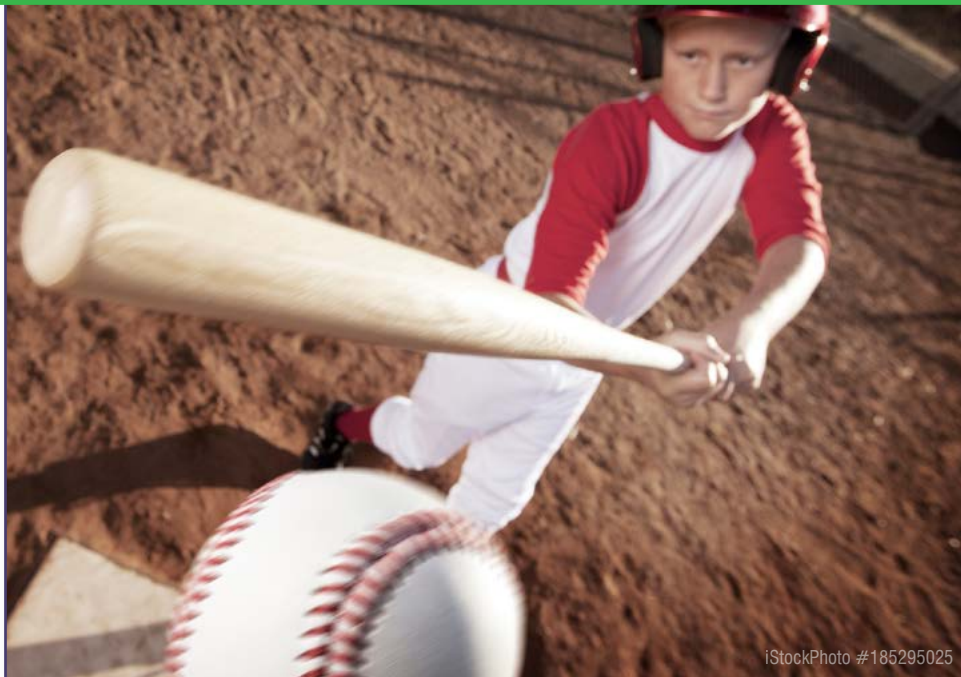
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BY DR. PETER GORMAN

As winter training slowly comes to an end, athletes eagerly await the start of a new season. Nowhere is this more apparent than in the sport of baseball. The Boys of Summer are once again ready to set new records and, hopefully, replace any previous disappointments with cheers and thrills. This goal of achievement relies heavily on the premise that the winter training program was fundamentally sound and efficient in correcting weaknesses and forging new strengths.

To do that, the winter training program has to realize that, like most sports, baseball is a true agility sport, which means that every movement on the field is decision-based. This requires not just great physical ability, but also great cognitive ability. Decision-based movement requires RADAR—it requires the athlete to (see Figure):

- **Recognize:** The ball was hit left, but the athlete must *recognize* that the ball was hit left, or the pitch is coming. *Recognition* starts the process—our mental engagement begins with recognition of the stimulus.
- **Attend:** Once the stimulus is recognized, the athlete must *attend* to it. This is the “think” part of the game. The athlete observes the target in motion, predicting where it is headed. The ability to do this is, arguably, more important than any physical attribute.
- **Decide:** The athlete attends to the stimulus while suppressing any distractors (no room to start right and then go left as too many moments would be wasted), and then *decides* what action is the right response.
- **Accept:** Once decided, the athlete’s mind and body must *accept* that decision by having the brain tell the body what to do.
- **React:** Once the decision is accepted, the athlete must now move and *react* to it. Yes, reaction is physical, but it is based in



a cognitive process. The efficiency of the athlete’s cognitive process, from *recognition* to *reaction*, is known as the athlete’s Speed of Processing (SOP).

How many coaches or trainers know the actual SOP of their players? It is amazing that terms like “bat speed,” or “exit velocity,” or “60-yard time” are thrown around with oohs and aahs. If we do not know the athlete’s SOP, then the fastest bat speed or 60-yard time might just be a wasted statistic. Remember, SOP is the time between recognition and reaction. If SOP is slow, then reaction is slow. If reaction is slow, then the athlete plays slow, and slow is often too late. Fast bat speed, but slow in pulling the trigger...you are out. Fast 60-yard time, but the athlete is slow to react to the pitcher releasing the pitch...you are out.

The Functional Movement Screen (FMS) states this very clearly: “First move well, then move often. Moving well speaks to quality of movement and speed of processing (cognitive function). While moving often is not simply quantity but rather the capacity and adaptation that allow brain and body to function cohesively

and optimally for life and sport.”

An efficient winter training program must understand the importance of cognition and must be able to evaluate and correct any physical imbalances. It is well understood that all position players must be able and agile in all directions. Speed of left leg must equal speed of right leg. Left-to-right acceleration must equal right-to-left acceleration. Anything less than this would create a favored side, and the need to compensate. How erroneous would it be to tell a player he has better range in a given direction, without giving him the reason and the way to fix it?

Training the Boys of Summer

Just before the pandemic, I had the privilege of working with a baseball team of 9-year-olds from my hometown of Mahopac, NY. I say *privilege* because, in my 37 years of sport science, I have had many professionals, Olympians, and World Champions come through my doors. The dedication these 9-year-olds showed to learning and developing was second to none.

My job was to oversee their training. At

Continued on page 46

our first team meeting we discussed 3 important facts:

- **Correct Imbalances.** Physical evaluations would be aimed at correcting weaknesses and imbalances. An athlete is only as strong as the athlete's weakest link. Fix weaknesses before developing strengths. This eliminates the need for the athlete to compensate. Train the true athlete, not the compensatory process.
- **Train SOP.** A fastball can reach the plate in 400 milliseconds, and the time to swing is approximately 175 milliseconds. This leaves only 225 milliseconds to recognize, attend, and react to the pitch. It was decided to train every athlete's SOP to faster than 200 milliseconds...quite a challenge for ballplayers of any age and ability.
- **Team First.** Every athlete has a unique set of strengths and weaknesses. Help your teammate first, and create bonds that will last forever.

Once the rules were set, we agreed on a team statement: "Maybe no one on the team will make it to Major League Baseball, but one thing is for certain, every athlete one day will graduate from the minor leagues of childhood to the major leagues of adulthood. Let's help each other be the best at this." As a USA Baseball contributor, a BareFoot Science board member, a certified Microgate trainer, and a certified BrainHQ trainer, I made sure each child was evaluated and trained according to their standards.

The incredible gold standard USA Baseball evaluation was performed for each athlete. This included:

- Game speed accelerations to determine the leg speed of each athlete, and the athlete's accelerations (both right and left).
- Broad jump, not just along a tape measure, but in a modular OptoJump system so that contact time could be measured. This provided a reactive strength index so that we could ensure that, with training, each athlete's flight time was improving while

their contact time was going down.

- DRIFT protocol by Microgate was performed so that the power, contact time, and most importantly, dynamic control of each leg of the athlete could be recorded in a series of 5 unilateral jumps.
- Physical reaction time was recorded by pairing a Microgate WITTY SEM countdown system with WITTY timing photocells to produce results accurate to a millisecond.
- Gait testing, both shod and barefoot. This gave the examiners the ability to make sure that each athlete's sneakers were actually helping to reduce or eliminate any asymmetries in the movement cycle.

We tested true agility by using Microgate WITTY Semiphores in a 4x4 box at 2 different levels of cognitive load. Total times were recorded and compared under each cognitive load. Any slowing of physical movement due to increased cognitive load was then baselined.

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By employing validated published tests from BrainHQ.com, actual brain SOP was recorded for each athlete to show double decision, eye for detail, and single-decision ability. This is where we recorded the greatest changes in athletic ability. At the beginning of the program, average SOP was approximately 600 milliseconds for each athlete. At the end of 12 weeks of training, average SOP improved to a super-fast 86 milliseconds. During the last week, we recorded an almost unbelievable average sub-32 millisecond brain speed. These kids are now “seeing” everything. Remember what we said before, you need at least 200 milliseconds to see and attend to the fastball. The hitting coaches noticed the difference on the field. They reported that the athletes were understanding and picking up the ball sooner, and their sense of game was becoming clearer, which is a big advantage when called on to bat. Of great importance was the fact

that BrainHQ allowed us to track each athlete’s cognitive ability. If, at any time, an athlete’s SOP slowed, questions were immediately raised about rest and fatigue. This same understanding of SOP could be applied to contact sports where words like “CTE” and “concussion return to play” still prevail at an alarmingly high rate. Monitoring SOP has to be standard procedure for all.

The BFS Science lab was used extensively, employing the 6 Absolutes (see box) at all training stations, both static and dynamic and the balance protocol was performed and monitored for each athlete. This ensured improved balance over time, and the avoidance of overtraining. The Absolutes were combined with FMS corrective movements through all arcs of motion and the emphasis was always on train the true athlete, not the compensatory process. We used a slant board to make determinations of strengths and weaknesses for each position of the foot strike. Proprioceptive ability was monitored to ensure improvements in Ground

Contact Time (GCT). Eleven of the 12 athletes initially displayed proprioceptive or balance deficits. These players were fitted with non-orthotic proprioceptive based inserts from the Barefoot Science Foot Strengthening System. Through the integration of the proprioceptive insoles and the Shumway-Cook balance training program all athletes were able to stand on 1 leg with their eyes closed for 1 minute.

As strengths and weaknesses were identified, proper training interventions were employed for their correction. Knowing that you are only as strong as your weakest link, our athletes had a burning desire to understand their results and to improve upon them. They understood there was no sense in building strength on an unstable foundation; identifying and fixing weaknesses became the mantra of the program.

We started hearing from coaches, parents, and other observers that the players were “hitting the cover off the ball” or about how they

Continued on page 48



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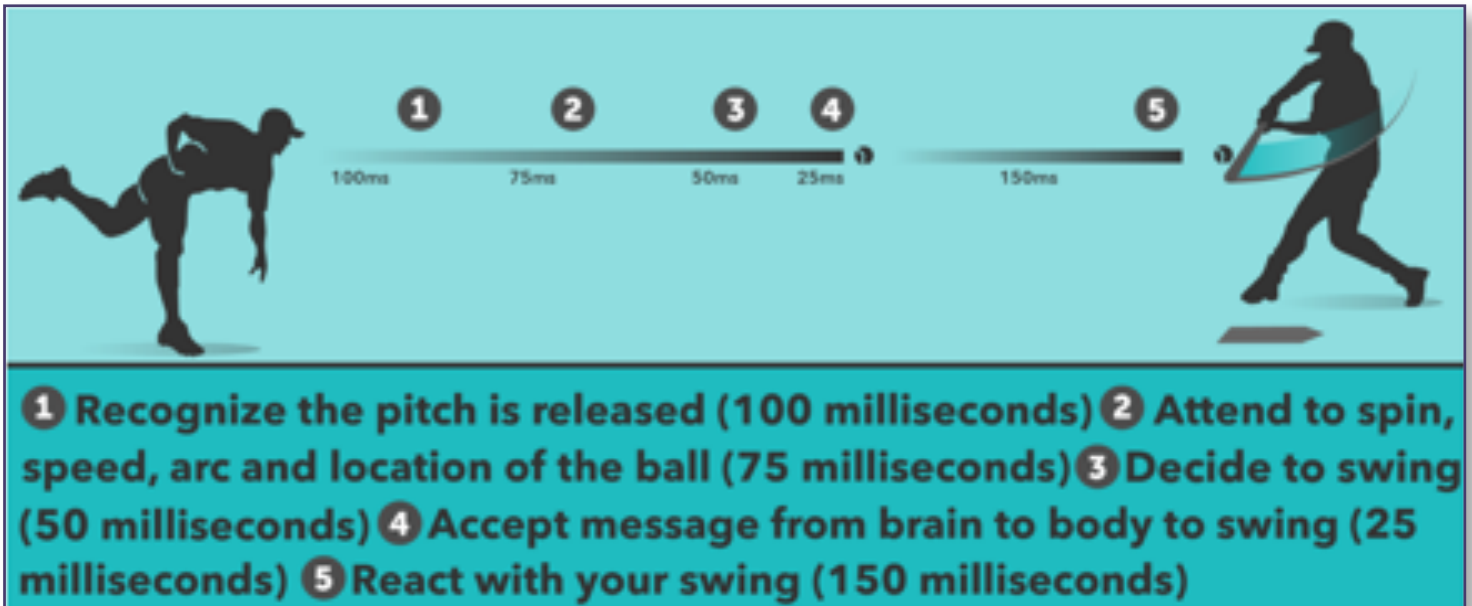
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were reacting faster and getting to position faster. But it wasn't just on the field.

I was very proud of our team when parents started telling me: "It's no longer a struggle to get homework done"; "he seems to understand and get it better"; "behavior and bed time are no longer a commotion"; or "he is setting a better example for his younger siblings." One mother brought her son's report card showing that her son's all Cs had become all As. Two of the players were taken off Ritalin. These comments struck home to the idea that we are preparing the children for the game of life. Baseball is just the vehicle we are using to do so.


I think head coach Sacco summed it up the best when he said, "You know you're doing something right when your boys would rather come to do their training than go to a birthday party or something else. They want to be here, they see the improvements they've made, and they compete against each other here so intensely, while always understanding it's team first. I see the level of quickness when we go the batting cages and the tremendous agility when reacting to ground balls and other drills. I've talked to parents who tell me how much better their child is doing in the classroom and at home. With what I've seen in the short few months, I firmly believe every sports program at any level (boys and girls) should be doing this training. Just the brain training alone speaks volumes and is great

for knowing when an athlete can or is able to return to play after an injury. I can't say enough how great I think this program is."

Succeeding at the Game of Life

Our team, which had ended the prior season in last place, won the championship that year. Proper training—being able to evaluate and train at game speed—was very important for a successful program. The game should never be the trainer. Training at high demand must be closely monitored. Objectively understanding the movement ability of each athlete and correcting it, as needed, helps significantly in injury prevention and movement efficiency.

I would like to personally thank USA Baseball, Bigger Faster Stronger, Microgate, Barefoot Science, BrainHQ, FMS, and my great staff for their involvement in this great program. Thank you to Anne Shadle, PhD, whose understandings on the cognitive side of sport makes everything blend so seamlessly. Most importantly I would like to thank the coaches and especially the athletes, whose dedication and determination made this the most enlightening training program I have ever seen at any level. Much was learned and many will be helped because of it.

As we all learn and share ideas, the impossibilities of today will fade, and the achievements of tomorrow will be greater than ever. 

Peter Gorman, DC, is a contributor to the USA Baseball Sport Development Blog, is widely referred to as the developer of heart rate monitor technology, and owns 7 major patents in the United States and Canada. He was named president of Microgate USA in 2010 and became an adjunct professor at the University of Bridgeport Chiropractic College in 2012. He later joined CourtSense, developing innovative and logical progression that helps athletes attain symmetry and better coordination. Dr. Gorman has previous experience working with the US military, as well as sports leagues and franchises around the world including those associated with Major League Baseball, FIFA, the National Football League, the National Basketball Association, the National Hockey League, and the US Olympic Committee.

The 6 Absolutes

1. Athletic or jump stance
2. Be tall
3. Spread the chest
4. Align the toes
5. Align the knees (knees over toes)
6. Eyes on target



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GUIDELINE UPDATE

AAN Updates Guideline for Oral/Topical Treatment of Painful Diabetic Neuropathy



The American Academy of Neurology (AAN) has updated its guideline on oral and topical treatments for painful diabetic neuropathy (PDN). The revised guideline,¹ which was published in the journal *Neurology* and updates the 2011 AAN guideline, has been endorsed by the American Association of Neuromuscular & Electrodiagnostic Medicine.

“Living with pain can greatly affect a person’s quality of life, so this guideline aims to help neurologists and other doctors provide the highest quality patient care based on the latest evidence,” said guideline author Brian C. Callaghan, MD, MS, of the University of Michigan in Ann Arbor and a Fellow of the AAN, in a press release. “Painful diabetic neuropathy is very common, so people with diabetes who have nerve pain should discuss it with their doctor because treatment may help.”

While several oral and topical medications are effective in reducing nerve pain, the guideline encourages clinicians—before prescribing—to first determine if a patient also has mood or sleep problems as treatment for these conditions is also important. To reduce nerve pain, the guideline recommends that clinicians offer treatments from the following drug classes: tricyclic antidepressants (TCAs) such as amitriptyline, nortriptyline, and imipramine; serotonin-norepinephrine reuptake inhibitors (SNRIs) such as duloxetine, venlafaxine, or desvenlafaxine; gabapentinoids such as gabapentin or pregabalin; and/or sodium channel blockers such as carbamazepine, oxcarbazepine, lamotrigine, or lacosamide.

Evidence shows all of these medications may reduce nerve pain. “New studies on sodium channel blockers published since the



last guideline have resulted in these drugs now being recommended and considered as effective at providing pain relief as the other drug classes recommended in this guideline,” said Callaghan. When prescribing, the guideline says clinicians should consider the cost of a drug and side effects, as well as other medical problems the person may have. Once taking a drug, patients should be checked regularly by their clinicians to determine if there is enough pain relief or too many side effects. If the first medication tried does not provide meaningful improvement, or if there are significant side effects, the guideline states that clinicians should offer patients a trial of another medication from a different class.

The guideline recommends against starting opioids, including tramadol and tapentadol, for PDN, and recommends offering the option of a safe taper off opioids for those already taking them. “Current evidence suggests that the risks

of the use of opioids for painful diabetic neuropathy therapy outweigh the benefits, so they should not be prescribed,” said Callaghan. The guideline states that clinicians may offer topical treatments such as capsaicin, glyceryl trinitrate spray, or *Citrullus colocynthis* to reduce pain. It also says ginkgo biloba may be helpful, as well as non-drug treatments such as exercise, mindfulness, cognitive behavioral therapy, or tai chi.

“It is important to note that the recommended drugs and topical treatments in this guideline may not eliminate pain, but they have been shown to reduce pain,” said Callaghan. “The good news is there are many treatment options for painful diabetic neuropathy, so a treatment plan can be tailored specifically to each person living with this condition.”

To further assist clinicians treating patients with polyneuropathy, the AAN has also developed a new AAN Polyneuropathy Quality

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Measurement Set² to accompany this guideline, published as a special article in the journal *Neurology*. A quality measurement set is a tool healthcare providers can use to improve the ways care is delivered to patients. According to the guideline, a key driver was the lack of clinician-patient interaction regarding pain—rarely is it discussed, and even when it is, patients are often not treated. Indeed, the authors cite evidence that shows 12.5% of patients with diabetes and chronic painful peripheral neuropathy do not report symptoms to their clinicians and nearly 40% receive no treatment for this condition.

The set includes 3 quality measures:

Avoidance of opioid medications for patients with diabetic neuropathy: This measure is designed to limit the number of new and existing opioid prescriptions for this patient population.

Pain assessment and appropriate treatment for patients with diabetic neuropathy: This is a paired measure designed to assess the


Living with pain can greatly affect a person's quality of life, so this guideline aims to help neurologists and other doctors provide the highest quality patient care based on the latest evidence.

Brian C. Callaghan, MD, MS

percentage of patients with whom pain was discussed AND had an appropriate medication offered. The quality measures encourage assessment of pain in all patients with polyneuropathy, especially African American and Hispanic patients as a means of reducing already identified health disparities, particularly in provider-patient communications.

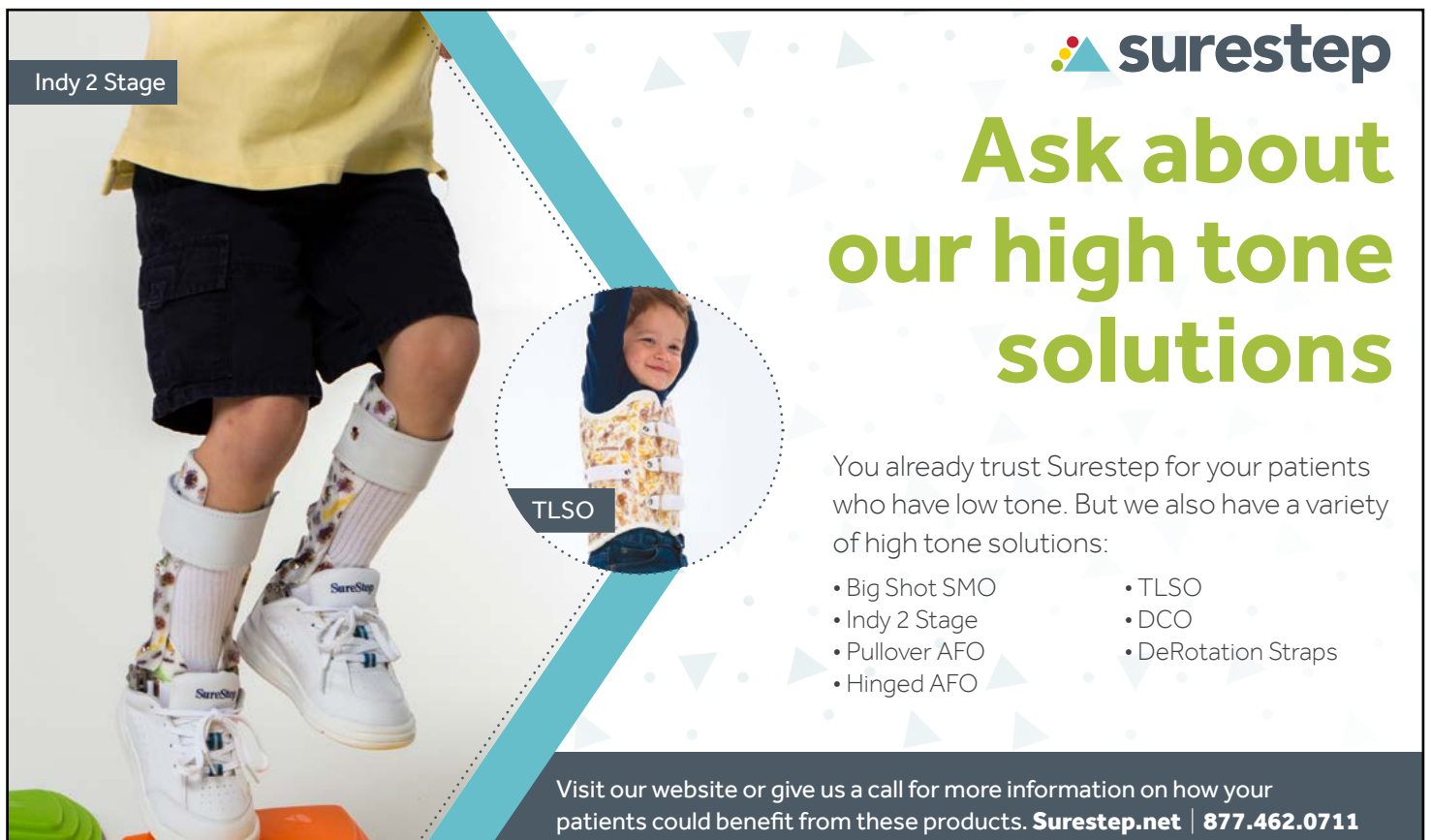
Reduction of pain for patients with polyneuropathy: This outcome measure applies to patients

diagnosed with polyneuropathy—not just DPN—whose pain scores are reduced by 30% over a 12-month period.

The American Academy of Neurology Institute worked with the Logical Observation Identifiers Names and Codes (LOINC) to facilitate code capture from electronic medical records to make implementation of these measures easier for clinicians. To learn more, both publications are available via open access (details below). 

References

1. Price R, Smith D, Franklin G, et al. Oral and topical treatment of painful diabetic polyneuropathy: Practice guideline update summary. *Neurology*. 2022;98;31-43.
2. Callaghan BC, Armon C, Bril V, et al. Polyneuropathy quality measurement set: quality improvement in neurology. *Neurology*. 2022;98;22-30.



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Parkinson's Exercise Recommendations

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Aerobic Activity

3 days/week for at least 30 mins per session of continuous or intermittent at moderate to vigorous intensity

TYPE: Continuous, rhythmic activities such as brisk walking, running, cycling, swimming, aerobics class

CONSIDERATIONS: Safety concerns due to risks of freezing of gait, low blood pressure, blunted heart rate response. Supervision may be required.



Strength Training

2-3 non-consecutive days/week for at least 30 mins per session of 10-15 reps for major muscle groups; resistance, speed or power focus

TYPE: Major muscle groups of upper/lower extremities such as using weight machines, resistance bands, light/moderate handheld weights or body weight

CONSIDERATIONS: Muscle stiffness or postural instability may hinder full range of motion.

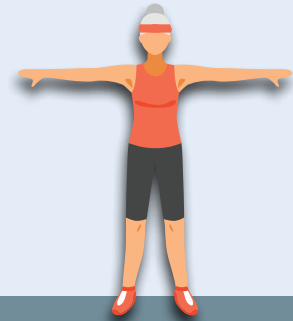


Balance, Agility & Multitasking

2-3 days/week with daily integration if possible

TYPE: Multi-directional stepping, weight shifting, dynamic balance activities, large movements, multitasking such as yoga, tai chi, dance, boxing

CONSIDERATIONS: Safety concerns with cognitive and balance problems. Hold on to something stable as needed. Supervision may be required.



Stretching

>2-3 days/week with daily being most effective

TYPE: Sustained stretching with deep breathing or dynamic stretching before exercise

CONSIDERATIONS: May require adaptations for flexed posture, osteoporosis and pain.



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Safety first: Exercise during on periods, when taking medication. If not safe to exercise on your own, have someone with you.



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PT CONTROLLER



Forward Motion Medical has released more information about its PT Controller custom orthotic, an aggressive device designed for posterior tibial tendon dysfunction (PTTD) and flexible flat foot. The PT Controller orthotic is the solution for excessive pronation, flexible flat feet, and posterior tibialis dysfunction. The design features unique varus control and subtalar support without adding motion to the device. Medial and lateral flanges are built-in to control the midfoot and prevent foot supination, while a lateral wedge stabilizes the varus correction. Forward Motion Medical is excited to offer this tool that will allow doctors to treat even the most severe cases of PTTD and flexible flat foot.

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'COMPUTER ON THE BONE' DEVELOPED TO MONITOR, PROTECT BONE HEALTH

A team of University of Arizona (UArizona) researchers has developed an ultra-thin wireless device that grows to the surface of bone and could someday help physicians monitor bone health and healing over long periods. The devices are called osseosurface electronics.

"With this interface, you basically have a computer on the bone," said Philipp Gutruf, PhD, an assistant professor of biomedical

engineering and Craig M. Berge faculty fellow in the College of Engineering at UArizona. "This technology platform allows us to create investigative tools for scientists to discover how the musculoskeletal system works and to use the information gathered to benefit recovery and therapy."

The device is about as thick as a sheet of paper, which means it can conform to the curvature of the bone, forming a tight interface. It does not need a battery to operate; rather, it uses a power casting and communication method called near-field communication, which is also used in smartphones for contactless pay.



Osseosurface electronic devices, which attach directly to the bone, could one day help physicians monitor bone health. It's shown here applied to a synthetic bone in the Gutruf Lab at the UArizona. Image courtesy of Gutruf Lab.

The outer layers of bones shed and renew just like the outer layers of skin. So, if a traditional adhesive was used to attach something to the bone, it would fall off after just a few months. To address this challenge, the team developed an adhesive that contains calcium particles with an atomic structure similar to bone cells, which is used to secure osseosurface electronics to the bone.

"The bone basically thinks the device is part of it, and grows to the sensor itself," Gutruf said. "This allows it to form a permanent bond to the bone and take measurements over long periods of time."

For instance, a doctor could attach the device to a broken or fractured bone to monitor the healing process. This could be particularly helpful in patients with conditions such

as osteoporosis, since they frequently suffer refractures. Knowing how quickly and how well the bone is healing could also inform clinical treatment decisions, such as when to remove temporary hardware like plates, rods, or screws.

CEP COMPRESSION'S ULTRALIGHT COLLECTION



CEP Compression's innovative Ultralight Collection is designed to help athletes stay cool and dry during their workouts. Built with innovative smart carbon technology, CEP's Ultralight socks and calf sleeves are engineered to provide extreme strength and high elasticity while also being light and breathable. Industry-leading FERAN ICP and HeiQ Smart Temp moisture management properties help athletes stay dry and prevent blisters. Combined with all the medical benefits of true graduated compression, the Ultralight portfolio offers a perfect solution for runners, cyclists, and other active users to stay comfortable and injury-free. CEP's Ultralight socks are available in tall, mid-cut, low-cut, and no-show options, as well as in calf sleeves, for both men's and women's sizes. Consumers will enjoy the lightweight feel and varied color choices.

CEP Compression

888/519-2338
cepcompression.com

SMART BANDAGE DETECTS BIOMARKERS FOR ONSITE CHRONIC WOUND MONITORING

A research team led by Lim Chwee Teck, PhD, from the National University of Singapore's (NUS) Department of Biomedical Engineering and Institute for Health Innovation & Technology (iHealthtech), in collaboration with clinical partners from Singapore General Hospital, has developed a smart wearable sensor that can conduct real-time, point-of-care assessment of chronic wounds, such as diabetic foot ulcers (DFUs), wirelessly via an app. The sensor technology can detect temperature, pH, bacteria type, and inflammatory factors specific to chronic wounds within 15 minutes, enabling fast and accurate wound assessment and personalized wound management.



The VeCare platform comprises (clockwise from bottom left) a chip, wound sensor, bandage, and app for real-time, point-of-care chronic wound monitoring. Image courtesy of NUS.

The point-of-care wound assessment platform, called VeCare, consists of an innovative wound sensing bandage, an electronic chip, and a mobile app. The bandage comprises a wound contact layer, a breathable outer barrier, a microfluidic wound fluid collector, and a flexible immunosensor. VeCare is said to be the first wound assessment platform that can detect bacteria type and probe inflammatory factors, in addition to measuring acidity and temperature, within a single 15-minute test. The immune-sensing bandage enables rapid assessment of wound microenvironment, inflammation, and infection state by detecting multiple chronic wound-specific biomarkers

from wound fluid using an electrochemical system. The microfluidic wound fluid collector attached to the sensor directs and boosts wound fluid delivery to the sensor by up to 180%. The design ensures reliable sensing performance regardless of the ulcer shape or size.

In addition, a chip integrated with flexible electronics is connected to the sensor to transmit data wirelessly to an app for real-time wound assessment and analysis onsite, enabling doctors to monitor the patient's chronic wounds remotely. The chip component, powered with a rechargeable battery, can be reused for subsequent applications. The bandage complements the patient's existing medical treatment while facilitating timely medical intervention for wound healing processes.

"The VeCare platform is easily scalable and customizable to accommodate different panels of biomarkers to monitor various types of wounds," said Lim. "The aim is to have an effective and easy to use diagnostic and prognostic tool for precise and data-driven clinical management of patients."

ÖSSUR PRESIDENT/CEO TO RETIRE; SUCCESSOR ANNOUNCED

Össur, Reykjavik, Iceland, announced that president and CEO Jon Sigurdsson will retire from his position after serving the company for 26 years. The company's board of directors has appointed Össur CFO Sveinn Sölvason to succeed as president and CEO effective April 1, 2022. Sölvason has been with Össur since 2009 and CFO since 2013.

A search for a new CFO is under way.

MOLECULIGHT RECEIVES \$10M USD TO SUPPORT GLOBAL EXPANSION

MolecuLight, Toronto, Canada, and Pittsburgh, PA, which provides point-of-care fluorescence imaging technology for real-time detection of

wounds containing elevated bacterial loads, announced that it has received \$10M USD in structure debt from SWK Holdings to support its global commercial expansion. SWK Holdings Corporation (Nasdaq: SWKH) is a life science-focused specialty finance company catering to small- and mid-sized commercial-stage companies through the creation of unique financing structures.

WEB SPACE INFECTION PCR TESTING



Bako Diagnostics developed a BakoDx Web Space PCR (polymerase chain reaction) test to identify the infectious agents involved in web space dermatitis. This highly sensitive, highly specific test provides podiatric clinicians with ease of use, rapid results, and accurate diagnostics, allowing for the best patient care. The test utilizes real-time PCR (RT-PCR) technology to detect the causative agent within the web space keratin when present, resulting in the clinically identified dermatitis. The BakoDx Web Space panel tests for fungi (dermatophytes, *Candida* spp) and bacteria (*Corynebacterium minutissimum*, gram-negative bacteria, and staphylococcus aureus, which, if positive, a reflex test is performed for the *mecA* gene of methicillin-resistant staphylococcus aureus [MRSA]). Interdigital infectious dermatitis may be due to a variety of organisms that may look similar, but their treatment differs. Differential diagnosis may include *Corynebacterium minutissimum* in erythrasma, tinea pedis, candidal intertrigo, and/or primary or secondary bacterial infections.

Bako Diagnostics

855/422-5628
bakodx.com

THE UPSWING LEG CAST COVERS



The Upswing is a new brand that believes in the holistic approach to healing, equalizing the importance of the body and mind. The company believes if you look better, you will heal better! Using thoughtful, elevated design and innovative, artistic styling, the company has designed a line of products including cast covers, arm slings, and walking boot liners along with coordinated face masks. The Leg Cast Covers are designed to slide easily over a below-the-knee cast and have a convenient, discreet toe pouch to cover up bare toes during the cold winter months, or to show off that pedicure during the beautiful days of spring. The cast covers contain Siverplus Anti-Microbial, which inhibits the growth of odor-causing bacteria. The Upswing offers discounts for the medical community.

The UpSwing
theupswing.com

U-M, HUMOTECH PARTNER TO BRING OPEN-SOURCE BIONIC LEG TO RESEARCH LABS

The open-source, artificially intelligent prosthetic leg designed by researchers at the University of Michigan (U-M) will be brought to the research market by Humotech, a Pittsburgh-based assistive technology company. The goal of the collaboration is to speed the development of control software for robotic prosthetic legs, which have the potential to provide the power and natural gait of a human leg to prosthetic users.

“We developed the open-source leg to foster the study of control strategies for robotic prostheses...,” said Elliott Rouse, PhD, assistant professor of mechanical engineering and core faculty at U-M’s Robotics Institute. “The open-source leg is now being used by over 10 other research groups to develop control strategies on a common platform, but we noticed some research groups would rather not build it themselves.”

First released in 2019, the open-source leg’s free-to-copy design is intended to accelerate scientific advances by offering a unified platform to fragmented research efforts across the field of bionics. The original prosthetic leg was designed to be simple, low-cost, and high-performance. Its modular design can act as a knee, ankle, or both, with an onboard power supply and control electronics that allow it to be tested anywhere. Now, for labs that need an off-the-shelf robotic prosthesis for research and development, Humotech will provide an assembled version of the open-source leg, including warranty service and technical support, according to Josh Caputo, PhD, president and CEO of Humotech.



Alejandro Francisco Azocar, mechanical engineering graduate student research assistant, puts the finishing connections together before testing an open-source robotic leg designed by Elliott Rouse, PhD, and his research group. Image courtesy of Robert Coelius, Michigan Engineering.

Humotech, originating from Carnegie Mellon University, develops tools for the advancement of wearable robotic control systems and other wearable devices. Using its own research community, Humotech will further build and support a development community around the open-source leg and seek to incorporate the leg into Humotech’s Cplex

platform, a hardware and software testbed that enables researchers to emulate the mechanics of wearable machines, including prostheses and exoskeletons.

In collaboration, Rouse’s lab and Humotech will also iterate on new versions of the open-source leg to meet the needs of prosthetic wearers and researchers. For researchers looking to build the leg on their own, the prosthetic’s parts list, assembly instructions, and programming remain freely available online.

OCCIPITAL STRUCTURE SENSOR PRO



Occipital and TechMed 3D have partnered to integrate support for Occipital’s Structure Sensor Pro into TechMed3D’s software solutions to meet scan-to-fabrication needs across the healthcare industry. Healthcare professionals can connect a Structure Sensor Pro to an Apple iPad or iPhone, select a body part, and capture precise 3D models of patients in less than a minute. It’s ideal for a variety of applications including orthotics, prosthetics, compression garments, spinal braces, and custom footwear. The resulting 3D models can be easily modified for prescriptions and sent to manufacturing with CAD/CAM or 3D printing systems. The Structure Sensor Pro is built from the ground up for healthcare with an all-new, industrial-grade manufacturing and calibration process, more accuracy than ever, and with reliability and consistency. TechMed 3D’s suite of apps fully integrate Occipital’s Structure technology for a seamless scanning, viewing, and documentation experience.

Occipital
415/890-5770
occipital.com

APB ALL PURPOSE BOOT



Featuring a 20% lighter EVA outsole, the DARCO All Purpose Boot™ (APB) provides patients with superior shock absorption, durability, and comfort when compared to traditional TPR-soled post-op shoes. This closed-toe post-op shoe offers 150% better rebound, retaining both shape and thickness over time. The APB comes equipped with a built-in MetaShank™ to maintain rigidity and provide stabilizing control under the metatarsal heads, ensuring proper foot positioning throughout the recovery process. Transform the shoe into a diabetic offloading solution with our PegAssist™ insole to maximize pressure reduction for plantar wounds.

DARCO International
800/999.8866
darcointernational.com

DARCO, SENSORIA HEALTH PARTNER TO CREATE SMART DIABETIC FOOTWEAR

DARCO International, Huntington, WV, and Sensoria® Health, Redmond, WA, have partnered to jointly develop smart diabetic footwear that is powered by mobile and cloud patient monitoring technology, to deliver remote patient monitoring–connected podiatry solutions to patients and providers. This new partnership will combine Sensoria’s remote patient monitoring software, and Sensoria® Core hardware technologies together with DARCO’s

podiatry products. These new products will not only provide valuable feedback to patients but will also supply clinicians’ compliance and usage patterns for healing diabetic foot ulcers and reduce the risk of recurrence.

REVOLOCK



RevoLock is a kit that a practitioner builds into a prosthetic socket. It offers an easy, simple, and secure solution so that patients can achieve proper suspension. There are 2 kit options: 4-Hole for standard alignment fabrication and Align for transferable alignment fabrication, pediatric applications, and upper extremity devices. RevoLock was designed for patients who struggle with their current suspension system or are looking for an innovative suspension approach, such as patients who have trouble locating a pin lock pin, have long or bulbous limbs, experience large volume change each day, or change activity often. To don, snap in the liner and turn the Click® Reel to pull the limb into the socket. To doff, turn the reel in the opposite direction to release and unsnap from the liner to disconnect from the socket. Learn more at ClickAcademy.co.

Click Medical
970/670-7012
clickmedical.co

BIOBRACE BIOCOMPOSITE SOFT TISSUE SCAFFOLD



The BioBrace implant from BioRez represents the first biocomposite soft tissue scaffold designed to reinforce tendon and ligament repairs, promote healing, and fully resorb. This new biocomposite soft tissue scaffold is intended to be used in a broad range of surgical procedures to reinforce soft tissue where weakness exists and can be used with existing surgical techniques and instrumentation. The novel biocomposite design of the BioBrace features a highly porous collagen matrix and resorbable PLLA microfilaments. This technical breakthrough results in a bio-inductive scaffold with strength. The company has received 510(k) clearance from the U.S. Food and Drug Administration for 2 sizes of its BioBrace Implant.

BioRez
biorez.com

STRENGTHEN YOUR FEET TO PREVENT RUNNING-RELATED INJURIES

Strengthen your feet to prevent running-related injuries

Reference: Taddei et al. AJSM 2020

Designed by @YLMSPortScience

118 runners were assessed at baseline and distributed into 2 groups

| | | | |
|--|--|--|---|
|  | FOOT CORE TRAINING GROUP  Supervised foot-ankle muscles training |  3 sessions per week | CONTROL GROUP  Placebo static stretching protocol |
|--|--|--|---|

WHAT THEY FOUND

Injury prevalence



The control group participants were 2.42 times more likely to experience a running-related injury within the 12-month study period than participants in the intervention group

Foot posture & strength



Time to injury was correlated with Foot Posture Index ($r = 0.41$) and foot strength gain ($r = 0.45$) scores

Recreational runners should strengthen their feet to reduce the risk of running-related injuries

Source: Taddei UT, Matias AB, Duarte M, Sacco ICN. Foot core training to prevent running-related injuries: a survival analysis of a single-blind, randomized controlled trial. Am J Sports Med. 2020;48(14):3610-3619. doi:10.1177/0363546520969205

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