Collaborative Care for Better Outcomes

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LOWER EXTREMITY REVIEW
November 20 / volume 12 / number 11

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Lower Extremity Review

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

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.

EDITORIAL PILLARS

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

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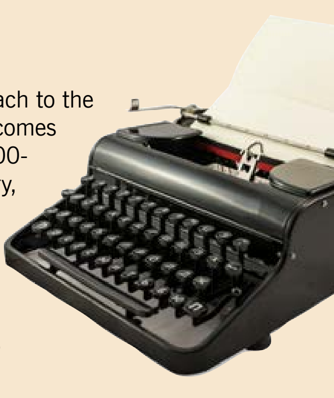
LER encourages a collaborative multidisciplinary clinical approach to the care of the lower extremity with an emphasis on functional outcomes using evidence-based medicine. We welcome manuscripts (1000-2000 words) that cross the clinical spectrum, including podiatry, orthopedics and sports medicine,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



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Editorial Appreciation

2020: The Year That Was!

By Janice T. Radak, Editor, and Rich Dubin, Publisher

Some years it's hard to say good-bye…and then there's 2020. We're sure we're not the only ones happy to see it in the rearview mirror. But to just drive away is to ignore the words of Socrates, who rightfully said,

"The secret of change is to focus all of your energy not on fighting the old, but on building the new."

We want to take this opportunity to express our appreciation for all those who have supported *Lower Extremity Review* this past year in oh, so many ways. And we want to thank those who have supported lerExpert, and now, lerEXPO. We're focused on building the new and are glad to have you with us.

2020 obviously saw a much-curtailed schedule for in-person visits, but we still want to thank our hosts:

- NY Podiatric Clinical Conference (NYC)
- American Academy of Orthotists and Prosthetists (Chicago)
- No-Nonsense Seminar (North Central Academy of Podiatric Medicine, Cleveland—ok, this didn't actually happen, but we made some good friends so that still counts)

While travel was curtailed, lerEXPO had the opportunity to launch and we want to acknowledge the sponsors for those events (check out lerEXPO.com for follow-ups):

- Pedorthic Footcare Association Virtual Symposium
- Guiding Parents through Clubfoot Treatment (MD Orthopaedics)
- Understanding Causes and Management of Partial Foot Amputations (PFA)
- Conservative Pain Management for Osteoarthritis (Medi)
- A Segmental Approach to AFO Design Using Composite Materials (Kinetic Research)

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- O&P Medicare and Insurance Billing and Documentation Virtual Interactive Workshop (PFA) ***(Coming January 15, 2021)***
- 2021 No-Nonsense Seminar Virtual ***(Coming March 5–7, 2021)***

And we continued to build on our four pillars:

1. Biomechanics matter.
2. Injury prevention is possible.
3. Diabetic foot ulcers can be prevented.
4. Collaborative care leads to better outcomes.

As a magazine, *Lower Extremity Review* is supported by a diverse group of dedicated professionals who choose to share their expertise on a variety of levels, and we are grateful for one and all. LER is also fortunate to have collaborative agreements with several organizations across the country who help make sure our content is accurate and relevant. And for that, we are grateful as well. And to our advertisers, thank you, thank you, thank you, for sticking with us through this difficult year; we surely would not still be standing without you.

As the following list attests, it takes a village to get LER out the door every month and please know, we value the contribution each of you has made for us.

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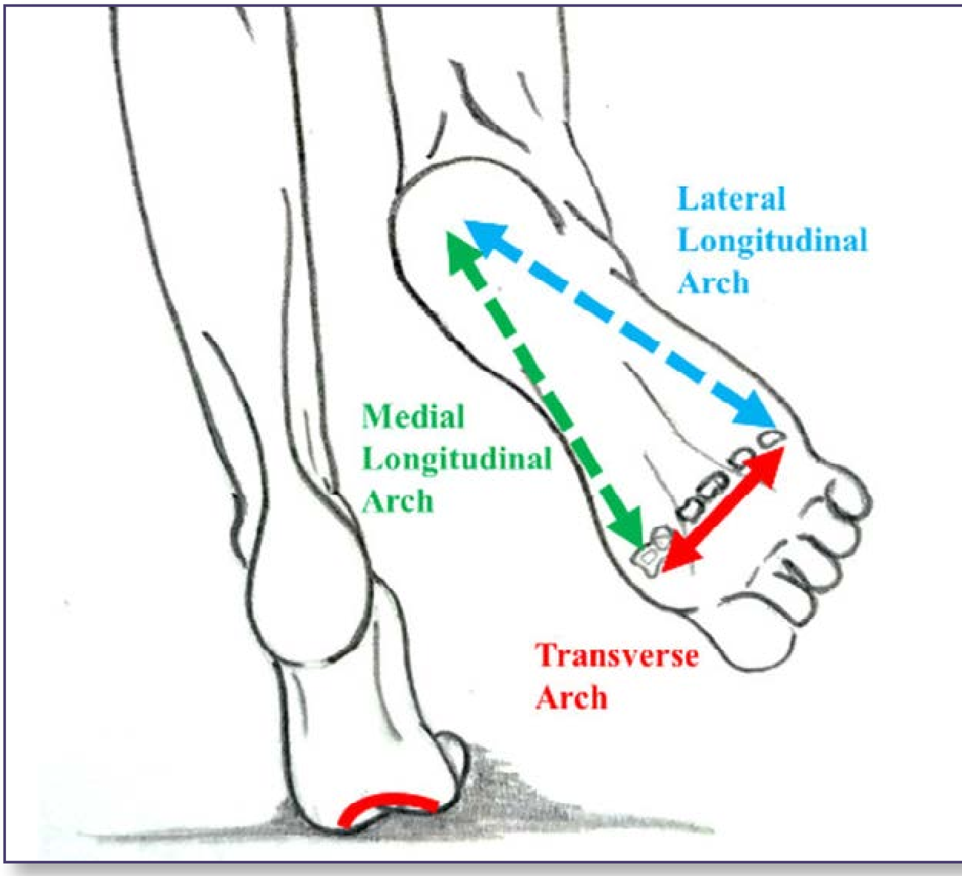
Letter to Editor

Transverse Arch Importance Overstated

By Kevin A. Kirby, DPM

I write in response to the September 2020 *LER* article, "Overlooked Arch in the Foot Is Key to its Evolution and Function," by William Weir, which discusses the article, "Stiffness of the Human Foot and Evolution of the Transverse Arch," by Venkadesan et al, published in *Nature* in early 2020.[1]

The article by Venkadesan et al discussed the possible importance of the transverse arch of the midfoot to the stiffness of the longitudinal arch of the foot. Unfortunately, both articles overestimate the biomechanical influence of the transverse arch on foot stiffness and whether Venkadesan et al's ideas truly "have not been studied previously."



For many years, the longitudinal arch was thought to provide most of the stiffness to the foot to improve the mechanical efficiency of human bipedal gait. In their paper in *Nature*, Venkadesan et al make claims that the transverse arch of the midfoot contributes "more than 40% of the longitudinal stiffness of the foot." While the authors have done their homework in modelling the transverse arch of the midfoot to estimate its contribution to longitudinal arch stiffness, the authors omitted important factors regarding the biomechanical importance of the longitudinal arch in increasing the mechanical efficiency of gait within the human bipedal animal. In other words, the estimate made by these authors that the midfoot transverse arch contributes "more than 40% of the longitudinal stiffness of the foot" appears to be wishful thinking on the part of these researchers.

Specifically, these researchers did not take into consideration how the various tension load-bearing components of the longitudinal arch work together to reinforce each other to "load-share" and thereby increase the stiffness of the longitudinal arch of the foot. In 2017, I first published the "Longitudinal Arch Load-Sharing System of the Foot," which describes how the plantar fascia, plantar intrinsics, deep flexors, peroneus longus and plantar ligaments all work together to contribute to longitudinal arch stiffness.[2]

Unfortunately, Venkadesan et al appear to under-emphasize the importance of the central nervous system (CNS)-controlled plantar intrinsic muscles and CNS-controlled posterior tibial peroneus longus, flexor hallucis longus

> "…the *Nature* authors omitted important factors regarding the biomechanical importance of the longitudinal arch in increasing the mechanical efficiency of human bipedal gait…"

Continued on page 14

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or flexor digitorum longus muscles and how they may also increase the stiffness of the longitudinal arch. These strong muscles certainly provide very significant stiffening to the longitudinal arch of the foot. In addition, these authors seem to over-emphasize the importance of the slight curve of the midfoot bones within the frontal plane.

Second, the authors did not reference other well-known authors who have also speculated on the importance of the midfoot transverse arch. Fifty years ago, Kapandji modelled the midfoot transverse arch as being a part of the "vault" of the human foot.[3] Kapandji even used a nearly identical "folded sheet" model to demonstrate the increased stability of the foot from the transverse midfoot arch that has also now been used, a half-century later, by Venkadesan et al in their paper in *Nature*. I would have thought that Kapandji's well-known reference should have been included within the paper as the first reference to suggest how the transverse arch may increase the longitudinal arch stiffness of the foot. One would think that an idea introduced 50 years ago with multiple references in the indexed medical and scientific literature would rate even a brief mention in a paper that claimed, somehow, the same idea was their original.

Third, there was little mention of the biomechanical significance of a higher longitudinal arch height and its role in increasing the stiffness of the longitudinal arch. In 1998, Arangio et al demonstrated that raising the longitudinal arch of the foot from a flatter to higher-arched structure increased the stiffness of the longitudinal arch by over two-fold.[4] Longitudinal arch height has a huge effect on longitudinal arch stiffness, a fact which was never mentioned by Venkadesan et al.

In conclusion, I doubt that the transverse arch of the midfoot contributes "more than 40% of the longitudinal stiffness of the foot", as the *Nature* authors claim. The potential for the longitudinal arch to greatly increase the sagittal plane stiffness of the forefoot seemed to me to be marginalized within this paper, so that the transverse arch of the midfoot came out, in the view of the authors, as being a dominant factor in longitudinal arch stiffness. The overall literature does not support this. ler

Kevin A. Kirby, DPM is an Adjunct Associate Professor, Department of Applied Biomechanics California School of Podiatric Medicine at Samuel Merritt College and has a private practice in Sacramento, CA 95825.

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COVID-19 Update

Hydroxychloroquine Does Not Prevent Death in COVID-19

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), the cause of COVID-19, emerged from a zoonotic source in China in late 2019. Its transmission has been ineffectively controlled and the world has been immersed in a COVID-19 pandemic since early 1st quarter of 2020. While most COVID-19 infections do not require hospitalization, a not insubstantial number of patients develop a respiratory illness that requires hospital care, with a smaller percentage requiring sustained ventilator care. With the growing pandemic, hospitals have been strained beyond capacity and ventilator use has reached near-rationing status. Evidence-based treatments for the disease are needed. This clinical trial sought to add to that evidence base.

In a randomized, controlled, open-label trial of 4,600 patients with COVID-19, hydroxychloroquine did not have a lower incidence of death at 28 days than those who received usual care. Hydroxychloroquine had been proposed as treatment for coronavirus based on in vitro activity SARS-CoV-2 antiviral activity and on data from observational studies reporting effective reduction in viral loads.

In a global trial, 1561 patients were randomized to receive hydroxychloroquine and 3155 to receive usual care. The primary outcome was 28-day mortality.

The enrollment of patients in the hydroxychloroquine group was closed on June 5, 2020, after an interim analysis determined that there was a lack of efficacy. Death within 28 days occurred in 421 patients (27.0%) in the hydroxychloroquine group and in 790 (25.0%) in the usual-care group (rate ratio, 1.09; 95% confidence interval [CI], 0.97 to 1.23; P = 0.15). Consistent results were seen in all prespecified subgroups of patients.

The results suggest that patients in the hydroxychloroquine group were less likely to be discharged from the hospital alive within 28 days than those in the usual-care group (59.6% vs. 62.9%; rate ratio, 0.90; 95% CI, 0.83 to 0.98). Among the patients who were not undergoing mechanical ventilation at baseline, those in the hydroxychloroquine group had a higher frequency of invasive mechanical ventilation or death (30.7% vs. 26.9%; risk ratio, 1.14; 95% CI, 1.03 to 1.27). There was a small numerical excess of cardiac deaths (0.4 percentage points) but no difference in the incidence of new major cardiac arrhythmia among the patients who received hydroxychloroquine.

In their conclusion, the authors note that hydroxychloroquine is not an effective treatment for hospitalized patients with COVID-19.

Source: Effect of hydroxychloroquine in hospitalized patients with COVID-19. The RECOVERY Collaborative Group. N Eng J Med. 2020;383;2030-2040.

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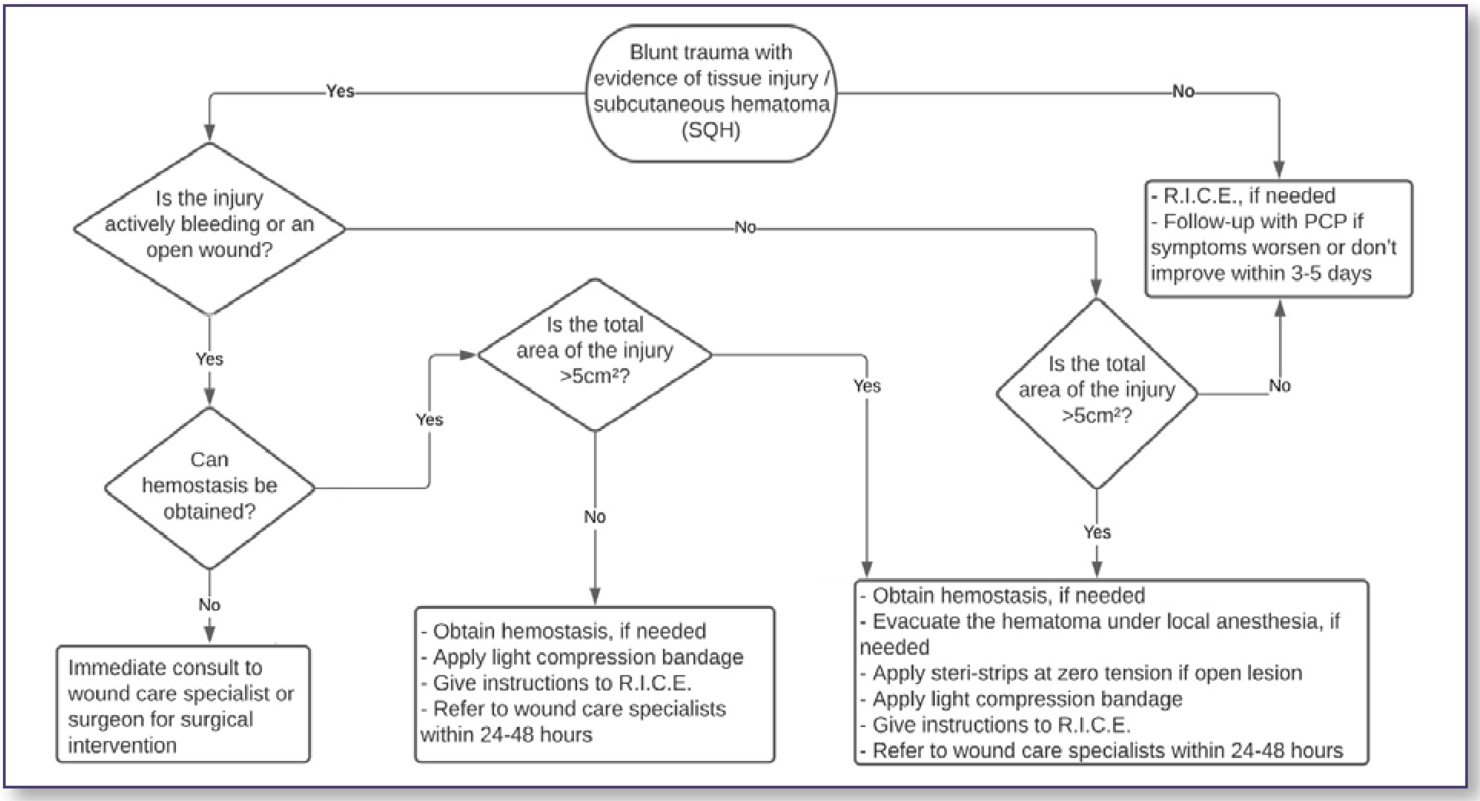

Figure 1. Authors developed this algorithm for use by providers to help appropriately treat and refer patients who experience blunt trauma to the lower extremity that results in soft tissue injury.

Hematoma Algorithm May Improve Outcomes

Researchers at the Kent State University College of Podiatric Medicine observed a specific subset of patients was frequently coming to their clinic with complications after mismanagement or misdiagnosis of initial blunt trauma soft tissue injuries to the lower extremity:

- Elderly (at greater risk for trauma or falls with resulting soft tissue injury)
- Multiple comorbidities (eg, diabetes or peripheral vascular disease) that contribute to thinning of the skin in the lower extremity
- Use of bloodthinners such as aspirin, warfarin, or Novel Oral Anticoagulants
- Sequelae such as infection, skin loss, chronic non-healing wounds, and a need for surgical intervention after developing deep dissecting hematomas (DDH)

In response to what they were seeing in their own clinic, these researchers sought to develop an evidence-based algorithm to help decrease mismanagement and/or misdiagnosis of initial injury by improving early detection, proper treatment, and proper referral of lower extremity blunt trauma soft tissue injuries to prevent serious complications.

After examining recent clinical cases of lower extremity blunt trauma soft tissue injuries that came to their wound clinic after having progressed to deep dissecting hematomas (DDH), they conducted a literature search and reviewed 25 articles focused on hematoma in lower extremities.

Then, they applied the algorithm to the case of an 85-year-old male with a left lower extremity skin tear laceration secondary to blunt trauma from a fall from a ladder (see Case Example, page 18). Using the algorithm, they found key differences from what happened and what the evidence base supported:

- Steri-strips at zero tension would have been used instead of Prolene stitches
- Referrals for follow up would have been for 24 to 48 hours after being seen, not 10 days.

The authors concluded that proper management of the initial injury may have prevented an additional ED visit, use of a second antibiotic, unnecessary patient pain, and surgery.

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Case Example: History

85 YO male with LLE skin tear laceration secondary to blunt trauma from fall from ladder

- Seen in local ED 3 hours S/P initial injury
- No labs collected; negative x-ray of LLE
- Irrigation of injured tissue; re-approximation of traumatically avulsed tissue flap with interrupted Prolene stitches; dry dressing
- Discharged with oral antibiotics and instructions to follow- up with PCP in 10 days for stitch removal

5 days post-trauma returned to ED with continued pain, swelling, and redness at injury site

- WBC 4.6, blood cultures negative
- Duplex ultrasound negative for worsening DVT
- Discharged with additional antibiotics due to patient history of MRSA and again referred to PCP for stitch removal

9 days post-trauma presented to wound care clinic with persistent and worsening pain, edema and discoloration

- Diagnosed with DDH requiring surgical evacuation

Figure 2

Figure 3

Figure 4

Figure 5

Figure 2: Patient taken to OR, Interrupted Prolene stitches were removed **Figure 3:** DDH surgically evacuated. **Figure 4:** Wound extended deep to the level of muscle and measured 8.2 cm x 6.4 cm x, 1.0 cm post-operatively. **Figure 5:** With aggressive wound care, patient healed in 11 weeks with minimal scarring

Patient outcomes can be improved through prompt recognition and appropriate treatment that can decrease the extent of tissue loss and associated wound defects and minimize the need for surgical intervention. The algorithm also streamlines the logistics of coordinating ongoing care for these at-risk patients by providing for proper referrals in appropriate timeframes.

Source: Cole W, Coe S, Chmielewski S. Implementation of the Dedicated Lower Extremity Hematoma Algorithm (LEHA) Will Improve Trauma Patient Outcomes. Poster presented at Symposium on Advanced Wound Care (SAWC) Fall Virtual. Sept. 18-20, 2020.

Measuring Topical Oxygen Therapy Result with NIRS

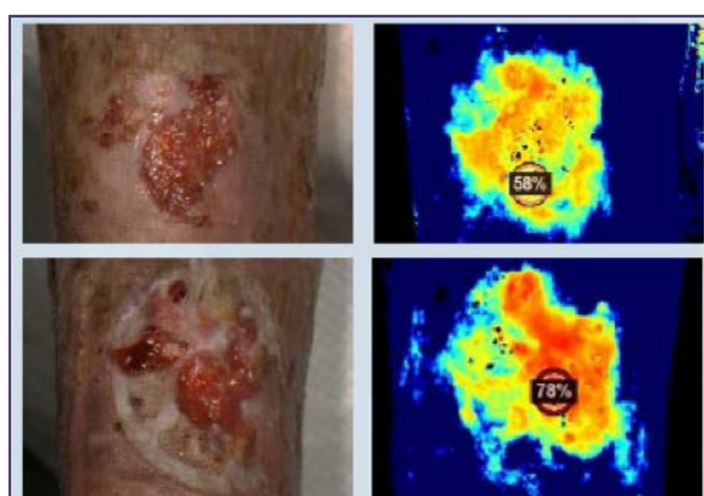
Chronic wounds are defined as those not proceeding through the orderly phase of tissue repair with 30 days; incidence of these wounds continue to rise, creating a burden not only on patients, but the healthcare system as well. This study sought to determine the effects of continuous topical oxygen therapy (TOT) on wound perfusion as measured with a near-infrared spectroscopy device (NIRS).

Five patients (age range 42 – 91 yrs) with a history of lower extremity wounds lasting more than 30 days qualified. After standard wound assessment, active continuous TOT was initiated, with weekly NIRS images to track oxygenated hemoglobin levels; standard wound measurements were also obtained. Patients were seen for 6 weekly visits or until the wound healed.

NIRS showed all 5 patients had increased oxygenated hemoglobin in the wound base along with improvements in other wound measurements. Healing was complete in 3 of the 5 patients by the 6-week mark, with the 2 others healing shortly thereafter (with continued TOT).

The author concluded that NIRS was a user-friendly imaging device for tracking wound progress and that TOT offers an effective non-invasive chronic wound treatment.

Source: Cole W. The Use Of Topical Oxygen Therapy System to Promote Healing in Chronic Wounds. Poster presented at Symposium on Advanced Wound Care (SAWC) Fall Virtual. Sept. 18-20, 2020.



Example of NIRS images and wound improvement achieved when TOT initiated

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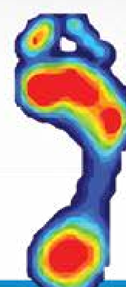

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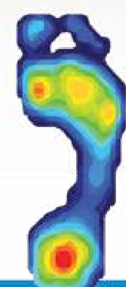

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Gellable Fiber Dressing in Chronic Venous Leg Ulcers

This investigational product case series looked the use of gellable fiber dressing technology in the setting of heavily exudating venous leg wounds in a series of 5 patients. Exudate management is key to healing this type of ulcer.

The author noted that proprietary design of the gellable dressing offered a balance between adsorptive capacity and structural integrity. In particular, the design pulls exudate away from the wound by absorbing throughout the entire dressing to preserve optimal moisture while protecting healthy skin. The poster presentation presented findings from 2 of the cases.

Case 1: 57-year-old male with a 5-month history of VLU on the left posterior calf. Alginate had failed due to adherence to wound tissues. After clinical evaluation, the gellable fiber dressing was applied with 2-layer compression as secondary dressing. Both were changed weekly. The wound measurement dropped from 4.0cm x 2.5cm x 0.1cm at baseline with a VAS of 7 to 1.3cm x 0.9cm x 0.1cm at visit 4 with a VAS of 3, to complete resolution at visit 8 (7 weeks total).

Case 2: 76-year-old female with >12-month history of VLU on the medial left ankle. Previous therapies included alginate, collagen, foam and ace wraps without significant healing noted. After clinical evalua-

1. Base has a mix of fibrosis and granulation. **2.** Moderate serosanguineous drainage. **3.** Measurements: 4.0cm x 2.5cm x 0.1cm. **4.** No malodor – VAS score: 7

VLU was noted to be completely resolved after 7 weeks of this wound care regimen.

tion, the gellable fiber dressing was applied with 2-layer compression as secondary dressing. Both were changed weekly. At baseline, wound measured 4.7cm x 2.3cm x 0.4cm with a VAS of 8 and a slight malodor. By visit 3, size had dropped to 3.6cm x 1.9cm x 0.2cm with a VAS of 3 and no malodor. Resolution was complete at visit 7 (total 6 weeks).

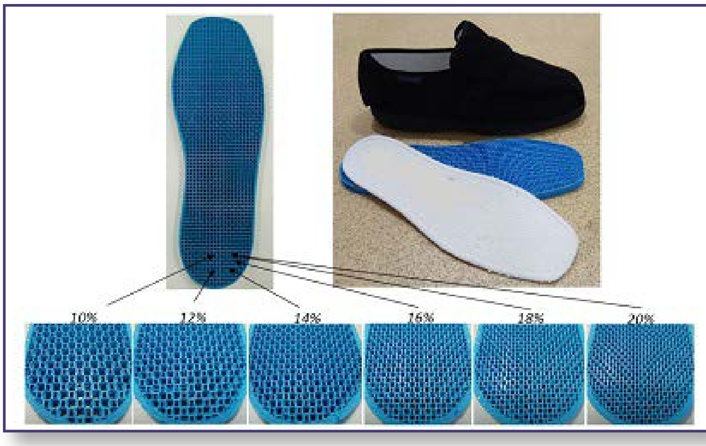
The author reported that the gellable fiber wound dressing in conjunction with multilayer compression wrap therapy facilitated healing in all 5 patients, with no adverse events.

Source: Cole W. Use of an Innovative Gellable Fiber Dressing Technology in Heavily Exudating Venous Leg Wounds: A Case Series. Poster presented at Symposium on Advanced Wound Care (SAWC) Fall Virtual. Sept. 18-20, 2020.

1. Base of wound mix of slough and fibrosis. **2.** Moderate serosanguineous exudate. **3.** Measurement: 4.7cm x 2.3cm x 0.4cm. **4.** Slight malodor – VAS score: 8

1. Wound continues to progress with weekly wound care visits and bandage changes. **2.** No adverse events or reported patient discomfort. **3.** Measurements: 2.0cm x 1.6cm x0.1cm.

3D Printed Insoles Offers New Hope for Patients with Diabetes



3D printed insoles can be adapted for individual patients to reduce the risk of foot ulcers. Image courtesy of Staffordshire University.

Scientists from Staffordshire University, England, claim that their new 3D-printed insoles can improve the foot health of people suffering with diabetes. Their study is said to present the first quantitative evidence in support of optimized cushioning in diabetic footwear as part of standard clinical practice. In their latest paper, "Optimised cushioning in diabetic footwear can significantly enhance their capacity to reduce plantar pressure," published in *Gait and Posture*, the researchers conclude that selecting the correct cushioning stiffness in footwear can significantly reduce pressures experienced on the feet, which can lead to ulcers and other painful complications.

In the study carried out in Malta, 15 participants with diabetic foot disease were asked to walk in footwear fitted with made-to-measure 3D-printed insoles designed by the Centre for Biomechanics and Rehabilitation Technologies (CBRT) at Staffordshire University. These footbeds were used to change the stiffness of the entire sole across a spectrum of very soft to very stiff.

"The optimum stiffness is clearly related to the patient's body mass index (BMI)," said Panagiotis Chatzistergos, PhD, associate professor at CBRT and the lead author of this study. "This study adds to our earlier findings and concludes that stiffer materials are needed for people with a higher BMI."

Further work is now under way to develop a method to help professionals identify the optimum cushioning stiffness on a patient-specific basis. ler

Source: Chatzistergos PE, Gatt A, Formosa C, Farrugia K, Chockalingam N. Optimised cushioning in diabetic footwear can significantly enhance their capacity to reduce plantar pressure. Gait Posture. 2020;79:244-250.

Low Energy Increases Fall Risk in Older Adults

Declines in feelings of energy can lead to balance problems in older adults, according to Clarkson University research published in the journal *Physical & Occupational Therapy in Geriatrics*.

"We wanted to see whether increases in feelings of fatigue or, alternatively, reductions in feelings of energy led to declines in balance or gait," said lead researcher Associate Professor of Physical Therapy Ali Boolani, PhD. "We found that declines in feelings of energy led to declines in balance—some declines in balance clinically meaningful."

Three years ago, an undergraduate researcher in Boolani's lab, biology major Stephanie Grobe 2017, published a theoretical paper that stated when older adults feel mentally fatigued, they are more likely to have changes in balance and gait, which can lead to increased fall risks. Several researchers tested the theory and found no change in balance and gait with mental fatigue unless the subject was performing 2 tasks at once. This was perplexing to Boolani's team, but their lab had subsequently found that feelings of energy and feelings of fatigue were actually 2 very different moods. When Grobe had written the paper, they were examining energy and fatigue as opposite ends of the same continuum—i.e. if you're not fatigued, then you're energetic; or if you're not energetic, then you're fatigued.

However, several new studies in the lab showed that a person could be both energetic and fatigued at the same time and that even biological responses to the 2 moods were very different.

The laboratory of Clarkson Associate Professors of Computer Science Natasha Banerjee, PhD, and Sean Banerjee, PhD, performed a pilot study, the results of which found that declines in feelings of energy lead to significant decreases in balance. After performing only 1 hour of mental work, these older adults reported a decline in feelings of mental energy, which then led to changes in balance. This primarily occurred when their eyes were closed, or their vision was obstructed. The Banerjee lab confirmed that what the researchers were "seeing" was true by using video of the subjects performing tasks and machine-learning models created by computer science undergraduate student Jenna Ryan 2021. They were able to identify when there was a decline in feelings of energy with 79 percent accuracy.

"Jenna and the Banerjee lab were instrumental in helping us identify which aspect of the Berg Balance Test had the greatest change in balance after the decline in mental energy," says Boolani. ler

Source: Clarkson University Researchers Find That Low Energy Can Lead to Falls in Older Adults https://www.clarkson.edu/news/clarkson-university-researchers-find-low-energy-can-lead-falls-older-adults

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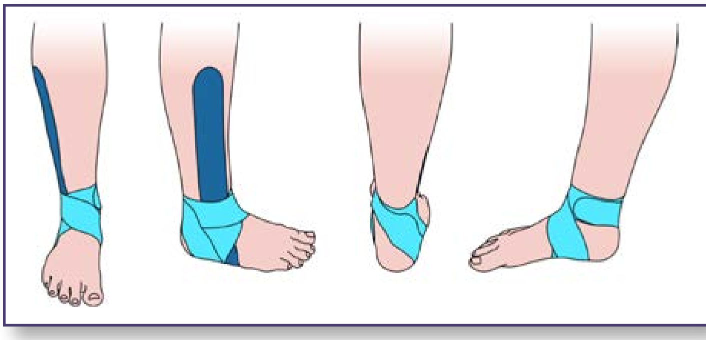
Don't Try This for Ankle Stability



While ankle sprain is perhaps the most common of sporting injuries, there remains no one-size-fits-all solution. But there is one solution that's losing ground based on new evidence from the Institute of Motion Analysis & Research (IMAR) at the University of Dundee in the United Kingdom.

Researchers led by Zack Slevin sought to assess the effect of newly popular (and colorful) kinesiology tape on ankle stability. Slevin's team recruited 27 healthy individuals and took electromyography (EMG) measurements from the peroneus longus and tibialis anterior muscles, the primary stabilizing muscles of the ankle. Using perturbations in a custom-made tilting platform system, they then recorded the muscles of the dominant leg during sudden induced ankle inversions. Measures were taken with and without kinesiology tape and shoes, creating 4 test conditions: barefoot (without tape), shoe (without tape), barefoot (with tape) and shoe (with tape). Peak muscle activity, average muscle activity, and muscle latency were then calculated for each of the 4 conditions.

Their results showed no significant difference using the kinesiology tape in any of the 4 conditions. In other words, kinesiology tape had no effect on the peak muscle activity, the average muscle activity, or the muscle latency for the peroneus longus or tibialis anterior during a sudden ankle inversion.

However, wearing shoes, demonstrated a different story: All mentioned variables increased during a sudden ankle inversion while shod. Results include an increased activity of the tibialis anterior, a prolonged peroneus longus latency, and a shortened latency from peroneus longus activation to tibialis anterior activation.

Writing in their discussion, the authors note that the lack of significant difference between the taped and non-taped conditions regarding peak and average activity of the 2 muscles shows that the tape offered no mechanical support nor did it improve proprioception. Indeed, they note, it may be the case that the tape in fact reduces proprioception rather than improves it. Furthermore, they note that while kinesiology tape appears to have effect on ankle stability, shoes appear to be detrimental.

Source: Slevin ZM, Arnold GP, Wang W, et al. Immediate effect of kinesiology tape on ankle stability. BMJ Open Sport Exercise Med. 2020;6:e000604.

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Missives From the 3D Front Lines

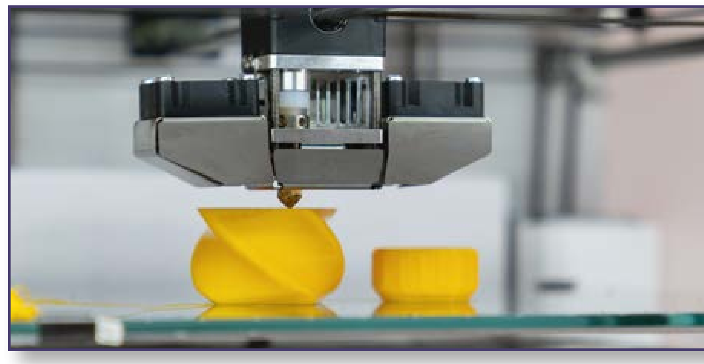
3D printing has been making countless inroads into everyday work routines. Here, O&P professionals share their use of the technology.

By Janice T. Radak and Friends

As this month's cover conveys, three-dimensional (3D) printing has created breakthrough opportunities across the spectrum of lower extremity challenges. 3D printing is allowing healthcare providers from surgeons to shoemakers to dare to dream of patient-specific therapeutic options for conditions once thought untreatable: crushing traumas and nonunions. This disruptive manufacturing process is also helping with neuromotor issues.

Since its discovery in the early 1980s, 3D printing or additive manufacturing (so called because products are built by adding layers of raw material versus traditional machine manufacturing which uses subtraction) has been evolving as a technology as end-users continue to find new uses for it and experiment with new materials.

Custom orthotics, a field that hadn't seen true disruption since the 1950's introduction of vacuum-forming plastics, began to see major integration of 3D printing starting in 2018. Indeed, the price of orthotics was already trending in the wrong direction at $9.80/unit in 2017 down from $10.70/unit in 2013. However, as recently as October of this year, the Research and Markets Report projected that the global foot orthotic insoles market will reach



$5.464.57 million by 2027 up from $3,560.00 million in 2019. Key drivers behind the market growth are the aging of the population and the increasing incidence of both diabetes and obesity, as well as the increasing use of orthotics in sports to achieve higher performance metrics.

To find out more about what's happening the real world, ***LER*** asked readers to share their thoughts on 3D printing in their part of the world. Here is a sampling of their responses:

Joe Fairley, BEP, Orthotic Resident, MPO, with Sampson's Prosthetics & Orthotics Laboratory in Schenectady, NY, (Sampsons.com) writes:

At Sampson's Prosthetics and Orthotics Lab, 3D printing has become an everyday staple in our prosthetic fabrication workflow. Over the last four years, we have been pushing the boundaries of what can be feasibly and usefully 3D-printed for prosthetic applications. We are currently utilizing the PVA Med Emergence Pro 3D printer to quickly and reliably fabricate lower limb prosthetic diagnostic sockets. By integrating 3D scanning with the Structure Sensor or Comb app, then performing 3D modifications with Ossur's Design Studio or PVA Med's RapidPlaster, we have drastically shortened appointment times as well as the technical hands-on time. We have tested our hand casts and plaster modifications against our 3D scans and 3D modifications, resulting in our patients preferring the 3D diagnostic socket in most cases. When comparing Socket Comfort Scores with clinical observations of total contact and dynamic gait mechanics, our 3D printed sockets have been surpassing the traditional sockets.

Other benefits we have seen involve lower material costs, time-saving convenience for our clinicians, and a quantitative way to document limb volume and shape changes over time. We have also dabbled with 3D printing prosthetic covers among other prosthetic componentry. So far, we have not found a consistent application for our orthotic workflow, but it is only a matter of time and more testing before we dive into using 3D printing for orthotics.

Bryan Craft with Additive America in Kinston, NC, (additiveamerica.com) writes:

We are a digital manufacturer who has placed an immense focus on the prosthetics and orthotics field. In fact, 2 of our co-founders are CP and CPO themselves. From our perspective, we're seeing that clinicians who use our technology spend less time in the dusty shop and more time out seeing patients. Their challenges start

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with the digital workflow, so we meet them where they are and go from there. We allow clinicians to keep their existing traditional casting process or move quicker into 3D printed check sockets. Either way they choose they're saving time.

Patient feedback is why we do what we do. We hear how the lighter weight, more customized 3D-printed sockets feel like they are a part of the patient's body. The built-in flex zones move with them and keep them from feeling the pain of walking that once haunted them. This is truly incredible feedback.

Those that are using the multi-jet fusion 3D printing technology are finding these results exciting. This raises the water level for clinicians to take advantage of the benefits of additive manufacturing (AM). As more clinicians come on board with AM, more patients see the end-user benefits of this technology.

What separates our business model from others is the way we think. Optimizing for 3D, fabricating for patients, and time-saving for clinicians are all very important things to make AM progress.

David Gerecke, CPO, FAAOP, with Maughan Prosthetic & Orthotic, in Burien, WA, (maughanpno.com) sent case examples:

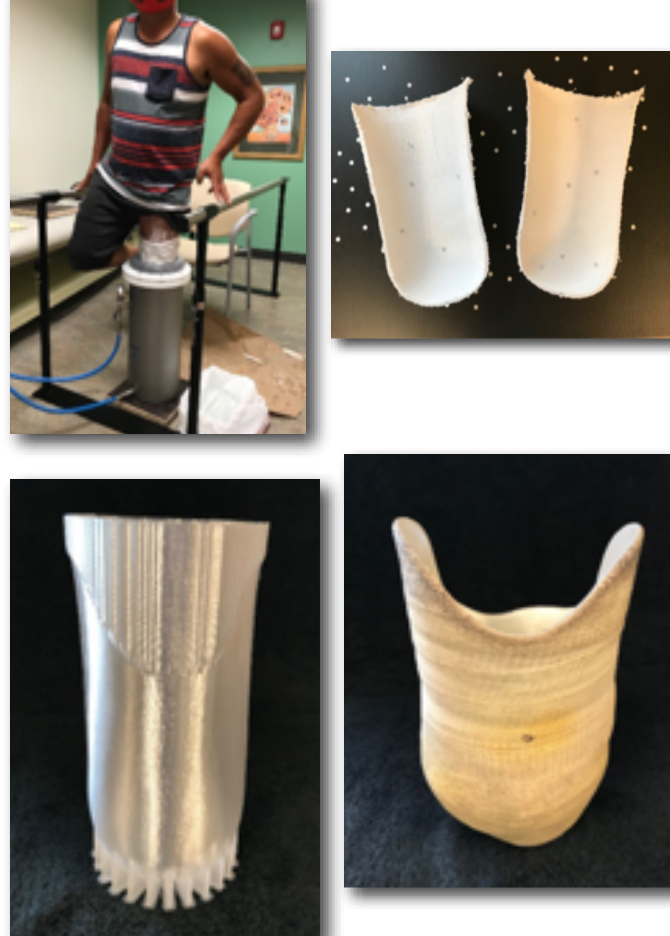
3D printing has revolutionized my prosthetic practice. I routinely deliver a reinforced test socket on definitive components for transtibial amputees in one day. I use the Symphonie Aqua System with Vector Control to take a full weight-bearing plaster cast, which I then digitize. After making almost no modifications to the shape other than correcting for the thickness of the print and adding a brim, I 3D print on my PVA Med/Create 1400 printer, epoxy on a distal connector and reinforce with Delta-Lite conformable casting tape. After alignment on definitive components, the patient walks out on a new prosthesis on the same day. After using this temporary socket for a few days, I re-assess fit and make necessary changes to the shape (seldom needed), then 3D print another socket to send to our fabrication facility for duplication in definitive materials.

Case 1

41 y/o male left trans-tibial amputation who lives about 290 miles from my clinic in Burien, WA. He usually arrives by car or train on a Wednesday night and comes in Thursday morning then leaves Friday afternoon when we are finished. Our challenge is his weight-loss program where he has lost about 40 pounds over the last year. This has resulted in a few socket changes. He has been in a series of Delta-Lite reinforced test sockets which are aligned on his componentry and delivered same day. These reinforced test sockets are durable enough for several months of use. He is close to his target weight of 165-170 lbs. where we will then create a definitive socket for him.

CAD/CAM software and 3D-printing allow me to check in with him

Case 1



by phone before he comes to my clinic to see where he is in residual limb volume. Number of ply, pressure points, and his recurrent lateral patellar bursa are reviewed. Zoom meetings provide needed visual information. If needed modifications are minor, I print a socket for him prior to his arrival. Socket changes take mere minutes, and he is often on his way home on the same day. If re-casting is needed, same-day turn-around is routine.

Case 2

Transtibial foam covers are easily produced by scanning the sound side, mirror imaging, then merging with a scan of the prosthesis. The resulting 3D printed mold interfaces intimately with the prosthetic socket and the foot shell allowing minimal finishing for the 2-part expanding foam. Prosthetic skin can then be applied over the resulting shape, producing a foam cover that is a mirror image of the uninvolved side. There are many possible variations with this technique, including the need to accommodate components or create a removable cover.

All in all, 3D printing has changed my practice philosophy. Rather than requiring multiple visits over the course of several weeks, I can provide a comfortable and functional definitive prosthesis in as little as a few days, with the patient routinely walking out same day on a prosthesis with a reinforced test socket. During these COVID-19 Pandemic times,

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"You wouldn't talk on a phone from 50 years ago and you wouldn't watch a television from 50 years ago...why would you make a prosthesis using techniques from 50 years ago?"

Case 2

Images provided by David Gerecke, CPO, FAAOP.

this approach also minimizes infection risk for patients, families and providers by requiring fewer visits.

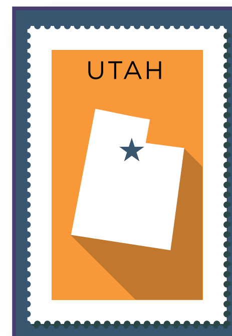
I see the potential for a same-day definitive prosthesis!

Alex Olsen, CPO, with Great Lakes Prosthetics & Orthotics, (greatlakespando.com), in Ypsilanti, MI, writes:

We integrated 3D-printing into our practice a little over a year ago and it has been a game changer. We are now able to reduce turnaround time on prosthetic devices dramatically, which enables our patients to be in their devices much sooner than with traditional fabrication methods.

We have used 3D printing extensively for check sockets for prosthetics, and even printed a few custom orthotic devices, from wrist/hand orthoses to custom humeral fracture orthoses. We are also using it to print protective cosmetic covers for lower extremity prostheses, and the flexible inner socket portions of the socket. This one is particularly beneficial because if the flexible socket tears or is otherwise unusable, it is very easy to just reprint it to the exact size and thickness of the original, which in traditional fabrication is very difficult.

Brian Greer, CP, BOCO, with Mobility Prosthetics (mobilityprosthetics.com) in Murray, UT, writes:



We have been using digital scanning and 3D printing for prosthetics for over 4 years now. These technologies have completely improved the patient experience and outcomes. First, taking a scan of a residual limb is far superior to taking a plaster or fiberglass cast because it is faster, cleaner, and more precise. Also, I will add that patients, family members, doctors, and physical therapists are mesmerized by the scanning process and the accuracy of the scan once it is taken.

Next, computer-aided design is far superior to model modification with plaster of paris because it is also faster, cleaner, much more precise, and fully replicable. Really, there is no comparison between plaster model modification and computer-aided design...it would be like comparing painting a portrait to taking a photograph.

Lastly, 3D-printing of a diagnostic or definitive socket has dramatically improved the process because it can be printed overnight, it can be fabricated to any specification (eg, wall thickness thinner in some regions for flexibility while thicker in others for strength), and it is completely and totally replicable. If a patient breaks a socket, a new one that is identical to (or even better than) the broken one can be printed before they arrive back at the office.

Honestly, scanning, computer-aided designing, and 3D-printing prosthetics are the way that it should be done in this day and age. You wouldn't talk on a phone from 50 years ago and you wouldn't watch a television from 50 years ago...why would you make a prosthesis using techniques from 50 years ago? 3D-printing is a 21st century tool for a 21st century professional.

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Clinical Applications of Custom 3D Printed Implants in Complex Lower Extremity Reconstruction

The authors present four cases of complex lower extremity reconstruction involving segmental bone loss and deformity – failed total ankle arthroplasty, talus avascular necrosis, ballistic trauma, and nonunion of a tibial osteotomy. Traditional operative management is challenging in these cases and there are high complication rates. Each case presents a unique clinical scenario for which 3D printing technology allows for innovative solutions.

By Rishin J. Kadakia, MD, Colleen M. Wixted, Nicholas B. Allen, Andrew E. Hanselman, MD, and Samuel B. Adams, MD

The use of three-dimensional (3D) printing has revolutionized the manufacturing process across various industries and enabled the creation of precise customized products. The origin of this technology can be traced back to 1984 when Charles Hull filed a patent for the stereolithography fabrication system and eventually began selling 3D printers for commercial use in 1988.[1,2] This technology has drastically changed over the years and is currently being employed in almost every major manufacturing sector. 3D printing technology has recently been more utilized in medicine and specifically in the field of orthopaedic surgery. Within orthopaedic surgery, 3D printing has allowed for the development of anatomical models that can be used for preoperative planning and education and more revolutionary, the development of patient specific instruments and implants that can be used intraoperatively. This technology can be helpful in cases of complex lower extremity reconstruction as deformity and bony defects can be challenging to manage. The ability to customize surgical instruments and implants to match the complex 3D deformity that is frequently seen with foot and ankle pathology has made 3D printing a novel tool when tackling these challenging problems. The applications of 3D printing within foot and ankle surgery are endless and as the technology continues to progress, the clinical utility will become more evident.

3D printing within orthopaedic surgery

3D printing technology is already being utilized within other subspecialties in orthopaedic surgery. Takeyasu et al. reported on a series of 30 patients who underwent correction of cubitus varus deformity – a complex deformity of the elbow - with custom made 3D printed surgical guides. They found statistically significant improvements in alignment and 90% of patients reported excellent results.[3] For total knee arthroplasty (TKA) and total hip arthroplasty (THA) cases in patients with complex or unique anatomy, 3D printed patient specific instrumentation and implants have become a viable alternative. Compared to standard implants, patients with custom implants reported fewer adverse events, decreased intraoperative blood loss, and were less likely to be discharged to an acute care facility or rehabilitation center in a recently published study.[4] 3D printing technology has also allowed engineers to improve upon standard implant designs through the manufacturing process. Patients who underwent revision hip arthroplasty with 3D printed acetabular cups demonstrated improved stability, better hip scores, and decreased pain.[5] While a majority of the products of 3D printing technology provides direct patient benefit, surgical trainees can develop, practice, and refine their technical skills with realistic 3D patient models as well. A survey of resident surgeons regarding the clinical utility of 3D models of posterior column fractures reported high overall satisfaction with these models when planning their surgical approach.[6] There are many applications of 3D printing already in place within orthopedic surgery and the applications will continue to grow as technology advances and access to 3D printers improves.

3D printing in foot and ankle surgery

Foot and ankle pathology can be challenging to manage given the complexity of the three dimensional anatomy and interactions between the several articulations. Deformity

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correction requires an appreciation for normal anatomy but also an understanding of the deformity in multiple planes. 3D printing technology can assist in the preoperative planning of these complex cases by providing precise anatomical models to plan out hardware placement and osteotomies. Jastifer et al. reported on using a 3D model to help plan for deformity correction for an ankle fracture malunion. The authors used the model to template their fibular lengthening osteotomy and fixation construct.[7] 3D printing has also been shown to be effective in the management of acute foot and ankle trauma. High energy trauma to the foot and ankle can be challenging as anatomical reduction of the articular surface is crucial for long term success. Zhang et al. presented a cohort of patients who underwent surgical management of high energy ankle fracture dislocations with the assistance of 3D printed models for preoperative planning. They compared this to a cohort of similar patients who did not have preoperative 3D models and found that the patients who underwent fixation with the models had shorter operative times and less intraoperative fluoroscopy and blood loss.[8] Yao et al. similarly created 3D models of calcaneus fractures to assist with preoperative planning but also used the models to precountour hardware to ensure it fits appropriately. They found that this technique improved accuracy of hardware positioning and placement and allowed for minimally invasive surgical approaches.[9] 3D printed patient specific cutting guides can be used to ensure precision and accuracy when making bone cuts and osteotomies for deformity correction. Several studies have demonstrated that patient specific instrumentation is accurate and reproducible performing total ankle arthroplasty.[10,11] 3D printed custom guides have also been designed for subtalar joint arthrodesis, and a recently published study found that these guides reduced operative time and radiation exposure from fluoroscopy.[12]

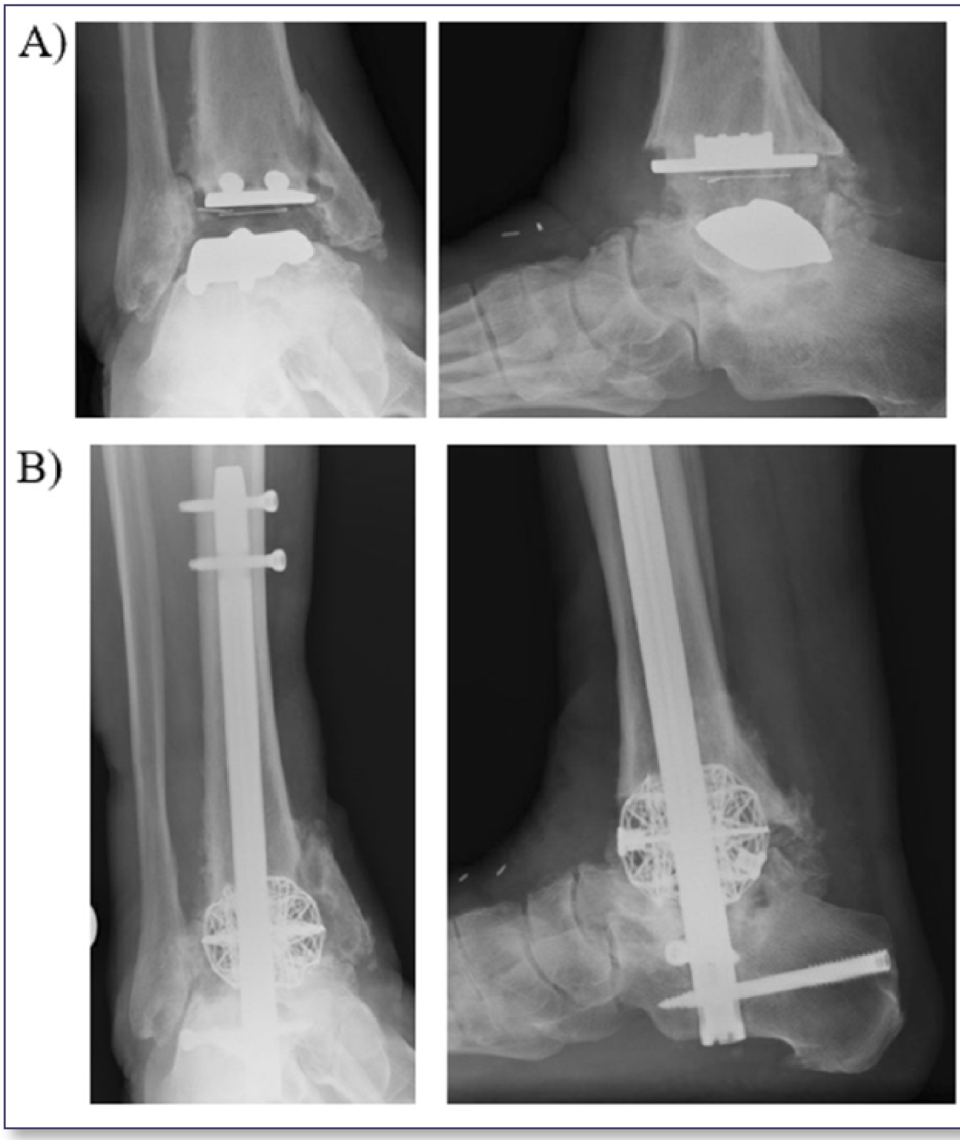

Figure 1. Tibiotalocalcaneal (TTC) arthrodesis for case of failed total ankle arthroplasty. A) Anteroposterior (AP) and lateral radiographs demonstrate STAR ankle prosthesis with evidence of talar component collapse with erosion into subtalar joint. Medial malleolus fracture present as well. B) Patient underwent TTC arthrodesis with 3D titanium cage. The cage is packed with allograft/autograft to enhance healing.

Complex foot and ankle reconstruction is frequently complicated by large osseous defects that require structural bone grafting. Structural grafts typically require significant contouring and can be difficult to mold to the patient's native anatomy. The graft can also collapse over time which compromises its mechanical integrity. 3D printing has allowed for the development of custom metal implants that provide superior mechanical stability while also conforming to the patient's anatomy. These custom implants can also be designed with surfaces that promote bone growth and can have areas to pack bone graft. Dekker et al. reported on a cohort of 15 patients who underwent complex lower extremity reconstruction augmented with a 3D printed titanium cage and demonstrated an 87% success rate with 13 of the 15 patients successfully healing their fusion/osteotomy site.[13] Nearly all of the patients in this cohort had a history of previous failed arthrodesis or significant bone loss/deformity from trauma. Reconstructive options for these patients without the assistance of 3D printed technology would be extremely complex and would likely involve large structural allografts and multiple surgeries. Hlad et al. reported on the use of custom 3D titanium implants in the management of bone loss in the setting of failed foot and ankle surgery. They used a titanium cage in cases of a failed total ankle arthroplasty and nonunions of a calcaneal osteotomy and a first tarsometatarsal (TMT) joint arthrodesis. They demonstrated successful healing at 1 year post-op with no complications.[14] 3D printing

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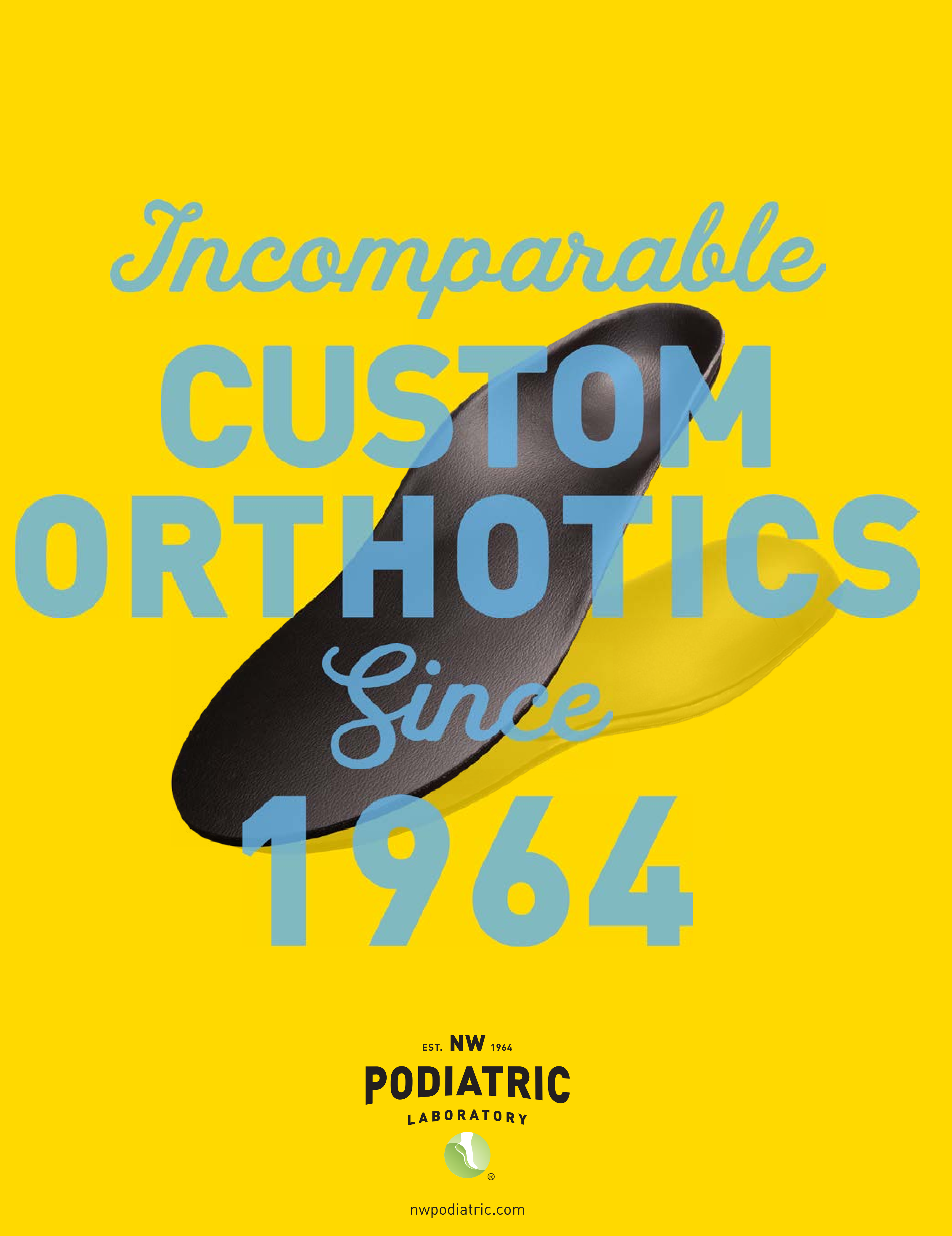
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has revolutionized the treatment of challenging foot and ankle pathology. It allows for better preoperative planning, improved accuracy with bone cuts and osteotomies, and also allows for customized implants in cases of complex deformity and bone loss. The following cases are examples of complex foot and ankle cases in which 3D printing technology was used in surgical management at the authors' institution. The custom metal implants in these cases were designed using the Materialise 3D printing software (Materialise, Plymouth, MI). The implants were printed using the DMP Flex 350 metal 3D printer (3D systems corporation, Rock Hill, SC).

Clinical Applications of 3D Printing

Case 1: *Tibiotalocalcaneal (TTC) arthrodesis in setting of failed total ankle arthroplasty*

Failed ankle arthroplasty can be challenging to manage. As talar components collapse, the native talus is eroded away and a large bone defect is often present. These cases can be managed with TTC arthrodesis and bulk structural allograft – most commonly a femoral head. Unfortunately, these complex reconstructions are prone to nonunion (when the bones do not heal together) and the graft can collapse over time. 3D printed cages can serve as augments in these cases to provide structural support and conform to the anatomy of the patient. These cages can be designed to have space for bone grafting and have surfaces designed to improve bony incorporation. Figure 1 is the case of a 65-year-old man who presented with a failed total ankle arthroplasty. His talar component had collapsed and eroded through most of the remaining talar bone and into the subtalar joint. He also presented with a medial malleolus fracture. The patient underwent a TTC arthrodesis augmented with a 3D printed titanium cage.

Case 2: *Total talus arthroplasty in the setting of talar avascular necrosis*

Avascular necrosis of the talus (AVN) is a challenging clinical entity to treat. This disease process occurs when the blood supply to the talus is damaged either by a systemic process or trauma. Nonoperative treatment frequently requires prolonged periods of immobilization which can be detrimental to a patient's functioning. While early stages of disease can be managed with joint preserving procedures such as core decompression and vascularized bone grafting, advanced disease commonly presents with talar bone collapse. For these advanced cases, prior to 3D printing technology, arthrodesis was routinely the only surgical option, especially with arthritic changes in the ankle or subtalar joint. Like in the previous case, arthrodesis involves removing all avascular bone which leaves a large bone defect. In some instances, talar AVN can present without significant arthritic changes in the surrounding joints. These cases are amenable to total talus arthroplasty with custom 3D printed implants. This implant is designed based on CT images of the talus from the contralateral limb. The implant is made from cobalt chrome and is smooth to allow for gliding at adjacent articulations. Figure 2 represents a case of a 45-year-old female who developed talar avascular necrosis in the setting of a previous subchondroplasty. She underwent total talus arthroplasty with a custom 3D printed implant.

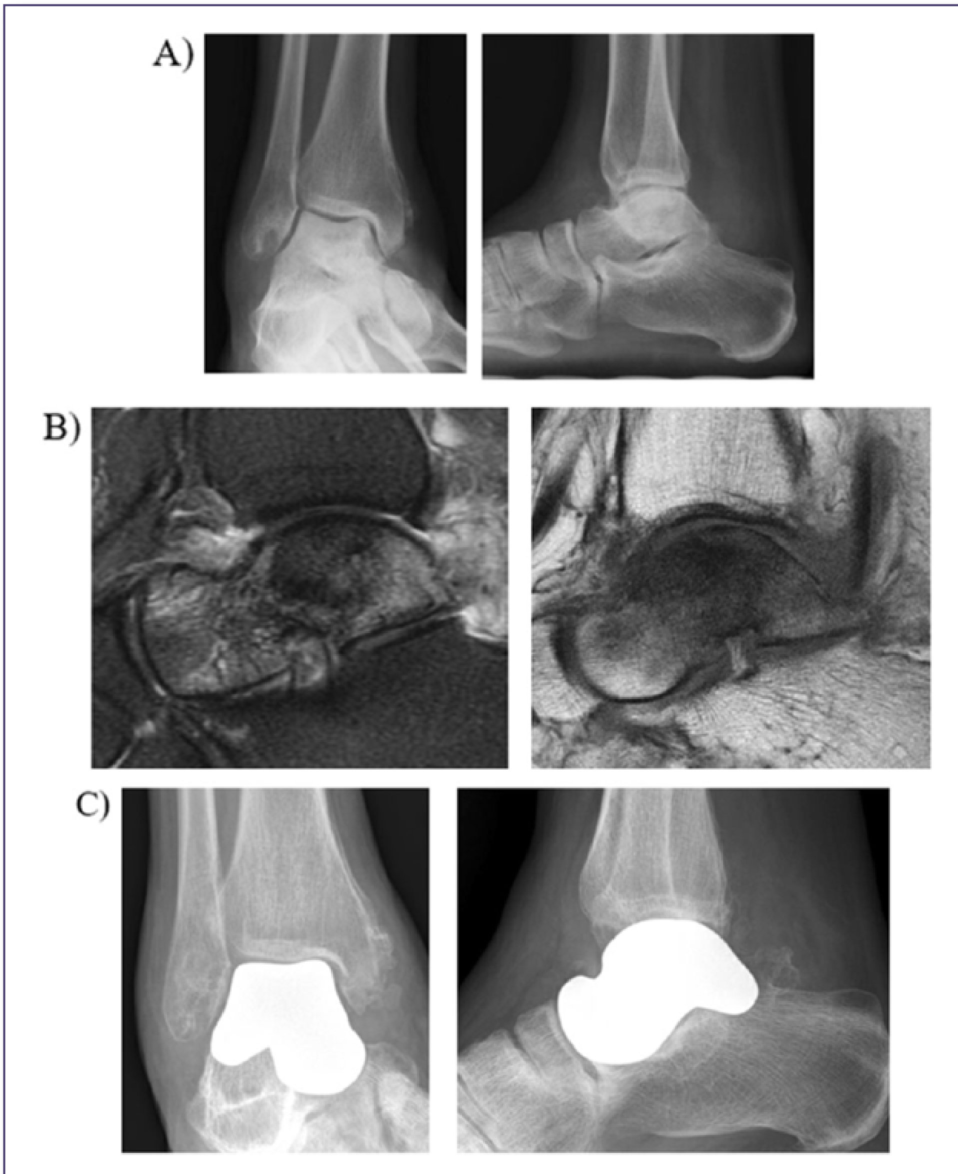

Figure 2. Total talus arthroplasty for talar avascular necrosis. A) AP and lateral radiographs demonstrate significant sclerosis of the talar body with some central collapse. B) Sagittal T2 and T1 cuts demonstrating diffuse talar avascular necrosis. C) Total talus arthroplasty with custom 3D printed cobalt chrome prosthesis. Implant is designed based on imaging from the contralateral normal talus.

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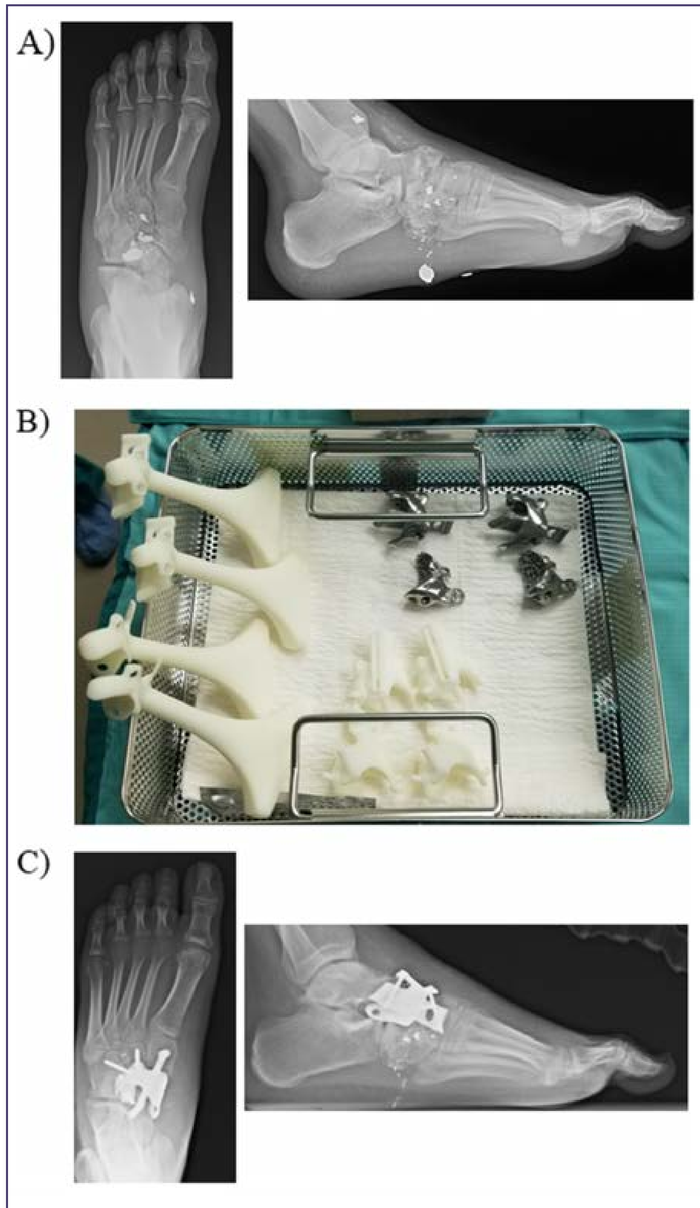

Figure 3. Navicular 3D cage for ballistic navicular fracture. A) AP and lateral radiographs of the foot demonstrating a ballistic comminuted navicular fracture. B) Sterile operative tray with the 3D printed objects. The plastic objects in the left of the tray are the sizers that are used to determine the implant size that will be used. The bottom of the image shows the custom 3D printed cutting guides. The top contains the 3D printed implants. Multiple sizes are printed and the sizers are used to determine which implant will be used. C) Immediate postoperative images with the cage construct in place

Case 3: *Navicular titanium cage in setting of navicular bone loss from ballistic fracture*

Ballistic trauma to the foot can be difficult to manage. These injuries typically result in severe comminution making anatomic reconstruction difficult. Ballistic fractures of the navicular can result in shortening of the medial column and this deformity can alter gait biomechanics. Figure 3 is the case of a 23-year-old male who sustained a ballistic navicular fracture resulting in severe comminution not amenable to surgical fixation. The patient had a 3D printed navicular cage designed for a medial column arthrodesis. The implant was designed based on the normal contralateral navicular from a CT scan and built to have struts that would extend out of the navicular cage into the talus and cuneiform to help increase stability. These struts also had bony ingrowth surfaces to promote incorporation. Furthermore, the implant was designed to have multiple possible screws to further enhance stability. In order to ensure the appropriate cuts were made for the struts and the implant, custom cutting guides were also designed to help ensure appropriate fit of the implant.

Case 4: *Custom 3D printed cutting guide for a tibial osteotomy*

Angular deformity can be challenging to correct especially when deformity is present in multiple planes. Preoperative planning for these cases is crucial and all planes of deformity must be considered when templating osteotomies and hardware placement. 3D printing technology can be helpful in these cases by providing precise cutting guides to assist with the osteotomies. Figure 4 demonstrates a case that used 3D printed custom cutting guides and implants. This is a 50-year-old female who has a history of previous supramalleolar tibial osteotomy (SMO) for a varus deformity that ultimately failed and required a revision surgery. Unfortunately, her revision procedure also went on to a nonunion and she continues to have residual coronal and sagittal plane deformity. She underwent a nonunion takedown and revision distal tibial osteotomy with the assistance of 3D printed custom guides and implants. The implant was designed to fit the patient's anatomy and correct the deformity. The implant also was printed with a plate attached to it so that fixation could be added directly to the construct.

Limitations to 3D printing technology

While these cases highlight the versatility of 3D printing within foot and ankle surgery, it is important to understand the limitations that come with this new technology. One of the main drawbacks of using custom 3D printed implants is the cost associated with making the implant. Healthcare costs are a tremendous burden on hospitals and patients – thus use of expensive implants may be denied in favor of more traditional and cheaper implants. However, as the technology continues to improve, costs of production will decrease and make these implants more affordable. The time it takes to design and manufacture the implant is also a limitation and it can take at a minimum 4 to 6 weeks for an implant to be made. This time delay has functional and economic consequences to the patient who continues to have pain and may be unable to work. It is important to note that this 4 to 6 week time frame is from experience at our institution and may vary between locations and practices. Finally, the technology is new thus there is a learning curve associated with its use. Each case is unique and presents its own challenges which adds complexity to using a custom implant and instrumentation. Surgeons must take extra time to prepare for each case and inspect the instruments and hardware before the case begins to better anticipate any intraoperative difficulties that may arise with its use.

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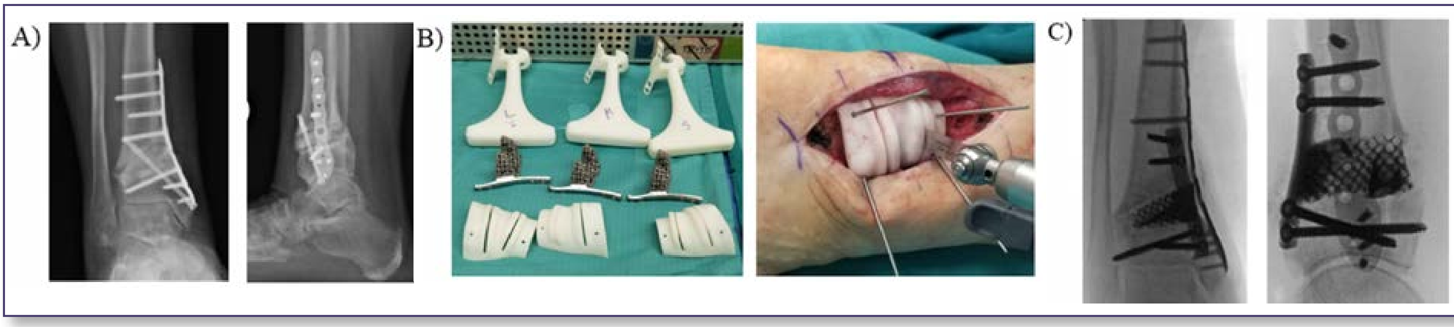

Figure 4. Custom cutting guide for revision tibial osteotomy. A) AP and lateral views of the ankle demonstrating previous SMO with nonunion. B) Custom 3D printed sizers, corresponding implants, and custom cutting guides. Cutting guide pinned in place to make appropriate bone cut. C) Immediate postoperative images with implant in place, bone graft, and additional medial plate added for stability.

Conclusion

3D printing technology has revolutionized the manufacturing industry. As the technology has advanced over the past several years, its clinical utility and applications have also increased. 3D printing in orthopedic surgery can be used to improve preoperative planning, customize implants and instruments, and improve surgeon education and training. Within foot and ankle surgery, orthopedic surgeons can use 3D printing technology in the surgical management of complex deformity and cases of significant bone loss.

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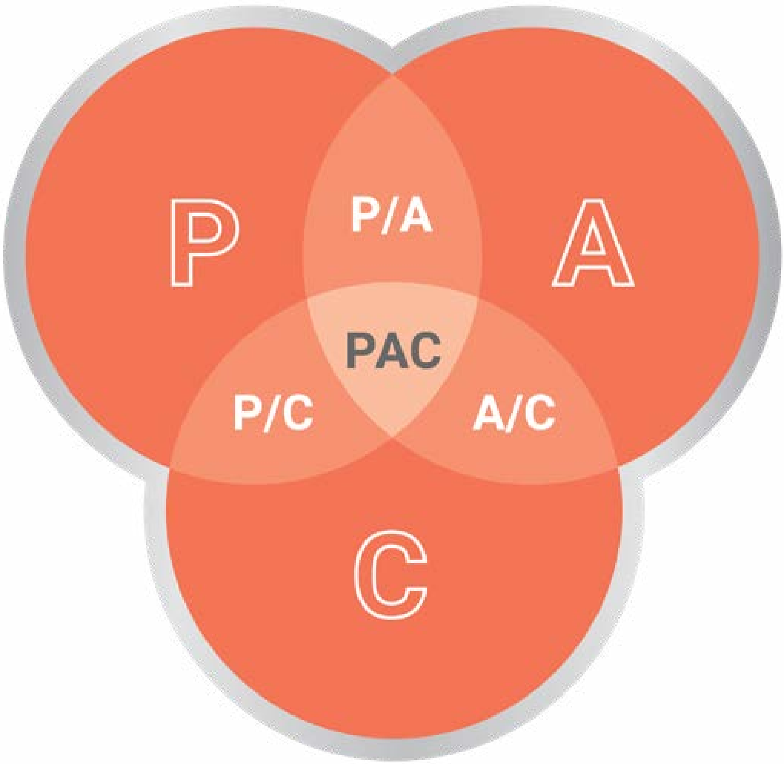
LER PEDIATRICS: Can't Vs Doesn't Understand: Coaching Toward Cognitive Abilities

Clinicians deal with clients and patients with a range of abilities. This author provides expert guidance on meeting patients and clients where they are to succeed in communicating.

By Eric Chessen, M.S.

Photos provided by Eric Chessen.



The Autism Fitness PAC Profile Method Venn Chart

"Okay, now let's see a squat, I'm gonna go first and then you try."

The above is a standard sentence during our initial session; what we call our PAC Profile® Assessment. PAC stands for Physical, Adaptive and Cognitive and that first sentence carries with it a powerful proactivity. When we teach movement, it makes sense to demonstrate first. Explaining an exercise, opposed to demonstrating, is far less conducive to success. This is regardless of whether discussing the autism or neurotypical population. With particular respect to those with autism and related developmental disabilities, *how* we coach and cue exercise is critically important. Certain practices give us and our athletes better opportunities to succeed and reduce breakdown.

In our Autism Fitness® programming, we've found the most efficient use of initial instruction time (the first time we are teaching an exercise) follows this format:

1. Label

2. Demonstrate

3. Do and Cue

This structure has become one of our training mantras. For those with Autism Spectrum Disorder (ASD), labeling in particular can have immediate and long-term benefit for language (productive *and* receptive), memory, and independence. Labeling refers to naming the exercise. Upon introducing squats, our labeling protocol would be:

> *"Let's try squats. I'll go first and then you go."*

By giving the exercise a name, and with consistent repetition, 2 highly important attributes emerge:

> We need to have a hierarchy of cues and strategies depending on what is observed. More show than tell. Label. Demo. Do and cue.

1. The athlete learns the name of the exercise
2. The athlete begins to associate the name of the exercise with the expectation for performance

If the athlete is familiar with the word "squat" and can equate it to the movement pattern that constitutes a squat (whatever their current ability level), the coach does not have to repeat and demonstrate and repeat and repeat and repeat – because the athlete already knows. The word "squat" and the movement/physical performance have been paired in a way that makes sense, and is memorable, for the athlete. Extraneous language use by the coach/instructor can kill momentum by causing confusion. Extraneous language typically goes something like this:

Continued on page 45

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An Autism Fitness athlete performing squats independently

Eric fading (reducing) a physical prompt when coaching Sandbell overhead presses

"Okay, it's time to do squats. Remember to bend your knees and keep your head forward. You remember how to do squats, right? They're really fun! Keep your feet on the floor. No, not like that, remember how to do it correctly..."

And the athlete is lost, and likely frustrated.

Labeling adds to the lexicon, and building receptive language is important.

It's remarkable just how much functional language we can build through fitness programs. Not only exercise names "squat, press, pull-down, push throw, rope swings..." but objects "Sandbell, rope, cones, Dynamax ball, sandbag..." and abstract concepts including prepositions "in, on, under, right, left, up, down...." When our athletes are actively engaged in fitness activities, teaching these terms/concepts is easily presented in a natural manner.

By labeling, we are also avoiding using abstract language that is often lost on our athletes with ASD, who tend toward very literal thinking. Labeling also leads to autonomy. When an athlete can choose one exercise over another and demonstrate preference, we can infer an understanding of what the name of the exercise represents. Choice is dependent on understanding the distinction between, for example, a medicine ball "push" throw, or an "overhead" throw.

Demonstrating is crucial because it circumvents us and our athlete standing there and staring at one another (or off into the distance for those of our less-eye-contact-inclined friends). We *always* demonstrate a new exercise; this provides context for our athlete's interpretation of what we just did. Demonstrating provides our athlete visual representation of what they are about to do.

Now, performance will vary, and demonstrating a movement once is no guarantee that the athlete will have the physical capability to complete the exercise to full independent mastery. But that is where we provide a regression. But we cannot regress an exercise until we've observed the individual perform it first. So, we demonstrate and allow them to follow our lead.

Do they get right down to squatting (pun somewhat intended)? Are they hesitating? Do they just bend their knees a little bit? Do they squat below parallel but with significant compensatory patterns present? What we get here is a *baseline*. A baseline is what level of ability the skill is at right now so that we can program accordingly.

We may provide a physical or guided prompt early on with an exercise to ensure safe and effective technical performance. With the squat, this may mean having the athlete use a box or elevated surface to ensure healthy hip flexion and neutral spine position. The quality of performance makes the exercise.

Depending on physical, adaptive, and/or cognitive ability, we may be able to fade this support in the first session or it could take months. I've had some highly motivated athletes who, because of their physical needs, require longer practice with a given level of an exercise. The athlete is held to the expectation of his/her best current level of performance.

Do and Cue. Effective assessing enables us to determine how best the athlete will learn a particular exercise. While it's tempting to classify our athletes as "more visual" or "more kinesthetic" learners, I've found that it is far better to approach this from an exercise-by-exercise basis. Some of my athletes need physical prompting through the end range of an overhead press but will independently perform a band row when I demonstrate pulling my arms

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back while standing parallel to them.

"Doesn't know how" is a misinterpretation of breakdown in effective coaching communication. We need to be instructing with less words, more action. We need to have a hierarchy of cues and strategies depending on what is observed. More show than tell. Label. Demo. Do and cue.

When our athletes, or any of us, don't understand the direction, the contingency, or the expectation, we freeze, get off-task, get frustrated, or a Lucky Charms marshmallow cornucopia concoction of all three. Being proactive in coaching means giving our athletes the information they require delivered in a way that is useful to them. It means having a structure that is reliable for assessing, addressing, and meeting goals in all three areas of ability (physical, adaptive, and cognitive).

It is easy to take for granted the neurotypical ability to interpret nuance, abstraction, and implied information; the untold stuff between the clearly marked things. Giving our athletes the context and environment to succeed, especially in the first few sessions or when teaching new exercises becomes our bridge to success in coaching and performance.

Eric Chessen, MS, is the founder of Autism Fitness®. An exercise physiologist with an extensive background in Applied Behavior Analysis, Eric has spent nearly 20 years developing successful fitness and adapted PE programs for the autism and special needs populations. Eric is the creator of the PAC Profile® Method and the Lead Instructor for the Autism Fitness Certification (Levels 1, 2, and Master). His work has been featured on Yahoo News, VICE Media, and he has Presented at TEDx. He resides in Charlotte, NC. For more information visit AutismFitness.com

This article expands a blog post that originally appeared on MedFit Network, a professional organization for medical fitness (fitness and allied healthcare) professionals, one of LER's partners. Their work can be found at medfitnetwork.org.

Eric providing a mirror/visual cue during cone touches

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PATIENT GUIDANCE:
Three Easy Steps to Eliminating Heel Pain Without Visiting a Doctor

By Paul J Betschart, DPM, FACFAS


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Who is this for?

Anyone who is suffering from heel pain and is looking for the best way to treat it at home.

Who is this not for?

People looking for an instant cure, pill poppers and those unable or unwilling to follow simple instructions.

What you will learn:

Self-management strategies for eliminating heel pain.

By far, the most common cause of heel pain is a condition called plantar fasciitis. This condition is an injury to a ligament on the bottom of the foot called the plantar fascia. This ligament runs the length of the foot from the heel bone to the base of the toes. This ligament is one of the most important stabilizing structures of the arch of the foot. The most common part of the plantar fascia to be injured is under the heel where it attaches to the heel bone. The body responds to this injury with inflammation, which is perceived as pain.

Lack of support of the arch in shoes is a common cause of injury to the plantar fascia.

Other causes include direct trauma, such as stepping on a hard object, overuse, like building up running mileage too fast, and inflammatory conditions, such as rheumatoid arthritis.

Less common causes of heel pain include fractures of the heel bone, bone tumors, bone cysts, foreign bodies, skin tumors and soft tissue or bone infections. These infrequent causes of heel pain would need diagnosis and treatment by a medical professional.

This article will focus on managing the most common cause of heel pain, plantar fasciitis.

I use 3 steps for treating heel pain:

- Recover
- Rehabilitate
- Recurrence prevention

Recover

Pain in an area after an injury is the body's signal to us to rest that body part. Rest is the first part of the recovery phase. Rest doesn't always mean no weight on the foot or bed rest. Relative rest is often good enough. What we mean by relative rest is reducing the level of activity to below the level of activity that causes the pain to increase. An example would be, if running causes pain to increase, then stop running and switch to walking, which would

"Offloading means taking the weight off the foot or leg with a walking boot or complete non-weight bearing with crutches or a knee scooter."

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provide the relative rest needed. Sometimes, a reduction in mileage or intensity is all that would be needed. Sometimes, offloading of the painful area may be necessary. Offloading means taking the weight off the foot or leg with a walking boot or complete non-weight bearing with crutches or a knee scooter.

The body often responds to injury with inflammation or swelling. Reducing inflammation is important in this phase. Using a cold pack is a great way to reduce inflammation: 20 minutes on, 20 minutes off around the clock for the first 48 hours is ideal, but often not possible. Just try to use the on-off cold pack routine as much of the day as possible. An easy way to apply cold at work is to freeze a plastic water bottle and rest the foot on it, gently rolling the arch on the bottle. Gel packs, crushed ice or frozen peas are other alternatives for applying cold. Over-the-counter anti-inflammatory medications, such as aspirin, ibuprofen, naproxen, etc., can be taken for 5-7 days to reduce inflammation (or as you are allowed). Cannabidiol or CBD products are an alternative way to reduce inflammation and pain naturally. Topical pain creams can help with symptom control, but these do not have anti-inflammatory properties. This means that they cannot get to the real cause of the swelling. Arnica is a homeopathic topical remedy that can be effective for pain relief.

Protection of the injured area is very important in this phase. Heel cups made from silicone or rubber can be used to protect the heel area for walking. Avoid flat shoes or sandals as these increase the heel strike force. Elevating the heel slightly also takes tension off the plantar fascia and forces your weight to the outside of the foot, which provides stability.

- A standard running shoe should have the right amount of heel lift.
- Dress shoes and boots should be limited to under 2 inches of heel.
- Night splints are a good way to protect the foot when sleeping or resting. These can be obtained online or through a medical professional.
- Elastic arch bandages and compression socks are helpful in resting the plantar fascia.

Using these recovery methods for 1-2 weeks should allow symptoms to reduce enough to begin the rehabilitation phase.

Rehabilitate

The rehabilitation phase is further divided into 3 components: support, stretch, and strength

Support

To allow the plantar fascia to heal properly, tension or strain throughout the tissue must be reduced. This is done by supporting the arch of the foot. Since the plantar fascia runs the length of the bottom of the foot, supporting the center of the arch will relieve strain on the insertion point on the heel bone where the injury usually occurs. Several effective support strategies are available.

1. Taping. Various taping techniques and materials are available to provide support to the plantar fascia. A simple and effective taping is called the Campbell's rest strapping. This technique uses ¼ inch athletic tape in short strips. Starting just forward of the heel pad, place a strip across the bottom of the foot, starting on the outside below the ankle bone and ending on the inside of the foot below the ankle bone. Add more strips in the same manner, overlapping each other by ½. End when you reach the ball of the foot. Anchoring strips can be used over the ends of the bottom strips on the sides of the foot. The tape can be left in place as long as it is providing support. The length of time it is effective can vary based on activity level, sweating, water exposure, etc. You can have a buddy apply this strapping for you if flexibility issues prevent reaching the bottom of the foot.

2. Elastic arch support. A variety of elastic supports are available without prescription in local drug, sporting goods or discount department stores, or online. These range from compression socks to arch binders to elastic with rubber arch supports. Though less effective than taping, they have the advantage of being removable and reusable.

3. Insoles. Most insoles sold over the counter (OTC) provide cushioning, but little if any arch support. There are brands available, such as Superfeet®, PowerStep®, Sorbothane®, and others, that have insoles with firm plastic arch forms. In my experience, these are the most effective brands of OTC insole. These can be found at sporting goods stores, running stores, or online. These types fit the average foot well. Extremes in arch height, low or high, may not be comfortable in OTC

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devices. Insoles have the advantages of convenience, comfort, and durability. I recommend that the foot be supported for at least 6 months to allow the tissue to fully heal and remodel.

Stretch

Stretching exercises and self-massage help to release tension on the involved soft tissues, improve blood flow and help realign tissue fibers. Stretching also addresses some of the underlying biomechanical imbalances that contributed to the injury. The most important area to stretch for most foot and ankle conditions is the Achilles tendon/calf muscle complex.

Achilles Tendon/Calf/Soleus: This tendon attaches to the back of the heel bone and its fibers extend to the bottom of the foot and blend with the plantar fascia fibers. Stretching this tendon will reduce tension on the plantar fascia. The easiest stretch to perform is the wall push-up or sprinter's stretch. Stand a few feet from a wall with feet together and toes pointed at the wall, place both hands on the wall and lean forward, bending at the ankle, keeping your body as straight as possible. When a comfortable stretch is felt in the tendon or calf muscle, hold the stretch for 10 seconds then relax for several seconds and repeat the 10-second stretch 10 times. As mobility improves, stretches can be held for up to 30 seconds to improve flexibility. Keep the knee fully extended in the initial set. With a slight bend in the knees, repeat the 10-second stretches for another 10 repetitions. This will stretch another part of the calf muscle, the soleus. Some people find it easier to stretch one leg at a time in a lunge position. An alternative to this stretch is the towel stretch. Wrap a towel or exercise band under the ball of the foot and while standing upright, pull the foot up toward the leg. Repeat the 10-second holds as above.

> The rehabilitation phase is further divided into 3 components: support, stretch, and strength.

Plantar fascia: Stretch/Self-Massage: To stretch the plantar fascia, sit on the edge of the bed or chair with the foot on the floor. Lift the heel and roll up on the toes. You will feel the stretch in the bottom of the foot. Do the 10-second hold 10-repetition set as above. An important note: The plantar fascia, which functions as a ligament to hold the foot stable, is not designed to stretch, so don't force it. Be careful with this stretch if you have arthritic toe joints. This stretch can be performed first thing in the morning when getting out of bed to help with the first step pain that is common with plantar fasciitis.

Self-massage of the plantar fascia should be performed for 10-15 minutes daily. A firm ball or foam roller works best. Alternatives are plastic water bottles or aluminum cans. Place

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the center of the arch on the ball. Roll the foot back to front using as much pressure as is comfortable. Avoid rolling directly over the heel where the plantar fascia attaches. Another area to massage is the calf muscle fascia. This area is in the back of the leg just below the thick portion of the calf muscle. While seated on the floor or couch, rest the leg on the ball or roller and roll from the calf muscle to where the Achilles tendon starts.

Warming up soft tissues prior to stretching and massage can increase their effectiveness. Epsom salt warm water solution soaks work well. Mix 1 cup of Epsom salt per gallon of warm water. Make sure the water is not too hot by using a thermometer. Soak for 10-15 minutes. Foot soaking devices are available that agitate the water and keep it warm. A deep basin works fine.

Alternative heating modalities include gel packs, electric heating pads and infrared devices.

Strength. Once the pain has subsided and mobility has improved, the final phase of rehabilitation can begin. The small muscles of the foot help to stabilize it during walking. They are difficult to isolate to exercise, but worth the effort. Towel curls are an easy first exercise. Place the foot on a towel and try to scrunch up the towel with the toes. Do this for 5-10 minutes. When you get good at the towel curl, you can try picking up a pencil with the toes or even marbles. One of the most effective exercises for the arch stabilizing muscles is a yoga technique called Short Foot. It can be dif-

> “A stretching program should be maintained after symptoms have stopped. Focus on stretching the Achilles tendon daily and after sporting activities.”

ficult to master, but the resulting improvement in stability and balance is unmatched by other exercises. A search of YouTube will bring up a number of videos to instruct the technique. As with most yoga techniques, there are many interpretations on the form and focus. My colleague Emily Splichal, DPM, has several videos on her website – barefootstrong.com – that explain and demonstrate it well.

Recurrence Prevention

Once symptoms have been resolved, the main objective is to keep the problem from coming back. The first step is to try to identify any causative factors that may have brought about the injury, such as training errors, inappropriate footwear, direct trauma, etc. and take steps to avoid that issue in the future. If a cause cannot be identified, the injury is likely the result of a biomechanical imbalance of the foot or leg. This is where seeking the advice of a foot and ankle specialist will likely be needed. A specialist certified by the American Board of Foot and Ankle Surgery or the American Board of Foot and Ankle Medicine is a good place to start.

A stretching program should be maintained after symptoms have stopped. Focus on stretching the Achilles tendon daily and after sporting activities. This tendon tends to get tight easily, especially in athletes and those who wear high heels. Regular stretching can help prevent this and many other foot injuries.

Continued support of the foot with a firm supportive insole should be maintained for at least 6 months. If a biomechanical cause is suspected, support should be maintained for the future. If symptoms return despite the use of a good OTC arch support, a custom foot orthotic may be needed. Again, this is where consultation with a foot and ankle specialist would be appropriate.

Paul J. Betschart, DPM, FACFAS, is a podiatrist in private practice in Danbury, Connecticut. A Fellow of the American College of Foot and Ankle Surgeons, his goal is to help his patients achieve optimal health from the ground up.

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NURVV COACHING APP AND INSOLES

NURVV is the pioneer of foot-based wearable technology using biomechanics. It's on a mission to provide runners with the power to understand what their bodies are truly capable of and find their true potential. NURVV Run is a coaching app and insoles to help runners run faster and reduce injury by capturing biomechanical data while you run, analyzing the data, and offering actional insights and real-time coaching. With 32 high-precision sensors embedded into 2 lightweight insoles, NURVV accurately captures cadence, step length, foot strike, pronation, and balance data from the feet. The app analyzes data using advanced biomechanics to deliver simple, actionable insights and personalized coaching that gives guidance on how to improve before, during, and after each run.

NURVV

866/224-2843

nurvv.com

A NEW PRODUCT FOR THE TREATMENT OF POST-TRAUMATIC OA

A team of investigators at Boston Children's Hospital and Rhode Island Hospital received a Military Medical Research and Development Award from the Joint Warfighter Medical Research Program (JWMRP) in 2016 to advance the development of a novel treatment for post-traumatic osteoarthritis (PTOA)—the stiffness and swelling that can result from the loss of cartilage and increased inflammation due to a joint injury. Their aim was to find another treatment option for PTOA and osteoarthritis (OA) given their prevalence: OA is the most common causes of disability in adults, and PTOA is the most common cause of disability in service members. The resulting product, J-PRO, is an injectable extracellular matrix composite that can be mixed with a patient's blood and injected into the injured joint to reduce the risk of developing PTOA.

Histology of the medial tibial plateau 6 weeks after ACL transection surgery. Left: Control knee (no surgery). Middle: A knee that had an ACL transection followed by a PBS injection. Right: A knee that had an ACL transection followed by an injection of J-PRO.

The investigative team, led by Martha Murray, MD, Boston Children's Hospital, and Braden Fleming, PhD, Rhode Island Hospital, has completed preliminary efficacy studies of J-PRO in a rat anterior cruciate ligament (ACL) transection model comparing a phosphate buffered saline (PBS) (control) injection to J-PRO administration. After 6 weeks of healing, hind limbs were retrieved and assessed by histology. While the ACL transection followed by a PBS injection led to significant structural damage, this was not seen in the ACL transection followed by J-PRO injection. Severe PTOA developed in 20% of the knees that received PBS injection compared to only 5% that received J-PRO. The team is now moving forward to assess J-PRO in additional preclinical models of OA.

With the JWMRP support, the investigative team has been working with the US Food and Drug Administration (FDA) toward establishing a regulatory pathway for J-PRO. The team is compiling the necessary preclinical information including manufacturing, biocompatibility, and stability studies, to support their FDA application and ultimately receive approval for a first-in-human clinical trial of J-PRO.

WEARABLE MOVEMENT-ANALYSIS SOLUTION

PodoSmart is an easy-to-use web-based solution that allows healthcare professionals to clinically assess patients with mobility disorders. Using smart insoles connected to a mobile application via Bluetooth, objective measurements of patients' walking and running activities can be obtained in real-world conditions, anywhere. PodoSmart provides immediate biofeedback, and the results are translated into clinical data that can be used to propose the most appropriate treatment. The following activity results are measured:

- Metrics: variability, asymmetry, gait line, and propulsion rate
- Kinematics: pronation/supination angle, foot progression angle, steppage, and clearance
- Spatiotemporal: speed, cadence, stride length and velocity, stance phase time, swing time, propulsion speed, double support, and contact time

The smart insoles come in 6 European sizes, from 36 to 47. They are rechargeable via USB for 33 hours of continuous active use

PodoSmart
podosmart.tech

SENSORIA SMART KNEE BAND: KNEE REHAB IOT PATIENT JOURNEY

The Sensoria Smart Knee Band consists of 2 Sensoria Core Devices, each with its own 9-axis IMU (accelerometer, gyroscope, magnetometer). One is placed above and 1 is placed below the knee to baseline the patient before total knee arthroscopy (TKA) surgery as well as measure range of motion and quantity and quality of repetitions. The device is Bluetooth smart, easy to use, and rechargeable. The customized mobile application and clinician dashboard enable remote patient monitoring (RPM) capabilities. The device was clinically tested by Cleveland Clinic. In this pilot study, the ability to acquire continuous data remotely without interruption or technical oversight for TKA patients, who found their data and daily notifications to be engaging and motivating, was established. With RPM, practitioners can more completely evaluate TKA patients in terms of mobility and rehabilitation compliance. L-Code 4386 reimbursable.

Sensoria Health
sensoriahealth.com
425/533-2928

AMERICAN LIMB PRESERVATION SOCIETY IS ESTABLISHED

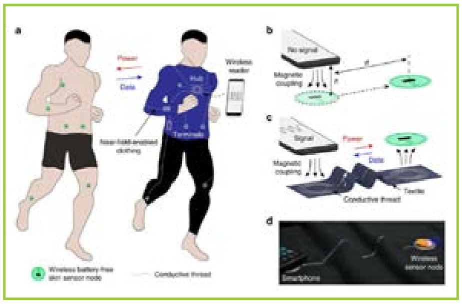
The American Limb Preservation Society (ALPS) has been established to advance the science and clinical care surrounding limb preservation as well as support year-round efforts to advocate for best practices that champion prevention and lead to better health outcomes for patients at risk of limb loss. In conjunction with the American Podiatric Medical Association, the Society for Vascular Surgery and Vascular Cures, the ALPS will focus on enhancing knowledge and bringing together an interprofessional team of experts within fields such as podiatry, vascular surgery, physical therapy, and infectious diseases to establish better care for the high-risk lower extremity.

"What we know is that when we put clinicians together that care about this problem, big change can happen," said founding president David G. Armstrong, DPM, MD, PhD, professor of surgery at Keck School of Medicine of University of Southern California. "That is what ALPS is all about. To be that interdisciplinary bridge to help eliminate preventable amputation over the next generation."

RESEARCHERS DEVELOP SMART SUIT TO MONITOR PHYSIOLOGICAL DATA

The current technology used to monitor an athlete's performance ranges from small wearable fitness trackers to elaborate clinical monitoring equipment. Fitness trackers are compact and lightweight but can only collect data from a single point, which is insufficient to generate meaningful insights. Clinical monitoring equipment uses multiple sensors to capture data from various points on the athlete's body but is mired in tangles of wires and is too bulky to be used outdoors. Now, a team of researchers from the National University of Singapore (NUS) Institute for Health Innovation and

Technology has developed a smartphone-powered suit capable of providing athletes with physiological data such as their posture, running gait, and body temperature while they are out on the field. Assistant Professor John Ho, PhD, led the team.



(a) Illustration of multiple battery-free sensor nodes mounted on the skin and interconnected to a wireless reader through the near-field-enabled clothing. Conventional near-field communication (b) is limited to at most a few centimeters separation between the reader and sensor, while near-field relays (c) enable near-field connectivity up to a meter scale in separation. (d) Photograph of a smartphone wirelessly powering a sensor node over a relay (40cm length).

The smart suit is made up of web-like circuitry, the pattern of which was designed to relay electromagnetic signals from a nearby smartphone to sensors on the body as far as a meter away; the inductive patterns act as hubs at strategic locations. Custom-made sensors placed at those hubs can transmit data back to the smartphone and are powered by the smartphone's NFC chip, removing the need for batteries. This reduces a significant amount of weight while enabling the collection of data from multiple areas on the body with minimal impact on the athlete's performance.

The current prototype can support up to 6 sensors per smartphone while collecting information such as spinal posture, running gait, and body temperature simultaneously. Among these functions, the ability to measure spinal position across multiple nodes is most significant as it is an integral part of developing a solid athletic stance. Good athletic stance can help reduce the risk of injury and optimize performance, as poor posture is biomechanically inefficient. The smart suit can constantly monitor an athlete's spinal posture to provide real-time data with minimal impact on their performance

"Our smart suit works with most modern smartphones, which act as both the source of power as well as the display to view the sensor data," said Ho. "The creation of a smart suit that can be powered using built-in smartphone wireless technology is a major breakthrough."

Moving forward, Ho and his team plan to develop new sensors to increase the range of data collected.

SKINEEZ HYDRATING DIABETIC SOCKS

Skineez Skin-Reparative Hydrating Diabetic Socks are infused with 5 key skin-healthy benefits: retinol, shea butter, apricot kernel oil, vitamins A and E, and rose hip oil. This patented product delivers 24-hour hydration. These non-elastic, seamless socks are made from moisture wicking fibers and are 100% latex free. In clinical trials, 80% of users achieved softer, firmer skin in just 1 hour. Skineez diabetic compression socks were designed to provide maximum comfort; relieve pressure on the foot arch, heels, and ankles; fight nerve pain; and offer protection from bacterial and fungus infections. Skineez brand proudly supports the movement to educate consumers about diabetes and the importance of protecting their feet, with a focus on offering these socks to repair and protect the feet and legs of people with diabetes. NDC-coded with skin protectant.

Skineez
978/261-5326
www.myskineez.com

PROPHYLACTIC DRESSING STANDARDS INITIATIVE IS LAUNCHED

The National Pressure Injury Advisory Panel (NPIAP) and the European Pressure Ulcer Advisory Panel (EPUAP) have announced the launch of the Prophylactic Dressing Standards Initiative (PDSI) and the establishment of a dedicated international task force to lead and develop this initiative. Currently, there are no known standards for prophylactic dressings, despite their international widespread and growing use.

The new PDSI task force will include expert representatives of all relevant stakeholder groups and apply a transparent policy for the balance of influences among the different stakeholder groups (e.g. industry, clinicians, researchers, policy makers, etc.). The immediate and first priority of the PDSI task force will be to develop a consensus on the scope of prophylactic dressing standards and prioritize specific topics and standards for initial development efforts. The testing standards will be developed over a 3-year period, during which time the developed standards will be validated and submitted for accreditation through international and national standard organizations. An Unrestricted Development Fund will be developed for resourcing the activities of the PDSI and all stakeholders are invited to support the initiative through this mechanism.

In the near future NPIAP and EPUAP will reach out to the relevant industry networks of the two organizations with additional information and details. At this time, all potential stakeholders, worldwide, that wish to be listed in the databases for this PSDI or are in need of information should contact either of the 2 co-chairs of the PDSI task force directly: David Brienza, PhD, at the NPIAP (dbrienza@pitt.edu) and Amit Gefen, PhD, at the EPUAP (gefen@tauex.tau.ac.il).

STRIDE IN STYLE WITH SOCKET SOCKS

Socket Socks prosthetic covers are flexible, comfortable, and affordable prosthetic fashion covers for adults and children. The covers are made from a 4-way stretch Lycra fabric that fits the unique curves and edges of all sockets like a glove, and they slip on and off as easy as a sock, allowing amputees to change their prosthetic socket to match their outfit with ease. Simply select the socket and size and choose the fabric and design. Multiple color options and patterns are available, including limited seasonal designs and limited-edition fabrics. The available fabrics are made with an antibacterial and water-resistant finish that helps to protect the socket while looking stylish. Practitioners can order a free sales kit, which contains everything needed to promote and place an order for patients. Patients can also order directly from the company.

Socket Socks
socketsocks.com

NYCPM TO JOIN TOURO COLLEGE & UNIVERSITY SYSTEM AND NY MEDICAL COLLEGE

New York College of Podiatric Medicine (NYCPM) will join the Touro College & University System and New York Medical College. Touro President Alan Kadish, MD, and NYCPM President Louis Levine signed a Membership Agreement in an online ceremony to mark the occasion. The transaction is expected to close on July 1, 2021, once it is approved by the US Department of Education, the New York State Department of Education, and other regulators and relevant accreditors.

BIONESS L100 GO SYSTEM FES

Bioness has launched the L100 Go System, which is a lower extremity technology that utilizes functional electrical stimulation (FES) to help patients with foot drop related to upper motor neuron disease/injury. Leveraging the success of the L300 Go System, the L100 Go System is designed to simplify the patient fitting process using single channel stimulation while still implementing a proprietary 3D motion algorithm to accurately detect gait events. An optional mobile control application provides the patient with the latest technology. Patients have the option to choose a treatment plan that fits their specific needs with guidance from their healthcare provider. Additional benefits of the L100 Go include patients being able to choose their footwear or walk barefoot.

Bioness
www.bioness.com
855/902-5252

"CAN YOU ADJUST?" REVOFIT™ EDUCATIONAL SERIES OFFERS 2 NEW COURSES

Click Medical offers free online RevoFit education that allows practitioners to learn how to identify the best patient candidates for RevoFit Technology, understand how adjustability saves time and money, and fabricate a transtibial and transfemoral diagnostic and definitive socket risk-free. Practitioners can earn up to 16 continuing education units (CEUs) and receive 2 free check socket kits. And now, 2 new courses have been added to Click's educational offerings: Advanced RevoFit Designs & Solutions (3 CEUs) and RevoFit™ Upper Limb Designs (1.75 CEUs). These two pre-recorded webinars feature Joe Mahon, CP, and RevoFit inventor.

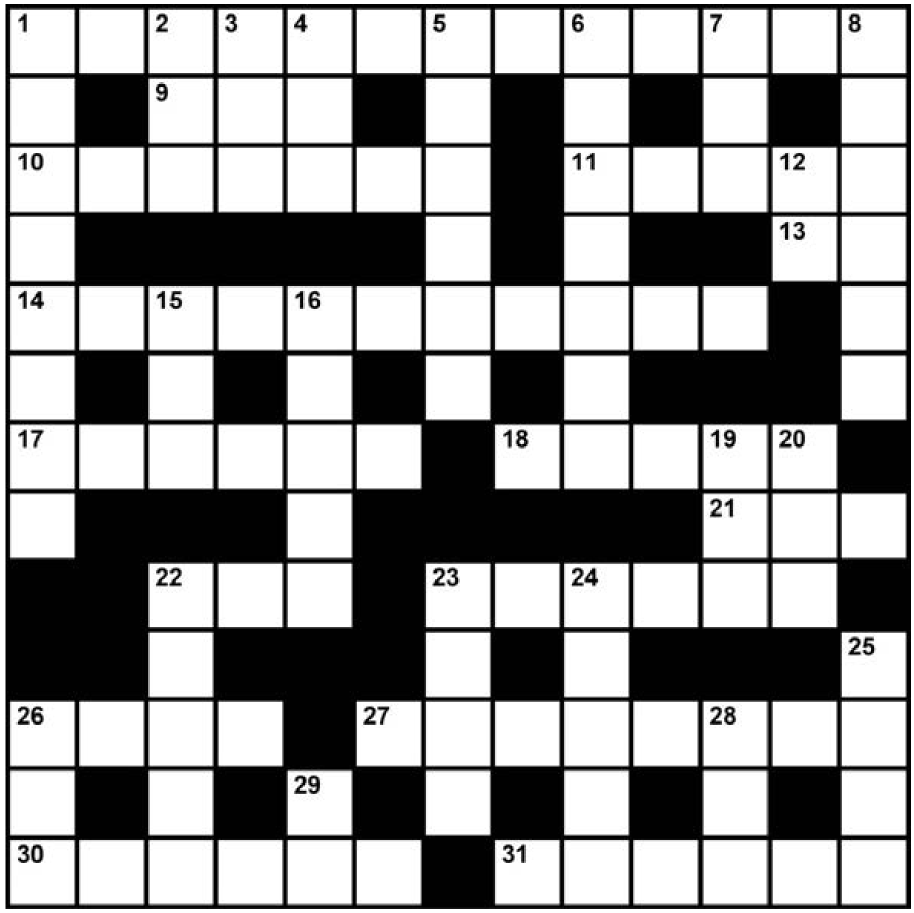
Click Medical
970/670-7012
clickmedical.co

TEXAS' FIRST PODIATRY SCHOOL TO OPEN IN 2021

Texas' first school of podiatry could potentially open in fall 2021 at University of Texas Rio Grande Valley (UTRGV) after being approved by the University of Texas System board of regents. The school of podiatry will be housed within the Division of Health Affairs, according to a UTRGV news release, and will prepare students for licensure. The campus that will house the program is yet to be determined.

How Well Did You Read This Issue?

Test your knowledge of information from this issue of *Lower Extremity Review* and the world in general with our crossword puzzle feature. The answer box can be found online at lermagazine.com.



ACROSS

1 The best way to teach an exercise
9 It holds a broken bone together
10 Person trained to compete in sports
11 Da ____ surgery system
13 Data storer
14 The D in 3D printing
17 Brings together
18 Makes better
21 Chew and swallow
22 "Help!"
23 3D printing has allowed for the development of ____ metal implants
26 Painful inflammation of the big toe
27 Metal used is bone implants
30 Put in stitches
31 Reconstruction of these foot joints has been improved with 3D printed models

DOWN

1 Coach with actions rather than words, 3 words
2 Speed abbreviation
3 Lubrication
4 Compass direction
5 Main argument
6 Scientific improvement
7 An electrically charged atom
8 3D printed custom cutting ____: they're aids in more accurate surgeries
12 Dose measurement, abbr.
15 Medical diagnostic technique, abbr.
16 Has to have
19 Zodiac sign
20 American's uncle
22 Crouching exercise
23 Small, broken-off piece of bone for example
24 Discoloration
25 CPR pros, abbr.
26 Not liquid or solid
28 Down with something
29 Surgery site, abbr.

Crossword by Myles Mellor

With over 12,000 crosswords published internationally, Myles Mellor is one of the top crossword writers in the world. His work includes crosswords, diamond crosswords, syndicated puzzles, cryptograms, diagramless crosswords, word search, sudokus, anagrams, and word games published on mobile devices and e-readers. www.themecrosswords.com

The Taleo Family of Feet by Ottobock

More than a foot, a foundation.

Quality for life

Taleo Low Profile **Taleo** **Taleo Vertical Shock** **Taleo Harmony**

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We are excited to introduce the two newest foot options for your foot portfolio, Taleo Vertical Shock and Taleo Harmony.

Give your patients enhanced comfort with a functional ring unit that absorbs torsion (+/- 10°) and up to 15 mm of vertical shock absorption with the Taleo Vertical Shock. The Taleo Harmony provides the same torsion and vertical shock absorption but with increased control over the prosthesis with an integrated vacuum pump.

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  professionals.ottobockus.com or talk to your sales rep.