

Podiatry Perspectives: Key Trends in Limb Preservation and Future Directions

Exploring modern limb preservation through a podiatry lens, highlighting biomechanics, offloading, multidisciplinary care, psychosocial support, and emerging technologies.

With David G. Armstrong, DPM, MD, PhD



From a podiatric surgeon's perspective, what does the vascular community, including trainees, most often misunderstand or overlook about limb preservation?

The biggest misconception is that limb preservation begins and ends with revascularization. Don't get me wrong—restoring flow is essential, and the vascular community has made extraordinary strides. But the foot is not just a passive endpoint of a vascular tree. It is a biomechanical organ that bears load, accommodates deformity, and breaks down in highly predictable patterns. If you restore flow but don't address the mechanical problem—the Charcot deformity, the equinus contracture, the plantar pressure that created the wound in the first place—you're likely to see that patient again, and sooner than you want to. Our goal is to make the recurrent wound as uncommon and uncomplicated as possible, but this is inexorably tied to mechanics.

The other piece that often gets lost is wound healing itself. There is an assumption that once blood is flowing, healing will follow. But, the biology of a chronic diabetic wound is fundamentally different from that of an acute wound. These are senescent, biofilm-laden environments that need active wound management, not just time and perfusion. The tissue must be surgically prepared, offloaded, and managed longitudinally.

Trainees in particular should understand that the most elegant revascularization in the world can be undone by a poorly offloaded foot. We need to train people to think about the whole limb, not just the vessel.

When you look at the modern limb preservation model, what is working well, where are we running into challenges, and what needs to be improved?

What's working well is the recognition—finally—that this requires a team. The multidisciplinary limb preservation model has gained real traction. Centers that have embraced this see measurably better outcomes. The data are clear on that point. We're also better at staging patients than we were even 5 years ago. The Wound, Ischemia, and foot Infection system classification, for all its imperfections, has given us a shared language across specialties.

Where we're struggling is scale. The centers that do this well tend to be academic hubs or dedicated limb preservation programs. However, the majority of patients with diabetic foot ulcers (DFUs) and chronic limb-threatening ischemia (CLTI) aren't being seen in those settings. They're in community hospitals, underserved urban corridors, and rural areas where the nearest vascular surgeon is 2 hours away. We have a profound access problem.

The other gap is longitudinal care. We're reasonably good at the acute episode: Get the patient in, revascularize, debride, treat the infection. But the disease doesn't end when the wound closes. We lose patients in the transition from acute to chronic management, and that's where recurrence and contralateral events eat our lunch. We know from our data that roughly 40% of patients who heal a DFU will recur within 1 year. That is not a success story. We need remission-based models, not just healing-based ones. That is a fundamental paradigm shift we have to make.

You founded the American Limb Preservation Society (ALPS), an interdisciplinary group aiming to eliminate preventable amputations. What have you learned at a national level about what actually drives effective interdisciplinary collaboration and what the barriers are?

What drives effective collaboration is surprisingly simple: shared vocabulary, shared data, and shared accountability. When a vascular surgeon, podiatric surgeon, and endocrinologist are all looking at the same patient using the same classification system and the same outcomes dashboard, the silos start to dissolve. ALPS has worked hard to create that kind of cross-pollination through joint meetings, shared guidelines, and advocacy efforts.

The barriers are structural and deeply rooted. Reimbursement models still reward procedures, not coordination. There is no CPT code for a limb preservation huddle. Hospital systems are built around departments, not disease states. And frankly, professional tribalism is real. Many vascular surgeons were never trained alongside podiatric surgeons. Many podiatric surgeons have limited exposure to endovascular techniques. We speak different languages even when we're treating the same patient.

The other lesson from ALPS is that advocacy matters enormously. Amputation prevention is both a clinical challenge and a policy challenge. We've been working on Capitol Hill and with the Centers for Medicare & Medicaid Services to ensure that limb preservation is recognized as a quality measure and that amputation rates become a reportable metric. If you don't measure it, you can't manage it. We need systemic accountability to match the clinical ambition.

Can you walk us through the “Toe, Flow, and Go” model at Keck School of Medicine? Who is involved, and how does it optimize patient care?

“Toe, Flow, and Go” is our shorthand for the integrated limb preservation pathway at Keck. The idea is that every threatened limb needs three things addressed in concert, not in sequence—and critically, that our job does not end when the wound closes.

“Toe” is the podiatric surgery and wound management component: aggressive debridement, biomechanical assessment, offloading strategy, and, when necessary, surgical reconstruction or limited amputation. “Flow” is the vascular assessment and intervention—angiography, endovascular or open revascularization, and ongoing perfusion monitoring. “Go” is where this model departs from the traditional paradigm, and it has a dual meaning. First, it refers to physical therapy (PT) and structured movement, which we consider a core pillar of the team, not an afterthought.

Second, it refers to the patient in remission: a functional, active human being, not just a healed wound.

The PT piece deserves emphasis because for decades, the standard response to a DFU has been to shut everything down. We focus so intently on offloading that we inadvertently prescribe a sedentary lifestyle, and the systemic consequences of that are devastating (eg, deconditioning, sarcopenia, depression, cardiovascular decline). Recent work from the University of Michigan highlights the concept of “exerkines”: bioactive molecules released during exercise that promote interorgan cross-talk, improve vascular health, and enhance glycemic control.¹ Even simple interventions like toe flexion exercises can immediately increase skeletal muscle blood flow around a wound. In supervised trials, patients using specialized offloading pedals for cycling saw dramatic wound size reductions. We have a world-class PT program at Keck, and PT is embedded in the limb preservation team, designing safe weight-bearing progressions, resolving the conflicting messages patients hear from different providers, and providing the psychosocial reinforcement that comes with structured movement.

The team also includes vascular surgery, interventional radiology, endocrinology, infectious disease, orthotics and prosthetics, wound care nursing, and behavioral health. We see patients jointly—not through sequential referrals but in the same clinical encounter or within the same care episode. What makes it work is the compression of time during the acute phase (we aim to complete the full workup and begin treatment within 24-48 hours) and the commitment to keeping the patient moving and monitored long after the wound has healed. Limb preservation is not just about a healed wound. It's about a functional, active patient. We must protect the toe, optimize the flow, and empower the patient to go.

When you compare the patients you're seeing in 2026 to those from 10 years ago, what's fundamentally different?

Three things stand out. First, the patients are younger and heavier. We're seeing type 2 diabetes in 30- and 40-year-olds with body mass indices above 40 kg/m² presenting with wounds and neuropathy that a generation ago we associated with people in their 60s and 70s. The metabolic epidemic is accelerating the timeline of complications.

Second, they're more medically complex. Many of the patients walking through our door are on dialysis, have had prior cardiac interventions, and are on complicated polypharmacy regimens that include anticoagulants, immunosuppressants, and now glucagon-like peptide-1 (GLP-1) receptor agonists and sodium-glucose cotrans-

porter 2 (SGLT2) inhibitors—medications that have fundamentally changed the metabolic landscape but whose wound-healing implications we're still learning.

Third, and this is encouraging, more of these patients are surviving. The cardiac and renal interventions that keep these patients alive longer also mean they live long enough to develop the foot and limb complications we treat. It's a paradox of success in cardiovascular medicine. We're saving lives upstream, which creates a growing population downstream that needs aggressive limb preservation.

The net effect is a larger, sicker, more complex patient population presenting with limb-threatening conditions at earlier stages of life. Our systems were not designed for this volume or this acuity. That's the fundamental challenge of limb preservation in 2026.

How do you think GLP-1 receptor agonists and SGLT2 inhibitors may change the trajectory of patients at risk for diabetes-related amputation or peripheral artery disease (PAD) progression? What do we still not understand about their long-term impact on limb outcomes?

This is one of the most important questions in our field right now. The cardiovascular and renal benefits of these agents are well established, and the weight loss effects of GLP-1 receptor agonists are genuinely transformative for many patients. We should be optimistic about what these drugs can do upstream—reducing metabolic burden, improving glycemic control, potentially reducing systemic inflammation.

However, the limb-specific data remain thin, and there are important unknowns. We all remember the canagliflozin amputation signal from the CANVAS trial. That has since been attenuated by subsequent studies, but it raised a critical point: We cannot assume that drugs that are good for the heart are automatically good for the foot. The mechanisms of tissue injury in the diabetic foot are not simply small-vessel versions of coronary disease. Neuropathy, biomechanical failure, and infection operate through pathways that may not be directly modified by these agents.

With GLP-1 receptor agonists specifically, the rapid weight loss raises questions about sarcopenia and potential loss of protective plantar fat padding, both of which could paradoxically increase ulceration risk even as the metabolic profile improves. We do not yet have long-term data on this.

What we need are prospective studies that include limb-specific endpoints as primary or coprimary outcomes (eg, ulceration, amputation, wound healing rates). Right now, limbs are an afterthought in most cardiorenal trials. That has to change. I've written about this at some length, and

I'll continue to beat this drum: Don't stop the gliflozin, but let's understand what it does and doesn't do to the limb.

Your DREADD study highlighted the burden of amputation-related depression and distress.² As we think about the future of limb preservation, how should psychosocial care become integrated into PAD and CLTI management?

The DREADD study was a wake-up call for us. We found that amputation-related distress is pervasive and profoundly underdiagnosed. Patients with diabetes-related amputations experience rates of depression and posttraumatic stress that rival those of combat veterans. And yet, in most limb preservation programs, there is no structured mental health component whatsoever.

This has to change, and it has to change at the systems level. Screening for depression and distress should be as routine as checking an ankle-brachial index. We should be deploying validated instruments—Patient Health Questionnaire-9, Problem Areas In Diabetes, Diabetes Distress Scale—at the point of care, not after a crisis. These screenings need to be linked to actual referral pathways, not just documented and forgotten.

Additionally, integration goes beyond screening. Patients facing potential amputation are making decisions in a state of profound psychological distress. Shared decision-making is meaningless if one party is in crisis. We need embedded behavioral health professionals in limb preservation clinics, not as a nice-to-have but as an essential team member.

The economic argument supports this too. Depression is associated with worse wound healing outcomes, lower adherence to offloading, and higher rates of recurrence and reamputation. Treating the mind is treating the limb. If we want to talk about value-based care in limb preservation, psychological support may be one of the highest-yield interventions we're currently ignoring.

Where do you see the most realistic opportunity for machine learning and artificial intelligence (AI) in the care of these patients, and what will be the barriers to adoption?

The most immediate and realistic application is in risk stratification and early detection. We have more data on these patients than we know what to do with: electronic health records, plantar pressure measurements, temperature data from smart mats and wearables, activity monitoring, and even satellite-level socioeconomic and geographic data. The challenge has never been data acquisition; it's been synthesis. Machine learning is ideally suited to integrate multimodal data streams and identify patients heading toward crisis before the wound opens or the limb becomes threatened.

We're working on this at the University of California through our C2SHiP (Center to Stream Healthcare in Place) center. Our Smart Boot platform (Foot Defender powered by Sensoria) uses embedded sensors and context-aware algorithms to monitor offloading adherence and predict recurrence risk. The idea is to shift from reactive care—patient shows up with an ulcer—to preemptive intervention.

AI-assisted wound assessment is another near-term win. Computer vision models can now measure wound area, classify tissue types, and track healing trajectories with a smartphone photo. That's transformative for community and home health settings where wound care expertise is scarce.

The barriers are what you'd expect: regulatory uncertainty, reimbursement gaps, workflow integration, and clinician trust. No one wants to be told by an algorithm that their patient is going to lose a leg. Honestly, the bigger barrier is cultural. Clinicians need to be willing to trust probabilistic tools and act on predictions before there's a visible problem. That's a different kind of medicine than most of us were trained to practice.

If you could design the single most important trial in limb preservation right now, what question would it answer?

I would design a large, pragmatic, multicenter, randomized trial asking whether a structured, multidisciplinary limb preservation program—with protocolized wound care, revascularization pathways, offloading, and embedded behavioral health—reduces major amputation rates compared to standard of care in community hospital settings.

We have plenty of single-center data showing that dedicated limb preservation programs work, but we have never rigorously tested the model itself in a generalizable way. The question is not whether any one intervention—a specific graft, a particular device, a novel biologic—works. The question is whether the system of care works, and whether it can be exported from academic centers to the places where most amputations actually happen.

The trial would need to be pragmatic, cluster-randomized, and powered for hard endpoints: major amputation, amputation-free survival, and patient-reported quality of life. It would have to include safety-net hospitals, Veterans Affairs facilities, and community centers serving predominantly underserved populations. It would need a health economics component to demonstrate value, because the payers ultimately have to buy in.

That's the trial that could change policy. Individual device and drug trials are important, but they're incremental. A trial that validates the care delivery model is

the one that bends the curve on preventable amputations nationally.

If we fast-forward 10 years, what does the ideal limb preservation ecosystem look like?

In the ideal state, limb preservation is not a specialty but rather a system. Every patient with diabetes and PAD has a risk score generated from their electronic health record data, wearable inputs, and social factors. That score triggers graduated levels of intervention before a wound ever develops, from community health worker outreach and therapeutic footwear to urgent multidisciplinary team activation.

When a wound does occur, the patient is seen within 24 hours by a coordinated team that operates under a single care pathway, regardless of whether they present at an academic center or a community clinic. Revascularization decisions are informed by AI-integrated perfusion assessment. Wound management is guided by point-of-care diagnostics (eg, biofilm detection, molecular microbiology, perfusion imaging) rather than clinical gestalt alone.

Offloading is continuous and monitored. The patient's adherence to their device is tracked in real time, and deviations trigger automated interventions—a text, a call, a home visit. Mental health support is woven into the care pathway from day one.

Amputation rates are a publicly reported hospital quality metric, just as door-to-balloon time is for ST-segment elevation myocardial infarction. Payers reimburse for prevention and coordination, not just procedures. Perhaps most importantly, a child born into a low-income zip code has the same probability of keeping their leg as one born into affluence.

That last point is not aspirational window dressing. The geographic disparities in amputation rates across this country are staggering and morally unacceptable. In 10 years, I want the zip code lottery for limb loss to be a historical artifact. That's the goal. ■

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Disclosures: None.