Blood Flow Restriction Training Becoming Standard Practice

A novel treatment not long ago, blood flow restriction training is rapidly being used by more and more physical therapists.

The patient, recalls Corbin Hedt, PT, DPT, was a women's Division I basketball player who had the "gnarliest meniscus and ACL injury that I think I've ever seen as a clinician." She'd made a routine pivot in her team's first practice of the year, "and her knee went into this massive valgus, slamming her medial tibia into the floor."

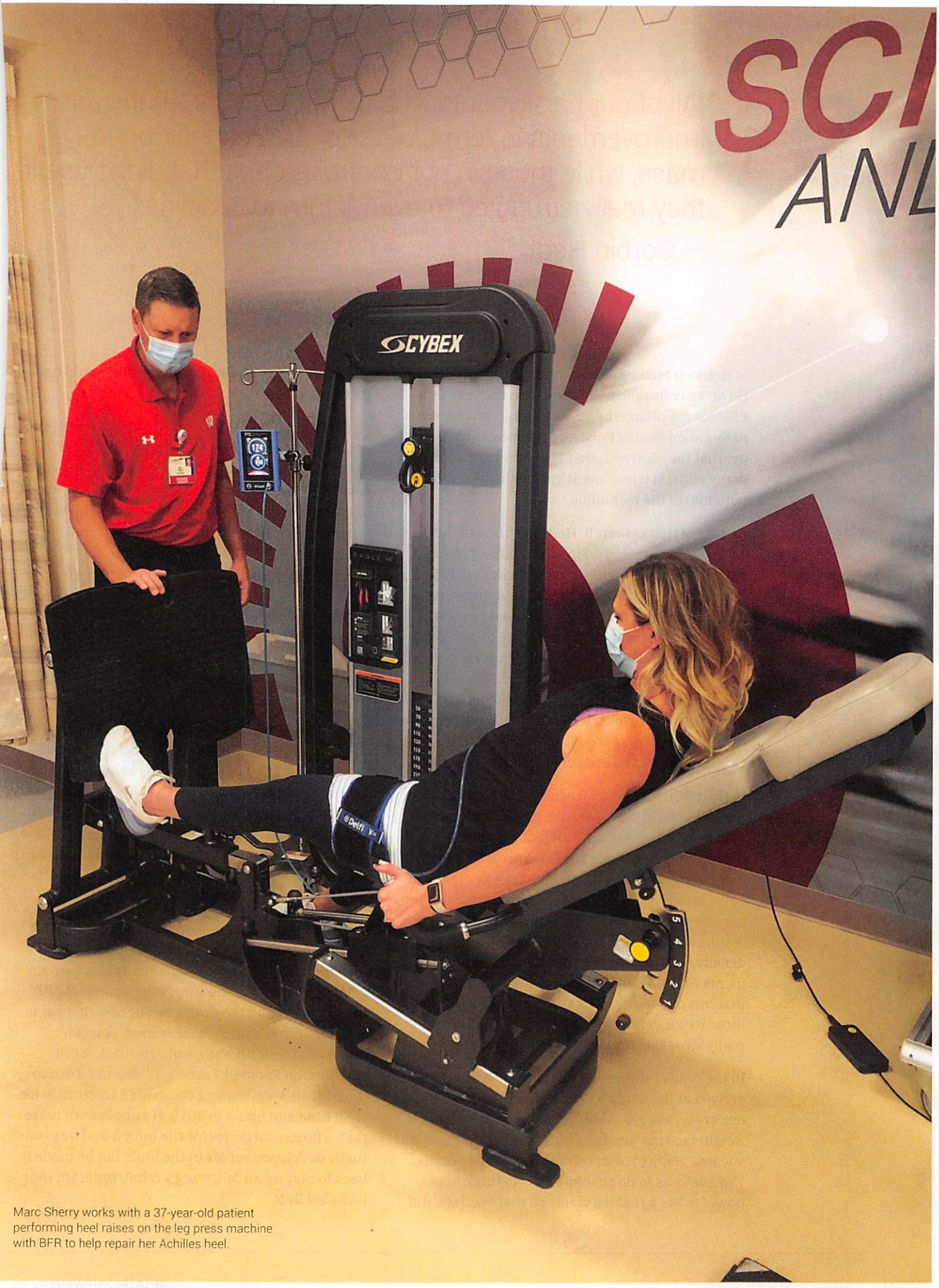
Examination revealed significant bone bruising, and an MRI showed the player had torn her anterior cruciate ligament. Later, when the orthopedist went in for surgery, "he literally couldn't locate the meniscus anywhere," says Hedt, who is a board-certified clinical specialist in sports physical therapy and a certified strength and conditioning specialist.

Eventually, the surgeon did find the cartilage — it had been pushed back into the knee's posterior capsule — "so he took it out, cleaned it up, and put it back into place," Hedt says. "And then he finished up with the ACL reconstruction."

A sports physical therapist at Houston Methodist Orthopedics and Sports Medicine, Hedt had helped many elite athletes get back on their feet after significant injuries. In this case, though, he wasn't sure what to think, and it didn't help that the surgeon had his doubts as well. "We talked quite a bit before I saw her for the first time, and I remember him telling me, 'You know what, if this one gets back to sport, I'll sing your praises from the mountaintops.' He wasn't confident in her prospects at all, and this was one of the best knee surgeons in the country."

From Research to Results

What that surgeon may have failed to consider was that Hedt had what amounted to a secret weapon in his physical therapy toolbox. "We hit BFR from basically day one — the very first session that I saw her," he recalls. Blood flow restriction training, he explains, was something he'd used since he started



Marc Sherry works with a 37-year-old patient performing heel raises on the leg press machine with BFR to help repair her Achilles heel.

"All of our participants who used BFR saw significant improvements in terms of building back their bone mass, while those in our control groups that didn't use it, they really struggled to even return to baseline."
— Corbin Hedt

at Houston Methodist as a sports resident in 2014. He and a colleague had enrolled in the very first BFR course offered by a San Antonio-based company called Owens Recovery Science. Intrigued by what they learned, they'd gone on to establish many clinical trials investigating the benefits and potential of the technique.

As part of that research, Hedt says, one of the areas they'd focused on involved how BFR might benefit a patient post-ACL reconstruction. Blood flow restriction training entails applying a pneumatic tourniquet cuff to the proximal portion of an extremity and applying pressure to partially impede arterial blood flow to the limb. Pioneered in the 1960s in Japan and named "Kaatsu" by its inventor, the technique causes blood pooling in the capillary beds of muscles distal to the cuff, and has been shown in numerous studies to increase muscle strength and size when used during exercise.

In their ACL research, Hedt says, they looked at how BFR use in postoperative physical therapy affects muscle mass and functional outcomes, and they explored its impact on bone mineral density. They were familiar with previous studies that had demonstrated gains in musculature, so they weren't surprised when their own findings mirrored those results. What they learned about bone mineral density was another story, he says. "All of our participants who used BFR saw significant improvements in terms of building back their bone mass, while those in our control groups that didn't use it, they really struggled to even return to baseline."

In the case of the basketball player, Hedt's patient arrived at the clinic with substantial effusion in her knee. "We knew she'd have to be entirely non-weight bearing for six to eight weeks, which meant she was going to be extremely weak," he recalls. "My goal was to do absolutely everything in my power to keep that leg viable so that once she did start walking and bearing weight, she would have a good outcome."

Hedt talked to his patient about the benefits of BFR, and once he had her buy-in, they got to work. "It took her a solid 14 months of straight rehab," he says, "but she made it back for the following season and was a key contributor in helping her team to the national tournament."

From Innovative to Integrated

There was a time when Drew Contreras, PT, DPT, would have been skeptical that BFR training might provide a patient such big returns. Today, though, he's a BFR believer — and he knows from personal experience how effective it can be.

"Seven or eight years ago, I'd have been surprised," says Contreras, APTA vice president of clinical innovation and integration. "I'm not surprised anymore." From his perspective, he adds, BFR has moved "from innovative to integrated." Practices are using it, it has clinical research behind it, "and it can be safely implemented and used across the physical therapy profession."

The ever-increasing number of promising studies on the subject is one reason for the uptick in BFR adoption, Contreras notes, but its use by PTs working with high-profile patients is also helping its popularity. "You see someone like Alex Smith utilizing BFR and the dramatic success that came out of that — as a physical therapist, you can't ignore that." Smith, the ex-quarterback for the Washington Football Team, was able to return to the NFL after suffering a compound fracture to his right tibia and fibula in 2018. He underwent more than a dozen surgeries for the injury, and he eventually developed sepsis in the limb, but he made it back to play again following a rehab program that included BFR.

Contreras, who also runs a private physical therapy practice in the Washington, D.C., area, says he uses BFR regularly in his own work. "It lends itself very well to outpatient orthopedics, where you're trying to accelerate healing and strength gains, and I've also found that it's highly effective with geriatric and postoperative patients."

BFR can be appropriate for these populations in particular, because it allows a patient who may be weak or healing from surgery to build muscle using very light weights. "When you use blood flow restriction, you can get the same training and rehabilitative effect with a lower load," Contreras explains. "That's the key to BFR. I can work with somebody and get the same effect without having to use the same amount of resistance."

That concept of "less is more" is certainly familiar to Johnny Gray Owens, PT, MPT. Owens is the physical therapist who worked with Alex Smith, and he's CEO and director of clinical education at Owens Recovery Science.

The company, Owens notes, leads clinical research on BFR and provides continuing education on the technique to physical therapists and other health care professionals. In his practice, he serves as a

Getting Started With BFR

BFR is within the scope of practice for any physical therapist and within the scope of work for PTAs under PT supervision (check local regulations and your state practice act), but experts in the technique say it's important to undergo training before using it in the clinic.

"The big thing to understand is that blood flow restriction rehabilitation requires a medical-grade tourniquet or equivalent," says Drew Contreras, PT, DPT, APTA vice president of clinical innovation and integration. The cuffs that typically are used for BFR are specifically designed to restrict blood flow without occluding flow completely. Training in the technique typically covers equipment options, how to safely apply cuffs at the appropriate pressure, and applications for BFR in rehabilitation settings.

BFR training and education resources include:

- APTA: "Blood Flow Restriction Rehabilitation: State of the Science," Centennial Lecture Series presentation by Johnny Owens, PT, MPT, September 2021. Recording available for purchase in the APTA Learning Center. learningcenter.apta.org/
- In-person BFR training course: One-day on-site training courses by Owens Recovery Science at locations throughout the United States. owensrecoveryscience.com/get-certified
- Online BFR training course: Produced by Mike Reinold, PT, DPT, ATC, co-founder of Champion PT and Performance. www.mikereinold.com/blood-flow-restriction-training-online-course

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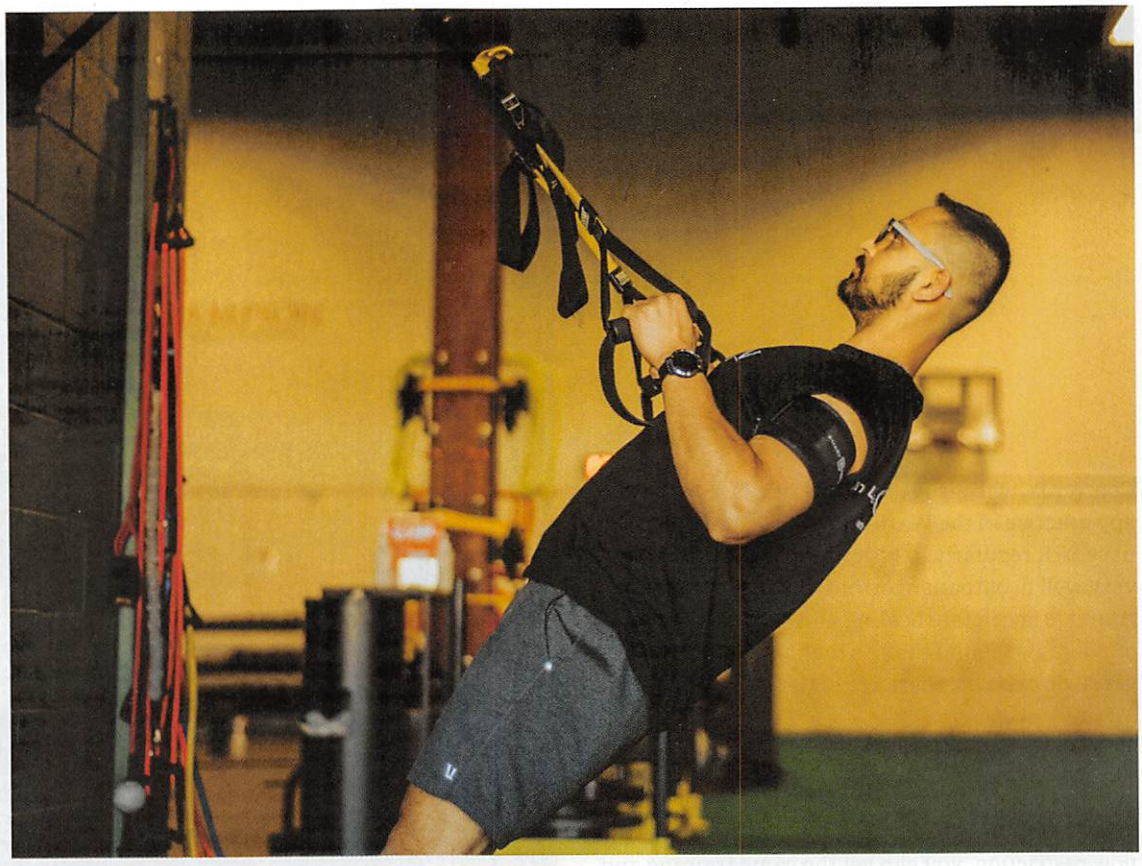

BFR is applied to the upper body for performing an inverted rowing exercise. (Courtesy of MikeReinold.com.)

medical consultant for teams across the professional and collegiate sports landscape, and he led a presentation on BFR at APTA's 2021 Combined Sections Meeting.

Owens says he first encountered BFR more than a decade ago as chief of human performance optimization at the Center for the Intrepid at San Antonio Medical Center. There, he worked with military service members who'd experienced severe musculoskeletal trauma during combat. "One of the major problems was, their injuries were often so bad that they couldn't handle any loads to get strength back and rebuild muscle," he says. Using federal research grants, his team led several trials studying the efficacy of BFR with these patients. "They did fantastic, and that's what led me to start my own business — the idea that I could share what we learned in the military with clinicians working with other patient populations."

Mike Reinold, PT, DPT, ATC, co-founder of Champion PT and Performance, also provides education of the science and application of blood flow restriction training, through an online course he produced. The board-certified clinical specialist in sports physical therapy, certified strength and conditioning specialist, and champion performance specialist, agrees about the benefits of BFR when load is an issue. "If someone is coming back from an injury or surgery and they can't lift heavy weights during exercise, we can use BFR to get the response that we want, while having them move a much lighter load."

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Beyond Elite Athletes

Today, Owens says he's most excited about applications for BFR among older adults. "I can use this technique with a professional athlete and maybe help them move just a little bit faster, but if I do this successfully with grandma, maybe she can get up those stairs."

Owens recently worked with one older patient who had an incomplete spinal cord injury and could move only with a walker or wheelchair. "He had some muscle that he could use, but he was never going to be able to push enough weight to get to where he could walk unassisted again."

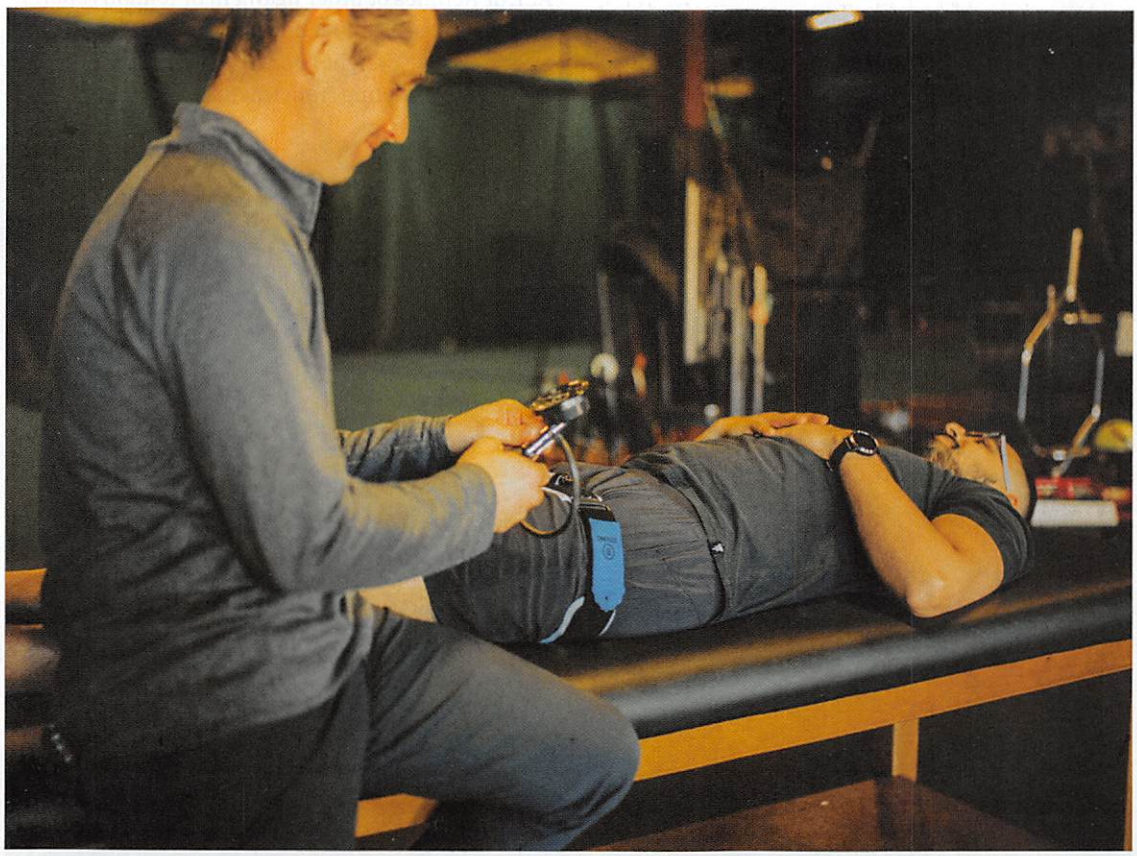
Owens put his patient on a BFR training regimen, "and that really changed the equation," he says. With pressure cuffs on the man's limbs, he used anaerobic metabolism and fast-twitch fibers to lift light weights and quickly rebuild strength. "He saw significant improvements almost right away, and within four or five weeks he was using a cane," Owens recalls. "The best part about it, for me, was that he reached his goal of being able to walk his daughter down the aisle when she got married."

Like Drew Contreras, Owens thinks that the word has gotten out about BFR. Still, he says, based on surveys that he's seen, adoption among physical therapists appears to be lagging. (One such survey showed that while 88% of PTs had heard of BFR, only 39% percent had tried it clinically.)

"There's still some resistance," Owens says, "and I think that will continue to be the case until we do more clinical trials," including research on potential complications with its use on patients with comorbidities, for example. He says he's personally comfortable using BFR "because I've done it with older patients, and with guys who've been blown up by IEDs, and with these athletes like Alex Smith postinjury or postsurgery." But he's also eager to learn more about the technique and to help facilitate new studies toward that end. "What does BFR do when you have elevated blood pressure? What does it do if you have cancer? We have some ideas, but for some of these populations, I can understand the need to pump the brakes."

Introducing BFR to Practice

One clinical practice that's taken a cautious approach to incorporating BFR into patient care is UW Health Sports Medicine in Madison, Wisconsin. The clinic's manager, Marc Sherry, PT, DPT, LAT, took a BFR-certification course last August



Mike Reinold applies measures for the right amount of pressure after applying BFR cuffs to a patient's legs.

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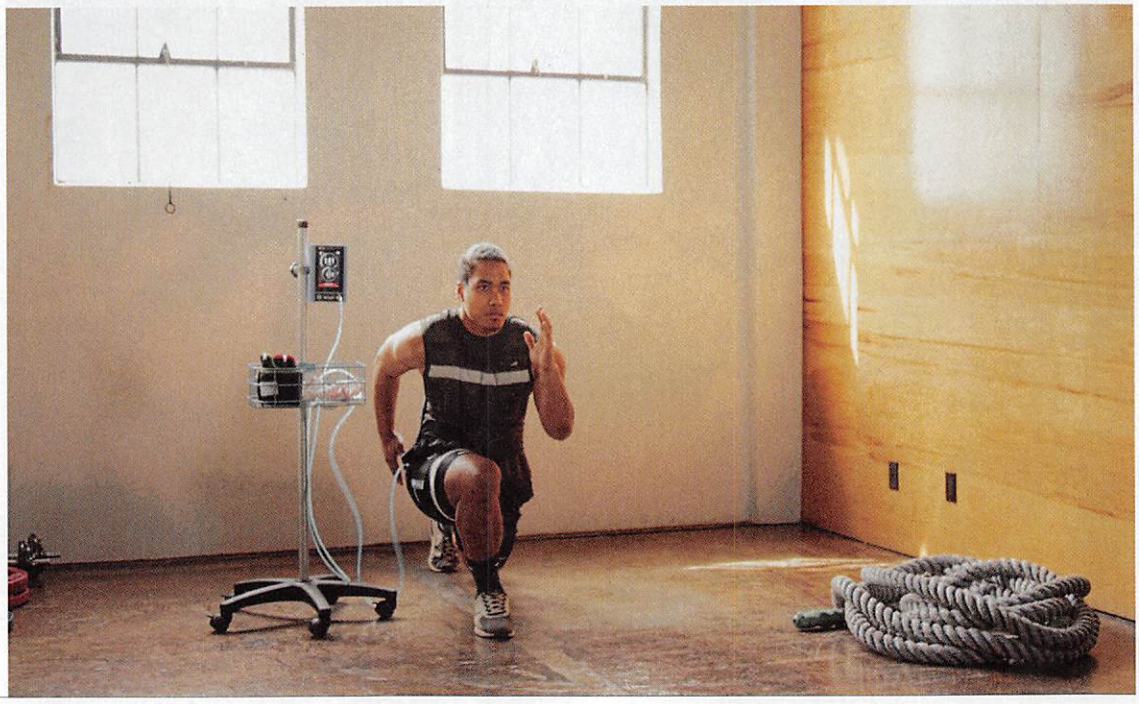
after "researching and talking" about blood flow restriction with his colleagues for the better part of a year, he says. By November 2021, the practice had two BFR tourniquet systems on hand, but it had only used them with a few patients. The team was holding meetings to review the science behind the technique, and to discuss how they might apply it to their patient population in a standardized way.

"We're basically doing a little fine-tuning before we fully roll it out," Sherry notes. If they're going to rely on BFR with their ACL patients, for example, "it shouldn't be that John's doing it differently than Melissa, who's doing it differently than Gary or me." In a large academic medical center such as UW Health, "we don't do anything unless it's evidence-based," he adds. Two years ago, he didn't think there was enough evidence around the use of blood flow restriction training in the types of patients they see. "But now I think that's changed. Today we know that it's not only safe; it's also beneficial."

Sherry, a certified strength and conditioning specialist, anticipates his team at UW Health will start by using BFR only for a limited number of cases. "If you read the BFR literature, it helps muscle strength and hypertrophy, it can decrease pain, it can increase muscle endurance, and it can promote bone healing. In our setting, because it's new to us, we're going to focus on the muscle-strength component before anything else."

Sherry adds that the patients they're most likely to treat with BFR fall into three categories: "Post-operative-protection" patients, including those with ACL or Achilles or other ligament or tendon repairs for which loading must be restricted during healing after surgery; "weight-bearing-precaution" patients who are still healing from fractures or procedures



BFR is applied to the lower body for performing lunges. (Courtesy of Owens Recovery Science.)

Johnny Owens works with a patient performing ham curls with BFR.

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and need time before they're able to handle exercises such as body-weight or loaded squats; and "overload-management" patients with conditions such as tendinopathy, whose pain or dysfunction resulted from excessive high-intensity loading.

The handful of patients with whom he's used blood flow restriction so far have "really liked it," Sherry says. In one case — a middle-aged woman with an Achilles repair — he'd started working with the patient before the clinic received its BFR tourniquet systems. They'd tried incorporating progressive-resistance exercises into her rehab, but she was limited by pain and discomfort at the tendon. "Once we got the BFR cuff, we were able to do those exercises, and she said it was the first time she'd felt soreness in her calf muscle — that prior to that, she'd only felt it in her tendon."

Another patient had suffered an Achilles rupture that was treated nonoperatively. Because the patient lived 40 minutes from the clinic, he'd only been coming to appointments once or twice a month and had struggled to get his strength back. "He came in one day," Sherry recalls, "and we decided to try BFR, and I told him that for it to be effective we'd probably need to do it a couple of times a week." The patient seemed skeptical initially, but the day after his first treatment, he was sold. "He said, 'You know what, that's the best my calf has felt from a workout in two months. The drive is worth it — I want to do more.'"

A Tool of Choice

If patients are saying they want more BFR, the same is true of many physical therapists. In his niche-area of practice working with professional athletes, Derrick Nillissen, PT, DPT, says, "I've been blown away with how much the use of BFR has increased over the last two years."

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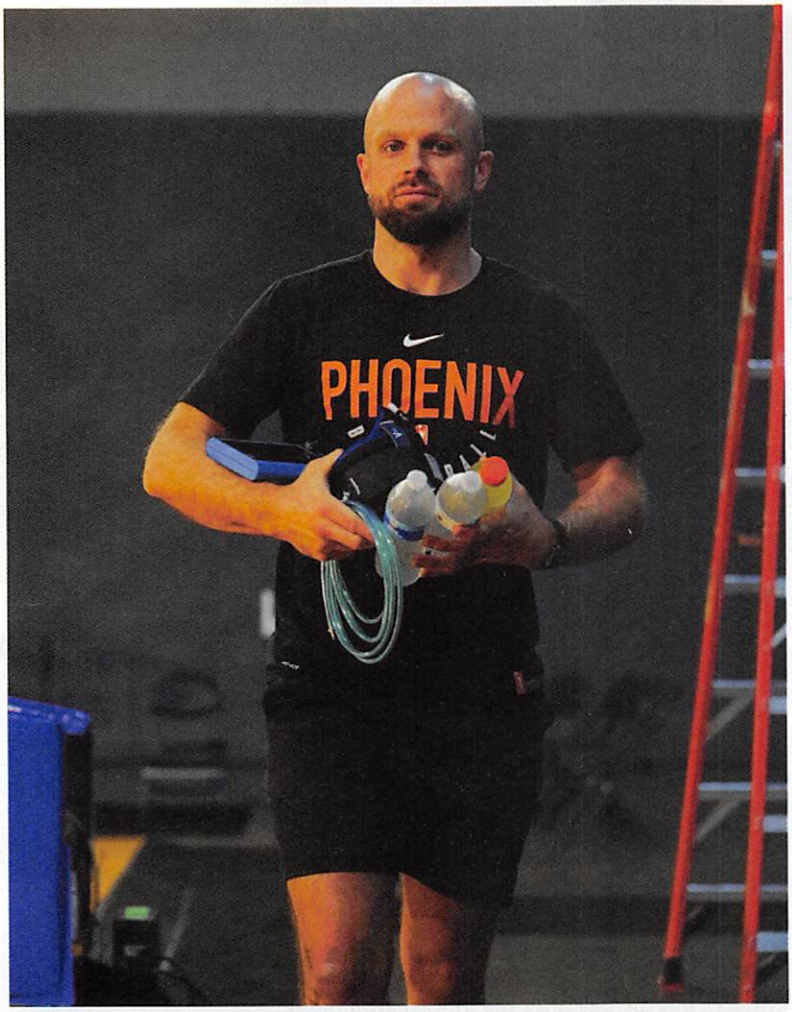

Derrick Nillissen holds a personalized tourniquet system for BFR as he prepares to treat one of the Phoenix Mercury basketball players.

A PT and strength and conditioning coach for the WNBA's Phoenix Mercury who also works with the NBA's Phoenix Suns in the NBA during the Mercury's offseason, Nillissen was introduced to the technique as a colleague of Corbin Hedt's at Houston Methodist. "When I came into this team-sports environment, I thought I'd use BFR the same way I used it in the clinic." Instead, he says, he's using it all the time. "Pretty much for any extremity injury but also as a recovery modality, and as an additional tool for strength training when the players are on the road."

Nillissen, a board-certified clinical specialist in sports physical therapy and a certified strength and conditioning specialist, describes BFR as a "first line of defense" for preventing muscle atrophy following injury. In the case of an Achilles or patellar tendon, for example — "a lot of our athletes have symptomatic tendons," he notes — his typical protocol would involve estimating the injured player's expected one-rep max for either a calf raise or leg extension, and then setting the weight for their exercise at 30% of that figure. Then he'd put a cuff on their limb to provide 80% occlusion, and from there, he'd have them do one set of 30 repetitions followed by three sets of 15 repetitions. "Once they're able to complete all the reps for two sessions in a row, we'll increase the load by 5%-10%," he explains. "It ends up being really uncomfortable, but they don't mind because they see the benefits and they want to push as much as possible."

Nillissen says he also uses BFR with injured players to help them maintain endurance — having them ride a stationary bike, for instance, with cuffs affixed to both legs — and with players who are healthy, he'll use it for ischemic preconditioning. "For IPC, it's meant to be done passively; they literally lie on the table while we alternate 100% occlusion for five minutes with no occlusion for five minutes." There's evidence that using BFR this way can increase vascularity throughout the limb and improve cellular exchange, he explains, "so it's something we like to do to speed up recovery, especially the day after a game."

The players he's worked with tend to ask for BFR once they've been introduced to the technique, Nillissen says, and he predicts that other physical therapists will find their patients respond the same way. The good thing is, he knows blood flow restriction training isn't just popular, it's also a great tool for a large number of patients. In the practice settings where the technique has been studied and proven safe and effective, he says, "if it's not a staple, I think we're doing our patients a disservice."