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When considering amputation, consider the whole patient

It is likely that someone close to you has faced a major health decision. After the choices and medical advice have been considered, a very personal factor came into play, and the words were spoken: “I don’t want to be a burden.”

This situation often arises when a patient with diabetes is faced with a decision regarding limb salvage or amputation. Often, the decision is clear, as with ischemic limbs that are unsuitable for revascularization, or necrotizing fasciitis is present. The choice is less clear, however, in cases in which the outcome from limb-sparing partial foot amputation is uncertain. Although major amputation is associated with higher mortality and lower quality of life (QoL), we have seen minor amputations result in transfer lesions, and limb salvage often involves further procedures and is associated with high rates of recalcification and reamputation.1,2 This is why we should listen when the patient says, “I don’t want to be a burden.”

As described in the article “Limb salvage vs amputation in the diabetic foot—the kindest cut,” on page 16, our decisions typically take into account clinical factors such as vascular status, infection, and previous amputations. Yet we often fail to adequately consider the patient’s mindset, ability to provide self-care, and perhaps most relevant, their QoL. Importantly, depression affects many patients with diabetes, and many patients with depression have some degree of functional impairment. Cognitive deterioration also may occur in patients who have diabetes, and a global cognitive deficit is more than 3 times as likely following amputation.3 Moreover, episodic memory loss is 4 times more likely after amputation and nearly 10 times more likely with microvascular diabetic foot complications.4 These cognitive deficits negatively affect adherence to foot care, and also decrease mobility and independence.5 A vicious cycle of depression and immobility can ensue, leading to nonhealing and recurrent ulcers.6,7 In such situations, it is QoL that cannot be saved.

Thus, our decisions regarding limb salvage and amputation must account not only for the standard clinical factors, but also the patient’s mental status, access to care, and family and community support. Which option will result in greater mobility, activity, and independence for the patient? For one patient, that may be limb salvage, such as a transmetatarsal amputation rather than multiple digital amputations. In another patient, an appropriate definitive procedure may be major amputation, with the goal of improving QoL over a shortened life expectancy. We clinicians must also bear in mind that a good prosthetic will help the patient beyond the acute process. The shorter recovery period following a more definitive amputation may also reduce the number of subsequent surgeries, admissions, and outpatient provider visits.

Because physical QoL parameters positively correlate with overall QoL, and considering morbidity and mortality associated with procedures, limb salvage is preferred when a definitive procedure can return the patient to mobility and independence. It can break the vicious cycle, yet is not always the best choice for the patient. When limb salvage may require multiple surgeries, an extended convalescent period, and potential deterioration in behavioral health and QoL, it is time to consider minor or major amputation.

The integration of a behavioral health specialist and a prosthetist to the care team can be helpful in determining when limb salvage is best for the patient. This added clinical dimension can better assess a patient’s wishes, prior functional level, and community support, thus providing more personalized care, including choice of a prosthetic based on the patient’s functional needs rather than degree of amputation. Doing so may help us optimize the patient’s ability to re-establish mobility and independence, and be a burden to no one.

Dr. Labovitz is professor and assistant dean of clinical education and medical director of the Foot and Ankle Center at Western University of Health Sciences College of Podiatric Medicine in Pomona, California.

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Treatment for post-stroke spastic equinovarus and plantar flexor spasticity

Spasticity occurs in 20% to 40% of stroke patients. Two new studies add to the body of evidence supporting the use of botulinum toxin type A (BT-A) injections for post-stroke spasticity: the first looked at the ideal timing of injections for plantar flexor spasticity, and the second looked at ultrasound-guided injections for spastic equinovarus.

Chronic plantar flexor spasticity concomitant with equinovarus, a common complication from stroke, leads to reduced foot clearance and circumduction of the involved leg during the gait cycle. Previous randomized controlled trials have shown that BT-A injected into the gastrocnemius muscle increases range of motion in the ankle, preventing spastic equinovarus. Ongoing research supports the use of BT-A injections in the subacute recovery phase of stroke rehabilitation, moving the timing up from prior reports to within the 6-month window post-event. Although the thinking is to prevent the development of abnormal muscle and motor activities, the potential for post-injection weakness at this early stage presents a clinical challenge. But so too does waiting too long to perform the injections, which can allow spasticity to become chronic, leading to secondary issues such as stiffness or fibrosis of surrounding tissues, thus compromising responsiveness to treatment overall.

To address this question, a Korean research team led by Hyun-Mi Oh, who had previously done a randomized controlled trial comparing the efficacy of different BT-A injection sites in the gastrocnemius (GC) for the treatment of spasticity, performed a secondary analysis of that data. This new analysis sought to understand whether the timing of the BT-A injection could affect reduction in plantar flexor spasticity or improve gait, specifically comparing those who received injections within 6 months of the stroke event (n = 12), those who received the injection between 6 and 12 months (n = 14), and those who received the injection between 1 and 2 years post-event (n = 12). Outcome measures included the Modified Ashworth Scale (MAS), ABILICO, Functional Ambulation Category, and others. Data were analyzed for baseline and 2, 4, and 8 weeks post-injection.

All 3 patient groups showed improvement in spasticity and gait post-injection. Per the MAS, significant improvement was seen as early as 2 weeks (P < .001). Gait improvements, based on ABILICO and Functional Ambulation Category assessments, were apparent for all 3 groups at the 8-week measure. The authors concluded that, regardless of the timing, the injection could be expected to lead to improvement in both spasticity and gait, and that the injections were beneficial and safe, even in the early phase of stroke rehabilitation.

The second study, conducted by Semra Aktürk and coworkers, looked at the use of ultrasound to guide injections into the innervation zones of the gastrocnemius (GC), soleus (S), and tibialis posterior (TP). Each of 23 post-stroke patients received injections of BT-A 25 U in the GC medial head, GC lateral head, S, and TP. Assessments made at 4 and 12 weeks post-injection included MAS, Brunnstrom stage, and Preferred Gait Speed.

MAS scores showed all patients had improved muscle tone at both 4 and 12 weeks. Brunnstrom scores showed improvements at 12 weeks post-injection. Gait speed showed continuous improvement from baseline to 4 weeks and through 12 weeks. The authors concluded that the ultrasound guidance, based on the EURO-musculus approach for lower extremity muscles, allowed the injected toxin into the innervation zones of hard-to-reach deep muscles, but avoided the neurovascular injuries that can occur with conventional needle insertion. The authors note, however, that BT-A injections alone do not improve spasticity, but rather that they should be part of a focused rehabilitation program that seeks functional improvements by reducing abnormal sensory inputs and uncontrolled motor activity.

Sources

Crossover prosthetic design

Prosthetic feet are typically optimized for a narrow range of activities, meaning active prosthetic users may need more than 1 prosthesis to fully participate in activities with varying degrees of impact. Modern energy-storing feet (ESF) support users’ ability to walk at differing speeds, as well as support static standing, but they can limit aerobic activities and running speeds. Running-specific feet (RSF), while ideal for running and sprinting, do not support low impact activities, particularly standing or walking.
Now, researchers from the University of Washington at Seattle have developed a crossover foot (XF) designed with a split keel for managing uneven terrain, heel springs, and the ability to fit a regular shoe. Its extended stiff keel allows users to walk and stand as well as run and jog, essentially letting users experience the full spectrum of mobility with a single prosthesis.

Activities along with mobility spectrum that ESF, RSF, and XF are estimated to span for most prosthetic limb users. The black sections of the arrows indicate that the foot is well designed for these activities, the faded section indicates that the foot design can be used for these activities, however, performance may be suboptimal.

In a randomized crossover study published recently in PLoS One, the researchers followed 30 participants with transtibial amputation as they wore custom-made XF and ESF interventions for 30 days each and provided feedback through a variety of measures. Participants reported improved health outcomes in mobility, balance, functional satisfaction, fatigue, and activity limitations using the XF compared to the ESF. The key difference? Sound side-step length improved significantly with XF use, which the authors indicated could provide benefit to the sound limb. Most important to the authors, the participants preferred the XF to the ESF overall.

Clinical relevance: Prosthetic limb users often report lower quality of life scores due to activity limitations. Based on these findings, prostheses that can accommodate users’ participation in a wider range of activities present a cost-effective opportunity to improve health outcomes for this population.

Source

Post-operative complications after Achilles tendon rupture repair
Achilles tendon rupture (ATR) is one of the most common injuries resulting from sports and exercise activities. Its resulting functional deficits can last more than 2 years from the original injury. While traditionally it has been an injury seen more among men, prevalence among women has been increasing, most likely due to increased participation in recreational sports.

Treatment for ATR can be surgical or nonsurgical. Although lower rates of re-rupture are associated with surgical repair, questions about general surgical complications persist. These authors sought to identify patient characteristics most associated with post-operative complications after surgical repair of ATR.

Using the American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) database, the authors first identified characteristics that put patients at high risk for 30-day post-operative complications, which included obesity (BMI >30), history of diabetes, or history of smoking. They then identified 1,164 patients for the study, with 615 meeting the criteria for the high-risk cohort, and 549 healthy controls.

Using multivariate logistic regression analysis, the researchers found that 2% overall had post-operative complications, with no significant differences between the 2 groups. A subgroup analysis compared ATR with and without graft and found the groups comparable with regard to outcomes. The only difference in this subgroup was operative time (58.34 ± 26.9 mins without graft vs 93.25 ± 40.41 mins with graft).

Superficial surgical site infection (defined by NSQIP as an open wound, cellulitis erythema, tenderness, and swelling) or wound infection noted post-operatively at the surgical site was the single most common adverse event at 0.9%. Rates of other complications are shown in the figure. Operative time for the high-risk group was significantly longer at 63.16 ± 30.2 mins, compared with the control groups at 57.95 ± 28.2 mins (P=.002).

Overall, the authors found a very low rate of 30-day post-operative complications in the study group, even those with risk factors. Obesity, diabetes, and history of smoking were not seen to increase post-operative complications. The authors note that these data can help inform the provider-patient discussion regarding the benefits of both surgical and non-surgical ATR repair.

Source
Clinical relevance: Although diabetes was not seen as a risk factor for post-operative complications in this study, a 2016 meta-analysis found that prevalence of tendinopathy was increased in people with diabetes (odds ratio [OR] 3.7, 95% CI, 2.71 to 4.97), diabetes was more prevalent in people with tendinopathy (OR 1.28, 95% CI, 1.10 to 1.49), and the tendons of people with diabetes were thicker than controls (standardized mean difference 0.79, 95% CI, 0.47 to 1.12). Those authors noted that the functional deficits caused by tendinopathies can prevent people with diabetes from adhering to their exercise regimens, which can compromise diabetes control. Furthermore, data show that in people with diabetes, Achilles tendinopathy has the potential to increase forefoot pressure, causing a traumatic cascade of plantar forefoot ulcers which can cause deep infection and lead to lower extremity amputation. Thus, actively monitoring these patients to prevent tendinopathies has the potential to improve several patient outcomes.

Sources

Low-cost trans-femoral prosthesis uses plantar insole sensors

Indian researchers have designed a trans-femoral prosthesis with plantar insole sensors that they found allow users to achieve near able-bodied gait kinematics. The passive prosthesis uses a magneto-rheological (MR) damping system with electronic control based on plantar insole feedback. While plantar insoles typically provide information only for the stance phase, the researchers developed a novel sensing method that would allow control during both the stance and swing phases of the gait cycle. Their design employs 24 sensors in 4 groups located in strategic positions on the heel, midfoot, metatarsal, and toe (see figure). Positioning of the sensors aligns with dominant plantar pressure points identified in previous walking experiments.

The mechanical design includes an MR damper, a hinge-type knee joint, and leg assembly brace supports. Information from the sensors provides enough information to control the current in the MR damper to allow for normal gait throughout the entire gait cycle.

The researchers’ goal was to develop an affordable prosthesis for manufacture and use in developing countries in accordance with the recommendations of the ISPO Consensus Conference on Appropriate Prosthetic Technology in Developing Countries. As such, the prosthesis was tested on a 24-year-old amputee, also from India, who walked 80 feet in each of 10 trials to test the design. The knee joint flexed up to 15° ± 5° in early stance; swing phase flexion only reached 45° ± 7°, which is below the biologically acceptable limit of 70°. However, the knee-angle trajectory provided by this prosthesis allowed the user to achieve near able-bodied gait kinematics with stability while achieving knee flexion-extension during heel strike and mid-stance. It also achieved controlled swing phase knee flexion-extension.

Designed for use in low-income and low resource countries, the researchers believe their prototype has commercialization potential in developing countries as well.

Supportive footwear for children with CMT

The effect of footwear on gait and balance of children and adolescents with Charcot-Marie-Tooth (CMT) disease is of interest to parents and clinicians. Children with CMT, which causes progressive damage to peripheral nerves, particularly the feet and ankles, often have gait difficulties due to muscle weakness, including problems with balance, resulting in falls.

Researchers from Australia evaluated different styles of footwear and their relation to specific gait and balance parameters. Subjects included 30 children and adolescents with CMT and 30 healthy volunteers, ranging in age from 4 to 17 years. The CMT group included children and adolescents with different genetic defects. Inclusion criteria were the ability to walk >75m without gait aids (orthoses permitted). Exclusion criteria included developmental disorders, neuromuscular/musculoskeletal disorders that could affect gait, and lower limb injury or surgery in the preceding 6 months. Assessments of anthropometry, gait, footwear, and disease severity were conducted at a single study visit.

The 2 groups wore similar shoes including several types of optimal footwear, such as athletic-type runners, high-top leather or...
canvas boots, leather school shoes, and canvas shoes with laces; and suboptimal footwear, such as flip-flops, slip-on footwear, sandals, and slippers. Seven participants with CMT wore foot orthoses.

For both groups, the optimal footwear was found to improve gait compared to suboptimal footwear and walking barefoot, and was found to significantly improve gait speed, promote longer steps, and decreased cadence. The base of support was found to be wider in both types of footwear compared with barefoot, which may be a compensatory response to the reduced sensory feedback in footwear and subsequent reduced balance, researchers noted. Also, the degree of difference was almost double in suboptimal footwear compared with optimal footwear.

Although the researchers found no interaction effect, they demonstrated that walking in suboptimal footwear resulted in worse gait performance in both groups of children, but that the finding may have greater clinical implications for children with CMT as they may be less able to successfully compensate for such changes brought about by loose or unfastened footwear. Additional studies are needed to further understand the effect of suboptimal footwear on CMT children and the potentially adverse effects it has on gait, such as falls.

Source

Study assesses role of corticosteroid therapy in Achilles tendinopathy

Achilles tendinopathy is the most common overuse injury in sport, and it is common in non-athletes as well. High volume image guided injection and structured rehabilitation (HVIGI+SR) has been shown in repeated studies to provide significant improvement in pain and function, and reductions in neovascularization and tendon thickness. Traditionally, these injections have included 25 mg of hydrocortisone acetate. Given the steroid’s potential to degrade the tendon, researchers from the United Kingdom and Spain conducted a pilot study to determine if the steroid was indeed necessary to maintain the clinical benefit of the HVIGI+SR regimen.

The researchers recruited 23 patients with 26 tendinopathies who were allowed to choose between injections of 10 mL of 0.5% Marcaine combined with either 40 mL of normal saline with 25 mg of hydrocortisone (n = 12) or 40 mL of saline alone (n=14). Injections were given with patients in supine position, hip externally rotated, knees flexed to 45°, ankle plantar grade. Using aseptic technique, a 21-gauge needle was inserted between the Achilles tendon anterior aspect and Kager’s fat pad, using ultrasound to identify neovascularization.

Assessments, including the Victorian Institute of Sports Assessment – Achilles (VISA-A) and a 100-mm visual analogue scale (VAS) designed to assess pain and symptoms both pre- and post-injection, were given pre-injection, at 2, 6, and 10 weeks post-injection, and at 12 months follow-up.

Both groups showed significant improvement in the VISA-A across all follow-ups. There was no significant difference in the VAS scores between the 2 groups: For those who chose steroid, VAS pain scores improved by 40.8 mm (P=.01) and symptom scores improved 31.7 mm (P=0.05). For those who chose no steroid, VAS pain scores improved 49.7 mm (P<.01) and symptom scores improved 46.3 (P<.01).

The authors concluded that their short-term results show that HVIGI+SR without steroid may be a viable treatment for this common but difficult-to-treat condition, particularly for patients who want a conservative option, and they called for full-scale clinical trials to confirm their pilot findings.

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The decision often hinges on how a given inter-
vention will affect the patient’s quality of life.
How, then, to define optimal QoL for your patient,
and to agree on the means to achieve it?

As clinicians well know, diabetes puts patients at risk of foot ul-
cers that can lead to poor outcomes, evidenced by the 40% 5-
year mortality in patients with newly diagnosed diabetic foot ulcers (DFUs). As many as 25% of patients with diabetes will de-
velop a diabetic foot ulcer, of which at least one quarter do not
heal, putting patients at risk of amputation.2

Amputation necessitated by nonhealing ulcers from diabetic
neuropathy or peripheral vascular disease has typically involved
the loss of part of the foot or part of the leg; in recent years, how-
ever, clinicians have developed options that, in the best of cases,
minimize the loss of structural parts. Surgeons may attempt to
salvage as much of the limb as possible, and can choose such
amputation levels as toe, transmetatarsal, or a more proximal par-
tial-foot amputation such as the Chopart’s or Syme’s amputation.
Severe infection often requires transtibial amputation (TTA).

Since 2000, the number of TTAs has declined as partial foot
amputations (PFAs) have increased. The apparent advantages of
PFA, compared with TTA, include improved mobility and quality
of life (QoL) as well as lower mortality—although the higher mor-
tality reported in patients with TTA may be associated with un-
derlying disease rather than the procedure itself.4,5

Increasingly, however, disadvantages associated with PFAs
have come in to focus for clinicians, including a significant rate
of failure due to complications such as dehiscence and re-ulcer-
ation, as well as the resulting secondary (and more proximal) sur-
geries these problems necessitate. Even a first-ray amputation
affects gait and QoL, and studies have reported that approxi-
mately one third of patients with a PFA require revision surgery,
compared with 10% of those who underwent TTA.7,8 An ipsilat-
eeral reamputation rate as high as 60% 5 years from the original
surgery has been reported in patients with PFA.\(^9\)

In light of these findings, clinicians face a complex array of variables to consider when choosing between limb salvage and a more proximal amputation such as TTA, including patient preference, which might not align with the practitioner’s clinical judgment. Illustrating this point is a 2017 report that 94% of patients who underwent a series of PFAs would prefer those salvage procedures again rather than undergo TTA.\(^10\) The decision often hinges on how a given intervention will affect the patient’s QoL. The questions about how to proceed then shift to: How does the patient define optimal QoL? And how can physician and patient agree on the means to achieve that goal?

Function, function, function

"Mobility is what counts," said Jonathan Labovitz, DPM, medical director of the Foot & Ankle Center at Western University of Health Sciences, Pomona, California (see page 9). When deciding on a below-knee amputation and attempting limb salvage, he looks for middle ground that is defined by how functional the patient is likely to be. It might be acceptable in some situations for the patient to undergo multiple limb-salvage procedures, noted Labovitz, “but you have to think about not just getting the limb closed, but getting it closed and functional.”

Function has not only physical but psychosocial implications. Patients who lose ambulatory capability can become more dependent on friends and family. “They feel like a burden, and no one wants that,” he said. “In deciding whether to amputate or salvage, it always comes back to function, so that the patient is as independent as possible. If you can’t give them that independence with limb salvage, then you may need to take more off, because they’ll do better with a higher-level amputation and a prosthesis. We know they have a shortened lifespan, so let’s give them the best life we can.”

Of course, the level of amputation affects function. For example, loss of metatarsophalangeal joints, as in a transmetatarsal or higher procedure, profoundly affects gait.\(^11\) These patients give up significant plantar flexor power at the ankle and also lose plantar weight-bearing surface, pronation and supination during gait, and active push-off.

Michael Pinzur, MD, professor of orthopedic surgery and rehabilitation at Loyola University Medical Center, Maywood, Illinois, added that decisions about limb salvage should include the answers to 4 essential questions—

1. Will limb salvage outperform amputation and a prosthetic limb?
2. What is a realistic expectation regarding results for each option?
3. What are the costs to the patient, financially and otherwise, of multiple procedures and time away from work?
4. What are the risks?

The goal of treatment, Pinzur noted, is not limb retention but optimization of the patient’s ability to function. And because QoL is subjective, a patient may consider his own QoL to be greater than does a patient with the same or even better function, simply because he can still perform the activities that are important to his happiness and independence.

Hard choices

Dane Wukich, MD, the Dr. Charles F. Gregory Distinguished Chair in Orthopaedic Surgery at the University of Texas Southwestern Medical Center in Dallas, told LER that several variables influence his decision to abandon attempts at limb salvage—

• Presence of severe life-threatening infection
• Presence of a deformity that cannot be reconstructed
• Inability to restore good circulation to the limb.

Wukich is mindful of his own research that found that patients with foot ulcers fear major lower-extremity amputation more than they fear death.\(^12\) “If a patient is frightened of losing their leg, and..."
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they spend 18 months trying to save it, amputation is a big, big decision for them,” he said. “One way we can help with that is to have them meet preoperatively with the physical medicine and rehabilitation doctors so they can talk about what it’s going to be like afterward.”

To better understand their situation, patients may also meet with a physical therapist or occupational therapist, a prosthetist, and even other patients who have undergone the same procedure.

Wukich noted that patients who have delayed amputation often admit months later that they would have done it sooner had they known what it would be like. “I look at an amputation as the first step in rehabilitation, rather than as a treatment failure,” he said.

Wukich agrees with Labovitz and Pinzur: Mobility and function strongly influence patient perceptions of their QoL. “The key is to get patients up and moving,” said Wukich. Those who ambulate are more likely to improve their QoL, even using a prosthesis.

**How best to assess QoL in patients?**

Wukich primarily uses the Short Form Health Survey 36 (SF-36) and the streamlined SF-12. “Those are validated instruments across many, many areas of health,” Wukich said. “They’re generic, so we also use the Foot and Ankle Ability Measure, which gives us further information about how patients are doing in terms of physical and mental quality of life.”

In March this year, Wukich and co-author Katherine Raspovic, DPM, examined a number of QoL measures in patients with diabetic foot disease, through patient-reported outcomes. No single measure is currently considered a gold standard but, taken together, they provide important—if often complex—information about aspects of diabetic foot disease and its effects on health-related QoL.

For example, it appears that foot disease can affect diabetes patients’ physical QoL more so than mental QoL, particularly in Charcot neuroarthropathy. Wukich and Raspovic also cite research demonstrating that:

- mental QoL is higher in patients with healing foot ulcers compared with patients who had nonhealing DFUs
- patients with unrehealed ulcers reported more pain and physical limitations than those with minor amputations
- 2-year survival was greater in patients with amputation preserving the ankle compared with patients who had undergone TTA (80% and 48%, respectively)

Additional studies reported improved physical and mental QoL following TTA, including lower-extremity function and mobility, particularly among those who amputated.

Overall, the authors concluded that in select patients—generally those with better cardiovascular status—amputation can improve self-reported QoL when it leads to better physical function.

Wukich and Raspovic also addressed the apparently lower impact on mental QoL, which has perplexed many researchers and clinicians. It might be that foot ulcers cause less-than-expected emotional distress because the associated neuropathy can diminish the sensation of pain. It may also be that SF-36 fails to adequately capture emotional distress in these patients.

Importantly, research has consistently shown that patients with diabetes have roughly double the risk of both clinical depression and elevated depressive symptoms compared with the general population. Furthermore, diabetic neuropathy has been shown to impair both physical and emotional function, and research has begun to delineate important connections between neuropathy and psychosocial outcomes, including depression, anxiety, and how well patients manage their risk of DFU.

**When the best choice is not obvious**

Because diabetes, neuropathy, peripheral vascular disease, and their sequelae affect so many aspects of a patient’s life, clinicians have developed team treatment approaches that strive to address, under 1 roof, most patient challenges. A recent systematic review of papers looking at multidisciplinary limb salvage teams reported that amputation severity was reduced, mortality in the postsurgical period was lower, and length of hospital stay was shorter when patients received multidisciplinary team care; another study found that multidisciplinary limb salvage teams effectively healed wounds, maintained ambulatory status in patients with limb-threatening wounds, and helped minimize readmission.

David Armstrong, MD, PhD, DPM, director of the Southwestern Academic Limb Salvage Alliance (SALSA) at the Keck School of Medicine at the University of Southern California, told LER that the team’s preference is for limb salvage to the greatest extent possible. The approach, summarized as “toe and flow,” involves clinicians from both podiatry and vascular surgery.

“We think that, in most patients, less is more; that is, a more distal amputation is preferable to a more proximal one,” Armstrong told LER. “That said, there are times when function may be better with a more proximal procedure such as a below-knee amputation. That tends to be true in younger patients with significant tissue loss and a lot of reconstructive surgery ahead of them,” in which 1 good-quality amputation could result in a higher QoL.

Older patients with other problems, such as cardiovascular or cerebrovascular complications, who may have reduced potential for rehabilitation, may benefit more from limb-sparing procedures. Armstrong indicated that, in such patients, a good-quality midfoot amputation can yield a higher QoL. Although he acknowledged that some clinicians prefer to proceed to a higher-level amputation such as a TTA rather than subject a patient to repeated procedures in an attempt to save the limb, Armstrong doesn’t always agree.
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“The best choice for a given patient isn’t always obvious,” he said. “The longer I work as a surgeon, the more I realize that thinking I can really fix anyone is the height of hubris. What I can do is help folks move through their world a little better. Sometimes that means performing multiple procedures, but most of the time it doesn’t. So, while I respect the argument that you don’t want to just keep operating on these patients, if you really extend that logic out, it means eliminating most vascular surgeries and most orthopedic surgeries, because the longer you follow these patients, the more certain you become that what you’ve done will fail.”

Armstrong agrees with his colleagues that function is a valuable measure of success, and that mobility is the key to QoL: that is, how well they can do what they care about doing.

“Ultimately, it’s the job of the team to figure out what that is,” said Armstrong, “and help the patient get back to doing it.”

**The team approach to optimizing QoL**

At the University of California–San Francisco Center for Limb Preservation, co-director Alexander Reyzelman, DPM, works with the medical center’s chief of vascular and endovascular surgery, Michael S. Conte, MD, to achieve optimal limb-salvage outcomes. “You can’t save the leg with vascular, or orthopedics, or podiatry alone,” Reyzelman said. “It has to be a team approach, so we see the patients together and assess whether they need revascularization, or a foot procedure, or both—and if they need both, which should come first?” Time is tissue, he said.

Reyzelman and his team use the Wound, Ischemia, and Foot Infection (WIfI) Scale\(^{24}\) to assess the status of diabetic foot wounds. Though not a QoL measure, the classification system was developed by the Society for Vascular Surgery. It has been shown to predict several outcomes including length of hospital stay and freedom from amputation.\(^{25-27}\) The classification system assesses the risk of losing the leg. “If the risk is high, that doesn’t mean we won’t try to save the leg; it just may mean multiple procedures over many months, and the patient needs to know that, because it will significantly affect their quality of life,” he said.

Reyzelman’s concept of QoL includes considerations of the patient’s age, cultural background, support from family and friends, and personal goals. “It’s important to discuss those goals, concerns, and desires,” he said, noting that a patient in the 7th or 8th decade of life who is less active and has comorbidities may have trouble rehabilitating a below-knee amputation, whereas a patient in the 5th or 6th decade of life who is functioning well might feel that a below-knee amputation is more appropriate. Some patients, regardless of age or function, want to save their foot at all cost. “It’s a complicated decision process and a difficult discussion for doctors to have with their patients because it’s like life and death—except it’s limb death,” he said.

Reyzelman does his best to meet with the patient and family members to help them understand that they are part of the process, and can continue the deliberations outside the doctor’s office.

“We have an honest discussion about the pros and cons of partial foot amputation versus below-the-knee,” Reyzelman continued. A PFA may require more than 1 procedure, long-term antibiotics, and rehabilitation at a skilled nursing facility, requiring patient and family understanding that the process will take months, not weeks. They also need to understand that below-the-knee amputation is not the end of the world, because advances in rehabilitation and prosthetics have improved the process of returning to function.

Jonathan Labovitz said that, for such reasons, he considers it...
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important to include either a psychologist or a psychiatrist on the treatment team when possible, to address those factors of getting at what the patient wants.

**Key to the conversation**

Australian and US researchers are collaborating to develop resources for such shared decision-making. The researchers note several important facets of any such decision, including psychosocial implications and conversations about mortality.28 Michael Dillon, PhD, BPO (Hons), associate professor at the National Centre for Prosthetics and Orthotics at La Trobe University, Melbourne, Australia, told LER that including the 5-year risk of death in the conversation often affects the patient’s decision.

“If you have a significant risk of dying within 5 years, how do you want to spend that time?” he asked. “Shared decision-making provides an opportunity to support patients in the complexities of the choices they have to make. I’m OK with whatever they decide, as long as they have the information to make that choice.”

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

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Most physical therapists maintain that resistance training is beneficial to patients with knee osteoarthritis, but evidence from trials that have been designed with consistency is lacking. Experts discuss how to create an effective regimen given this information vacuum.

By Jill R. Dorson

Osteoarthritis (OA) affects nearly 27 million people in the United States; it is more common in those ≥65 years.1 The disease causes progressive erosion of the surface layer of the cartilage and, eventually, underlying bone, resulting in pain, swelling, and stiffness that limit mobility, cause disability, and impair quality of life.2 OA of the knee is the most common form.2

According to the American College of Rheumatology 2012 update to its guidelines for treating OA of the hand, hip, and knee,3 symptomatic pain relief in patients without contraindication can be managed medically with acetaminophen (to a maximum dosage of 4000 mg/d); oral and topical nonsteroidal anti-inflammatory drugs (topicals are preferred for patients ≥75 years); tramadol; opioids; and intra-articular corticosteroid injection; these can be prescribed in conjunction with nonpharmaceutical modalities, such as thermal therapy, joint-protection techniques, and assistive devices. Moreover, the College strongly recommends that patients with OA of the knee participate in aerobic, aquatic, or resistance exercises according to their physical capabilities and preferences.

What research demonstrates

Resistance training is one of the most widely used nonpharmacotherapeutic modalities for treating osteoarthritis (OA), but there is debate over what form it should take, particularly in OA of the knee.

Resistance training is one of the most widely used nonpharmacotherapeutic modalities for treating osteoarthritis (OA), but there is debate over what form it should take, particularly in OA of the knee.
PhD, a researcher at the Carnegie School of Sport, Leeds Beckett University, Leeds, United Kingdom, and a specialist in rehabilitation and conditioning, believes that proper strength training is effective. “For me, resistance training, when done correctly, can have a significant and positive effect on symptoms of knee osteoarthritis,” she said. “However, the problem that we have, which we highlighted in our systematic review, is that so many of the randomized controlled trials have been poorly designed.”

Keep on moving
Anecdotally, physical therapists do see a clear benefit from resistance training for OA of the knee. Resistance training can take any of several forms: Patients can use their own body weight, gravity, free weights, exercise machines, and resistance bands—essentially, any technique that gives the targeted muscle group something to work against. The goal is to improve muscle strength and exercise endurance. For physical therapists treating patients with OA of the knee, the first order of business is to get the affected joint moving so the patient can participate in therapy.

“The emphasis here is about getting [patients] functional again,” said Aaron Robles, PT, MPT, CFMT, president and owner of John Goetze Physical Therapy, Jacksonville Beach, Florida. “Early on, OA causes pain and keeps you from moving: ‘I have to do the exercises to protect my knee,’ patients tell me, ‘but it hurts.’ So then we have to loosen the knee joint up.”

Physical therapists accomplish this by manually moving the patella up and down and side to side; they can train patients to do this themselves and show them how to test to see if the joint is tight before beginning exercise. Exercising the knee without proper preparation is like asking someone to paint a room blue with red paint, said Taylor Miksell, PT, DPT, also at John Goetze. “The room is never going to be painted blue if you don’t give them the right tools.”

Open-chain and closed-chain exercises
Once the joint is loosened up, Robles and his team work with patients on exercises ranging from simple to complex. He and Miksell said they use both open-chain and closed-chain exercises, depending on patients’ needs and capabilities:

- **Open-chain exercises.** The foot is not fixed in place, unlike its position when using a weight machine; this allows isolation of specific muscle groups. The seated leg extension is an example of an open-chain exercise: The seated patient lifts his (her) leg from a 90° angle to straight in front and then lowers it to the original position.

- **Closed-chain exercises.** The foot is stationary—set on the floor, for example, or attached to a piece of exercise equipment. An example of a closed-chain exercise is a squat, in which the feet are placed firmly on the floor.

Physical therapists and researchers agree that resistance training is most effective when there is a clear plan of action, which includes progression in both repetitions and weight load. Minshull

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Continued from page 28

said that some physical therapists increase repetitions first; in her experience, however, adding weight before increasing repetitions is more effective.

Bo Bregenhof, MD, a PhD candidate in the Orthopaedic Research Unit, Faculty of Health Sciences, University of Southern Denmark, Odense, is also a proponent of increasing weight before repetition. He is lead researcher for a clinical trial7 that studied the effect of combined, progressive-resistance, and neuromuscular exercises on knee-flexor and extensor strength. The study focused on prevention of OA as well as strengthening the hamstring following anterior cruciate ligament (ACL) reconstruction.

As mentioned, many patients with OA are ≥65 years,1 and working with an older population can present challenges that require medical professionals and physical therapists to be flexible in developing a treatment plan. Older patients might not be motivated to join the local health club, Bregenhof said, or they might not live near one. Resistance bands can provide a good alternative.

“The main strategy should focus on progression,” Bregenhof added. “In terms of resistance training for the OA population, there are as many views as there are health professionals. Still, heavy resistance and progression are the main ideas.”

Best practices in treating OA

Best practices for resistance training vary from professional to professional, as Bregenhof pointed out but, Minshull said, by definition, strength training involves lifting weights, with a target of 3 to a maximum of 5 repetitions, because after 5 repetitions the weight load becomes too heavy to complete another repetition.

In the opinion of many physical therapists, including Minshull, weight should increase before the number of repetitions to gain strength. Once the patient can do more than 6 reps at a certain weight, the number of reps can be increased. Leg extensions, leg presses, and mini-squats are effective and straightforward gym-based exercises, Minshull said. She added that, for older patients with more OA progression, lighter, body weight–focused exercises, such as sit-to-stands, step-ups, and mini-squats, possibly with a weighted backpack, are good options.

Robles and Mikkell follow the patterns that Minshull and Bregenhof describe, first trying exercises that use body weight. Mikkell said, “We’re not going to add resistance to someone who can’t lift their own body weight.” They will strive to increase endurance next, eventually adding ankle weights or resistance bands.

Robles works along the same lines, increasing repetitions at a given weight and adding more weight with fewer repetitions before building back up the maximum number of reps.

Keeping patients motivated

Motivating patients to stick to the program is among the major challenges in training, according to researchers and physical therapists.

“You can have the best intervention in the world; however, if you don’t get the buy-in from your patients, then it’s useless,” Minshull said. “I work closely with a consultant psychologist for this reason. Each person has his or her own personal barriers and motivations that will determine whether … they adhere to their rehabilitation… There will be a section of the population, who, despite your best efforts, will not adhere.”

Despite not having consistent protocols for the management of OA of the knee, physical therapists can still create a clear plan for treatment, recognizing that each patient is unique.

“We’re either challenging patients to do more or pulling them back from doing too much,” Robles said. “It depends on personality…. We have to understand the patient’s goal and keep them motivated to keep the goal in sight.”

Besides consulting with a psychologist, Minshull builds individualized programs for each patient and then measures even the smallest gain—such as level of pain while descending stairs—twice a month to provide motivation.

Studies have shown that, over time, building strength is the cornerstone of treating OA of the knee. Two 12-week studies measured the relationship between increased strength and improved physical function:

• In a 2015 study6 the authors concluded that increasing strength in the upper leg significantly reduced pain in patients with OA of the knee.

• A 2017 study7 found that, although increased knee-extensor strength did not result in improvement in function for patients with mild-to-moderate knee OA, patients with severe dysfunction at the start of the trial did see improvement.

These studies mirror what medical professionals and physical therapists see daily. Bregenhof is hopeful that the results of his trial will, ultimately, help prevent OA of the knee in patients who have had ACL surgery.

Although it seems clear that resistance training is an accepted and effective treatment for managing symptoms of osteoarthritis of the knee, there is no standard for research, making it difficult, and often frustrating, to interpret the results of studies.

“Despite having 34 ‘high-quality’ papers included in our review stating that their intervention was ‘strength training’ in nature, fewer than 10% of investigations designed their intervention properly to elicit strength gains,” Minshull said. “As such, you can see why it’s unclear whether … resistance training truly helps with osteoarthritis of the knee.”

Jill R. Dorson is a freelance writer based in San Diego, CA.

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Gait therapy in osteoarthritis of the hip: An assessment

Although clinicians and researchers have been gathering data for the use of gait therapy in patients with knee OA for some time, its use in hip OA is less far along, but shows promise.

By Nicole Wetsman

Does correcting for gait abnormalities have a role in the treatment of hip osteoarthritis (OA)? Both its use in knee OA and the research that has led to its inclusion in clinical practice guidelines for that condition suggest to some clinicians that principles of gait therapy as applied to knee OA may also apply to hip OA.

Gait changes in hip OA

Clinicians know well the connection between hip OA and abnormal gait—patients walk slowly with a forward lean, and drop the pelvis on the affected side. The reduced range of motion (ROM) in the hip and knee alter movement and mechanics throughout the lower extremity. Pain can further reduce ROM.

The relationship between gait biomechanics and OA can be viewed as a chicken-and-egg problem, observed Robin Queen, PhD, associate professor of biomedical engineering and mechanics at Virginia Tech: the directionality remains unclear. “We don’t know whether arthritic changes are driving gait changes, or gait is causing the arthritis,” Queen says.

These biomechanical changes can, however, be observed once cartilage begins to deteriorate, said Deborah Solomonow-Avnon, PhD, a researcher on the faculty of mechanical engineering at the Technion—Israel Institute of Technology, in Haifa, Israel, and lead author of a recent paper on biomechanical therapy for hip OA. A patient will adopt a pathological gait—pain restricts how the patient uses their muscles, causing a cycle of gait change leading to pain, and further gait change. Proof that compensatory strategies lead to disease progression is lacking, but abnormal gait patterns might increase abnormal loading on the joints of patients with hip OA, said Keelan Enseki PT, MS, orthopedic physical therapy residency director at the University of Pittsburgh Medical Center in Pittsburgh, Pennsylvania.

The logic behind gait therapy, then, is to correct for abnormal stress that changes associated with hip OA may have on joints. “We can correct what we know are faulty mechanics,” Enseki said. “Patients perform better, and perhaps, we can slow progression of the OA.”
The pace of research on gait and hip OA has increased along with advances in research in the knee, reflecting a trend in osteoarthritis: “The knee sets the tone, and the hip will follow,” said Enseki. OA of the knee is more prevalent than hip OA; the prevalence of symptomatic OA in patients older than 45 years is approximately 16%, compared with 9% for hip OA.5 Queen observed that patients with hip OA tend to have more degeneration than knee patients before seeking medical help, and Enseki surmised that because patients may more easily adapt to the limitations of hip OA compared with the same degeneration seen in the knee, physical therapists and physicians may see fewer hip OA patients.

Gait modification interventions have been found to reduce loading on the knee in patients with knee OA, and to reduce pain and symptoms. “It at least reduces pain,” Queen said. Investigators have assessed foot orthoses to assist in gait therapy for knee OA patients, with mixed results.6 Clinical practice guidelines for both the Osteoarthritis Research Society International and the European League Against Rheumatism have suggested that orthoses might be useful.7

From knee to hip
Solomonow-Avnon and her collaborators took a step toward applying those findings from the knee to the hip through research published over the past several years using the APOS biomechanical device to drive biomechanical changes. The device consists of 2 elements attached to the sole of the shoe at the heel and at the ball of the foot. The positioning of the 2 pieces is adjustable, allowing for individual calibration. The device forces the patient to walk in a
specific manner. Because the foot is the point of contact between the ground and the body, Solomonow-Avnon said, manipulating that intersection can impact loading on the joints of the lower extremity.

In a 2013 study, the authors reported on gait patterns, pain, and quality of life of 60 hip OA patients using the device for 1 hour a day. After the 12-week trial, patient walk speed, step length, and cadence had improved from baseline. Patients also had reduced pain and stiffness, as measured on the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC).8

Solomonow-Avnon then looked more closely at specific gait changes caused by the same device in a pilot study of 12 healthy men, and demonstrated that walking with the device led to increased hip abduction and decreased forces on the hip joint.9

The group next conducted a longitudinal study of a gait treatment program using the device in patients with hip OA. Twenty-one women with hip OA completed the year-long program, with testing at baseline, 3, 6, and 12 months, with patients gradually increasing their use of the device from 10 minutes to 2 hours a day.10 Over the 12 months of the study, patients reported improved quality of life and physical function, including measures included on the WOMAC. Importantly, gait speed increased.

Study limitations were the inclusion of only women, and lack of control group, and further trials are needed to confirm the initial promising findings, Solomonow-Avnon said.

“For the first time, we showed you can impact the hip using manipulations at the foot, and that we can see improvement in hip OA using this concept,” she said.

Implementing in practice

Current first-line treatments for hip OA that are supported by research findings include 1) patient education and, 2) strength, flexibility, and endurance training, Enseki said. Solomonow-Avnon’s research is an initial step toward evidence for the use of gait therapy in hip OA, which presently falls under the category of treatments that may be employed by clinicians with the understanding that more studies are needed.

Although the evidence for gait therapy and hip OA remains limited, Enseki said that it is sometimes used by therapists and doctors working directly with patients, and anecdotal evidence from that use supports it as a strategy. “We often utilize those sorts of interventions, even though the evidence isn’t as strong yet,” he says. In individual cases in which gait retraining has been included in therapy, Enseki says he’s seen good results.

From a clinical perspective, Queen said, a major goal of OA treatment is to ease pain, and gait retraining might be among the methods used to reach that goal, by, for example, ensuring the patient is not hiking up their hips, or walking with a Trendelenburg gait pattern.

Where do we go from here?

Hip OA treatment focuses on functional outcomes, Enseki said. An overarching goal is to maintain the patient’s lifestyle, which might include delaying surgery as long as possible. Gait therapy might contribute to reaching that goal. Queen is uncertain whether orthoses or similar devices are the best approach to gait therapy for all patients. “No 2 patients are going to alter their gait mechanics in the same way,” she said. “It may help a subset of people, but it’s going to be a challenge to really make it a broad solution.”

Continued on page 36
Gait therapy research also fits neatly into what Enseki describes as a broader trend: a focus on hip preservation across the lifespan, with early modifications. “We’re trying not to reach the point of hip OA,” he said, noting that gait and higher-level biomechanics might have a role.

Overall, the literature with regard to gait therapy for hip OA is in early stages, particularly compared with other areas of orthopedic medicine. Despite early, seemingly positive results for hip OA and gait intervention, continued inquiry and expanded lines of research are the most important next step, Enseki said.

Nicole Wetsman is a freelance writer.

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We might be falling short in our efforts to prevent ACL injury by allowing athletes to focus on how they are moving during screening.

By Sarah Marie Tighe, SPT, and Thomas Gus Almonroeder, PT, DPT, PhD

Almost 8 million athletes participate in high school sports each year in the United States, and an additional 490,000 compete at the intercollegiate level. Regrettably, acute lower-extremity musculoskeletal injuries are relatively common in sports that involve frequent high-impact maneuvers, such as landing and cutting (e.g., basketball and soccer). Anterior cruciate ligament (ACL) injuries are of particular concern, because they can be season- or career-ending, and can contribute to premature osteoarthritis of the knee.

Prevention of ACL injury is a priority in sports medicine; evidence suggests that targeted training might reduce the risk of ACL injury in some cases. However, epidemiological studies of injury trends indicate that prevention efforts might have had minimal influence on the rate of ACL injury in athletes.

As a result, improving our ability to identify athletes who are at risk of injury and then intervene effectively continue to be key objectives in sports medicine. An important step in this process might be to develop better understanding of variables that contribute to ACL injury.

What movement pattern increases ACL injury risk?

Most ACL injuries in athletes are noncontact in nature (i.e., they do not involve collision with a teammate or opponent) and typically occur during what appears to be a fairly routine maneuver that the athlete has undoubtedly performed countless times during a career. Observations from video analysis indicate that landing with limited knee flexion and marked knee abduction motion might place athletes at risk of ACL injury. A simulation study also showed that landing in this manner can place high load on the ACL. As a result, landing and cutting with limited knee flexion and high knee abduction motion or loading is discouraged.

Although it appears that we have a fairly well-developed understanding of the movement pattern that places an athlete at risk of ACL injury, our understanding of the cognitive and neuromuscular factors that contribute to this high-risk movement pattern is underdeveloped.
Influence of divided attention

From a motor-control perspective, a potential challenge associated with sports such as basketball and soccer is that athletes must maneuver while simultaneously attending to their opponents, teammates, the goal, etc. In addition, they might also need to allocate attentional resources to manipulating the ball if they are in possession (e.g., dribbling). As a result, they are unable to fully focus on their movement (i.e., they must divide their attention).

The limited nature of attentional capacity has been characterized theoretically and tested experimentally. However, studies that have explored biomechanical variables related to the risk of ACL injury by means of laboratory-based motion analysis typically do not reflect the attentional demands of sports, because athletes are often able to fully attend to their movement during testing. Interestingly, it appears that attempts to reflect the attentional demands of the sports environment by requiring athletes to attend to a teammate, opponent, or ball might result in mechanics that are associated with greater risk of ACL injury.

Three studies reported useful, enlightening findings:

- McLean and colleagues found that peak knee abduction angles were more than 30% higher (15.0°, compared to 11.3°) when athletes performed a lateral cutting maneuver with a simulated defensive opponent present, compared with baseline trials performed without a defensive opponent.
- Fedie and collaborators reported greater loading of the knee in the frontal plane when intercollegiate basketball players were required to intercept a pass shortly after cutting, compared to baseline trials during which they did not need to attend to a ball.
• Almonroeder and colleagues21 recently found that female athletes demonstrated less knee flexion and greater knee abduction when they attended to executing a basketball chest pass shortly after landing from a cut—in contrast to what was observed in trials performed without the chest pass.

These findings appear to show that the attentional demands of sports might contribute to the risk of ACL injury by limiting an athlete’s ability to fully attend to their movement.

There is also evidence that the addition of a relatively simple secondary cognitive task, unrelated to sports, might be sufficient to influence performance of common athletic maneuvers:18,28,29

• Seymore and collaborators29 recently found that soldiers completed a run-and-cut with less knee flexion when they were required to simultaneously count backwards, compared with baseline trials performed without an additional cognitive task.

• Dai et al28 also reported that athletes landed with less knee flexion and higher ground reaction forces during a land-and-jump task while counting backwards, compared with baseline trials.

These findings indicate that even a subtle change to a testing protocol—to limit an athlete’s ability to fully attend to their movement—can alter cutting or landing mechanics in a manner that could increase ACL loading.

Opportunity for further research

It appears that attempts to more fully reflect the attentional demands of the sports environment could provide additional insight into mechanics that contribute to ACL injury. Conversely, failure to account for attentional demands of sports within a testing protocol could limit its ecological validity. Continuing to develop and implement testing protocols that more adequately reflect the attentional demands of sports appears warranted.

Virtual reality. Perhaps virtual reality could allow for development of a more “game-like” testing environment and, therefore, offer opportunities for advancement in this regard.30 Virtual reality would also allow researchers to adapt the environment to the actions of the athlete(e.g., virtual defenders that react during testing), which could also promote more realistic testing. In addition, development of methods that allow for analysis of movement during competition, such as model-based image-matching31 or wearable technology (e.g., inertial measurement units),32 could also provide a better understanding of how attention influences movement in sports.

Study of the individual. Attempts to explore the influence of an individual athlete’s attentional capacity might also be an avenue for future research. It is possible that athletes who have more limited attentional capacity might be challenged to a greater extent to control their movement when they must divide their attentional resources; however, this premise has not been systematically tested.

Swanik and colleagues33 reported that athletes who go on to sustain a noncontact ACL injury demonstrated relatively poor baseline performance on a clinical test of cognitive functioning (using Immediate Post-Concussion Assessment and Cognitive Testing [ImpACT]), in comparison to athletes who remain uninjured. This finding appears to indicate that cognitive factors might contribute to the risk of ACL injury. However, the testing battery used by Swanik did

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not specifically assess attentional capacity; rather, it was designed to test cognitive processing speed and memory.

Considering the demands of the sports environment, attempts to relate the individual athlete’s attentional capacity to risk of ACL injury might also be a worthwhile avenue of research.

**Cognitive study.** Sports medicine professionals have highlighted the need to develop a better understanding of the role that cognitive factors (including attention) play in noncontact ACL injury.34 We agree that continuing to investigate the potential contribution of task-related cognitive demands and individual cognitive attributes is warranted. Optimally, these efforts will involve experts from a variety of disciplines.

**Relevance of screening tools to assess risk of ACL injury**

Development of screening tools that can identify athletes who are at risk of injury is undoubtedly a major component of prevention. Assessment of lower-extremity mechanics during performance of a drop vertical jump is a common approach to screening for risk of ACL injury.35-37 For this task, athletes drop or jump from a box, land on both feet, and immediately perform a vertical jump. Studies attempting to relate baseline landing mechanics to subsequent ACL injury have yielded inconsistent findings (i.e., some researchers have identified mechanics during the drop vertical jump that predict injury; some have not).38-42

Part of the reason for the inconsistent or limited predictive validity of the drop vertical jump might be that athletes are able to fully attend to their movement during testing—a situation that does not reflect the attentional demands of sports. Studies that have modified the standard drop vertical jump by including an overhead goal that requires attention during performance (e.g., a ball suspended overhead) have found that athletes demonstrate less knee flexion and greater knee abduction than they do in trials performed without an overhead goal.22,27 It is possible that our ability to identify athletes at risk of ACL injury would improve if we required them to divide their attention during testing. Although including sport-related “distractors” seems logical, relatively simple secondary cognitive tasks (e.g., counting backwards) may offer a sufficient challenge.

Programs for preventing ACL injury might also benefit from considering the attentional demands of sports. Providing athletes with instruction to alter their movement pattern (e.g., “Bend your knees when you land!”) is recommended for preventing ACL injury.9 Visual feedback training has also been explored, and appears to show potential for reducing mechanics associated with the risk of ACL injury.43-45

**Summing up: Are benefits of training transferable to play?**

Sports medicine professionals must 1) consider that athletes will be challenged to attend to movement-related cues emphasized in training when they compete and 2) not assume that improvements in performance made in a controlled training environment will carry over to movement during competition. It seems likely that training of this nature might need to be sufficient enough to achieve some level of automaticity before there will be transfer; however, the type or amount of training necessary to achieve stable changes in a movement pattern requires additional exploration.

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The future is now—
Implications of 3D technology for orthoses

2018 is shaping up as a breakthrough year for 3D printing in orthoses, as the industry moves from promise to reality. Experts agree: Three-dimensional printing will deliver custom clinical products, designed for individual patients at an affordable price.

By Keith Loria

3D printing is still a young technology for orthoses, and has great potential to change the way orthoses are designed and produced, say experts and specialists in the field.

The technology opens the possibility of adding value to the complete digitalization of analysis, design, and manufacture, said Blake Norquist, director of North American sales and business development for RS Print, a Paal-Beringen, Belgium–based company. He noted that combining digitized gait analysis and 3D printing may provide new standards and frameworks for experts based on objective, scientifically proven data.

One of the big game-changing aspects of this digitalization, Norquist noted, is the translation of data from objective analysis into a design that is then manufactured digitally. Expert involvement in the analysis and conversion toward design remains crucial, he said, adding, “After that point, the manufacturing becomes completely unbiased and reproducible.”

Gordon Styles, president and CEO of Star Rapid, a manufacturing company of 3D-printed medical applications based in Guangdong Province, People’s Republic of China, explained that 3D printing allows for orthoses manufacturers to respond quickly to requests for custom-made parts needed for rehabilitation. With this technology, he indicated, it is simple to create tailored supports, such as an insole, using high-resolution medical scans of a patient’s foot to determine arch and pressure points. By creating 3D computer-aided design (CAD) models from these scans, highly accurate sizes and shapes are built with very tight tolerances. This helps ensure optimal fit for the patient to support weak joints and limbs.

Moreover, according to Styles, 3D printing is being used to create patient-specific supports and braces, designed to enhance outcomes owing to their ability to create intricate lattice structures that can be used to create lightweight yet strong parts. “This ultimately makes orthoses more comfortable for patients,” he said. “If there is a requirement for a strong and durable brace, metal 3D printing often provides a stronger support than conventional methods.”

Clinical implications of 3D printing of orthotic devices include new possibilities of customization that have not been available with traditional methods. 

Continued on page 48
Commentary:
We’re in a time of mass production of customized orthoses

3D printing is an accessible manufacturing option. Any other approach is just wrong.

By Chris Lawrie, MSc

As an engineer, I printed my first automotive part in 1989 and my first pair of insoles in 2010. It took until 2017 for the stars to align, however: 3D printing technology capable of printing a pair of shells quickly, in materials that meet the demands of the foot, at a production price point that means 3D printing is no longer just a premium offering.

It’s a fact: Today, labs can have shells made for a price that is comparable to shells manufactured by direct-milling polypropylene or positives. Scanners are off-the-shelf items that can, with the right app, give us results that make casting an insanely poor choice. Design software (such as FITFOOT360) can give you complete clinical control over a custom, print-ready device, and you can, case by case, choose whether to mill or print a shell or a positive. I describe this digital mass-customization process as simply “capture–design–make.”

What’s the key to us introducing 3D printing into our foot-health community (for good, this time)? It’s producing a device that is better clinically while being believable to both clinicians and patients; after all, 3D printing it is just another way of making something. Any strategy that presents 3D printing as a premium product or high technology is dated and flawed; it simply maintains the low-volume, high-price strategy that has slowed the evolution of 3D printing, in all markets, over the past 30 years. The recent move by Hewlett-Packard to promote the democratization of printed materials has enabled entrepreneurial companies (such as iOrthotics and FIT360) to capitalize on a wholesale approach to designing and manufacturing 3D-printed insoles. As a result, 3D-printed insoles are already the preferred choice of many labs worldwide.

This is an exciting time in the world of 3D printing—a time that we will all benefit from, as our colleagues in the dental world did nearly a decade ago. As you invest in new technology for rapidly capturing the human form to benefit from, as our colleagues in the dental world did nearly a decade ago. As a result, 3D-printed insoles are already the preferred choice of many labs worldwide.

Clinical implications

3D printed foot orthoses are designed and manufactured using the latest digital technologies and require limited manual intervention. Industry experts say that this not only guarantees clinical accuracy of the product, required by clinicians for their patients, but also ensures that orthoses are of consistent quality, durability, and flexibility.

From a clinical perspective, Raju stated, the orthoses produced by 3D printing will deliver all the clinical modifications needed, while also making the insoles more flexible, durable, and ultra-light compared with co-poly-- or carbon-based competing products. This may broaden the range of choices in shoe type and lifestyle available to patients.
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Raju offered an example of how a 3D-printed orthosis can aid in correcting a pronated foot, in which the hind foot is directed into excessive valgus and impairs efficient heel strike and toe off in the gait cycle, causing calf pain and fatigue. The 3D-printed insoles have built-in hind-foot corrections specific to the patient’s deformity to permit a stable, neutral hind foot during the gait cycle.

Andrei Vakulenko, chief business development officer at Artec 3D, Luxembourg, believes the clinical implications of using 3D scanning and 3D printing are limitless. Following the creation of personalized 3D medical solutions, such as prosthetics, back braces, and even something as intricate as an ear, orthopedists are finding an industry that is constantly creating and improving the software and expanding the tools available for the seamless creation of both ready-made and custom orthoses.

For instance, Vakulenko said, the Robotics and Multibody Mechanics research group at Vrije Universiteit Brussel (University of Brussels) has, as one of its projects, a lower body–powered exoskeleton, built using the Artec Eva 3D scanner. The design uses a tightly fitting orthotic device for the user’s leg that is created by 3D-scanning of the limb. This process replaces the use of uncomfortable, messy plaster molds to capture the shape of a limb; the molds are then shipped to a manufacturer.

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“The precise 3D scan is used to digitally model an orthosis that can be 3D printed,” Vakulenko said. “Once printed, the orthotic is reinforced with carbon fibers and epoxy composite. Creating this form-fitting interface between the user and device ensures less energy is lost by the exoskeleton’s actuators and mechanical components that are built around it.”

Bruce E. Williams, DPM, DABFAS, director of gait analysis studies at the Weil Foot & Ankle Institute, Chicago, Illinois, said the potential for 3D-printed devices is huge because of the ability to control segmental stiffness in a way that has never been done before. “There are huge benefits to being able to control specific segmental elements in an orthotic. This cannot be achieved with traditional polypropylene devices,” he said. “The ability to stiffen the medial arch, create more flexibility in the medial or lateral columns has huge benefits for athletes and even day-to-day patients.”

This variation in both local and directional flexibility reflects the biomechanical data from digital, dynamic analysis. “It results in lightweight devices that last longer than traditional orthotics, giving the patient better value for money,” Williams said.

For example, Dr. Williams has made orthoses with decreased stiffness of the lateral column specifically for athletes who have had, or are at high risk of having, a 5th metatarsal fracture. After implementing this modification, the pressures and length of high pressures under the 5th metatarsal decreased markedly and greatly reduced or minimized further risk to these athletes for that type of injury.

Continued on page 54
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Norquist added that from a technical perspective, using 3D printing offers new possibilities of customization that have been impossible with traditional methods. What the clinician has ordered is what is received, fostering a trusting relationship with patients.

Getting results

The process of using 3D printing can produce high-quality results, and Vakulenko shared that, with constant technological advances and new developments in the tools and materials being used, customized solutions are becoming lighter, more ergonomic, and more cost-effective. In most cases, customized 3D-printed orthoses have the potential to improve on standard methods in terms of accuracy, cost, and procedure. Using 3D scanning to create a model that is then 3D printed delivers the exact data required for sizing the orthosis, creating a perfect fit and a durable solution. Because the process is additive, there is no wasted material when creating parts, eliminating the risk of additional costs.

Williams added that some materials, such as nylon, are largely unbreakable and allow for significant variability in stiffness and flexibility. Norquist agrees: “The choice of the material wasn’t just a lucky guess,” he said. “PA 12 [nylon powder] is a material that lasts far better than, for example, EVA [ethylene vinyl acetate] or cork and leather.”

However, Vakulenko cautioned that, just as with anything else, there is always room for improvement. “3D printing is the best option for personalized orthoses; however, if an orthotic is mass-produced, it will be more cost-effective to do so with a more traditional manufacturing process,” he said. “In addition, 3D printing can be rather slow compared to, for example, milling machines.”
Looking ahead

3D printing is already being used in orthopedics to create implants and in minimally invasive surgery to create small devices, resulting in less tissue damage during operations. With the growth of this technology, most believe that use will be more widespread in the future.

Although 3D printing for the medical industry is highly practical for the creation of customized devices, Styles noted that, regretfully, using this process for mass production of supports and braces may not become a reality in the near future. Until plastic 3D-printing machines reach commercial speed, he explained, the time needed to create a part will be days, and the size of a finished orthotic is limited to the size of the 3D machine’s print bed—typically smaller than what can be made using computer numerical control machining or custom casting.

Ultimately, Raju explained, the biggest caveat for the 3D-printed orthotics industry is not what technology is being used but, rather, how that technology is married with the entire value chain of production—from design to global supply chain to product pricing to quality control to research and to design and innovation.

One key competitive advantage of 3D printing is that it can be used to manufacture objects with complex geometry, such as an object within another object that cannot be created by any means other than 3D printing. In the long run, 3D printing may eventually replace traditional methods of manufacturing, both mass-produced and customized, in numerous industries.

Vakulenko said that most traditional methods of creating prosthetics are approaching obsolescence, and practicing orthopedists are embracing the new 3D technologies for a much cleaner, faster, and more precise process. “Today, using both high-tech 3D-printing and 3D-scanning technologies opens up a large variety of possibilities and allows for a much more flexible workflow with the use of the cutting-edge systems,” he said. “With the development of highly advanced tools to tailor to the healthcare industry, it is safe to say that we are now witnessing a significant shift in the procedures of the orthotics field.”

Keith Loria is a freelance medical writer.
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CMS UPDATES 2018 MEDICARE FEE SCHEDULES

The Centers for Medicare and Medicaid Services (CMS) has posted a Medicare fee schedule update effective April 1, 2018, announcing that diabetic shoe inserts fabricated using scanning devices will be now reimbursed using temporary HCPCS code K0903 at the same rate as inserts made over a positive model of the patient’s foot (A5513). The fee schedule for K0903 is set at $43.56, the current Medicare fee schedule for A5513.

In addition, CMS has posted an April update to its 2018 Medicare durable medical equipment, prosthetics, orthotics and supplies (DMEPOS) fee schedule, effective for Medicare claims for service on or after January 1, 2018. The 2018 Medicare fee schedule for orthotic and prosthetic services increased by 1.1% over 2017 rates, a net reflection of the 1.6% increase in the consumer pricing index for urban areas from June 2016 through June 2017, plus the annual multifactor productivity adjustment of –0.5%. Medicare fee for service payments continue to be reduced by 2% due to sequestration, which remains in effect until 2025. The complete 2018 Medicare fee schedule is available for download from the CMS website.

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PFA 59TH ANNUAL SYMPOSIUM SET FOR NOVEMBER

The Pedorthic Footcare Association (PFA) will hold its 59th Annual Symposium and Exhibition November 15 through 17, at the Marriott Grand in St Louis, MO. According to the PFA, this meeting is the largest educational event in the world solely dedicated to the practice of pedorthics and offers a full program of general and breakout sessions, networking and exhibiting opportunities, and social events.

The PFA Council on Pedorthic Education notes, “Continuing education is a critical element of our professional development. It not only allows us to continually provide our patients and clients with the best care and the most cutting-edge products but laisal offers us valuable insight into managing the business side of our practices.”

LYNDA WOODRUFF, LEADER IN PHYSICAL THERAPY EDUCATION

Lynda Woodruff, PT, PhD, a visiting professor at Alabama State University (ASU), where she initiated the transitional doctor of physical therapy program, died at age 70 years on March 20. She was a lifetime American Physical Therapy Association member. Woodruff continued as a consultant with ASU until her death. In 2012, ASU established the Baines-Woodruff Endowed Lectureship on Health Disparities to honor Woodruff and Ruth E. Baines, PT, PhD, former assistant chancellor of health sciences for the State University of New York Central Administration.

Woodruff was the founding director and professor in the department of physical therapy at North Georgia College, having retired in 2005. She received her master’s degree in physical therapy in 1971 from Case Western Reserve University and in 1974, she was the first African American to join the faculty of the Division of Physical Therapy at the School of Medicine at the University of North Carolina at Chapel Hill. In 1978 she joined the faculty in Georgia State University’s Department of Physical Therapy, and in 1984 Georgia State awarded her a PhD.
BIOFREEZE SOOTHING PAIN RELIEF CREAM

Biofreeze is launching its new Soothing Pain Relief Cream. Biofreeze also offers gel, roll-on, and spray external pain relief products. Research-proven to provide temporary relief from many aches and pains, Biofreeze Soothing Pain Relief Cream also hydrates and moisturizes the skin. Indications include sore muscles and joints, sprains, strains, and bruises. The new product is a deep penetrating, long-lasting, and non-greasy formula that contains natural moisturizers to promote overall skin health. The new Biofreeze product is designed with a proprietary formula made from USP-grade ingredients. Biofreeze Soothing Pain Relief Cream can be applied to foot, ankle, knee, and other muscles and joints. Samples are available from the company.

Biofreeze
800-246-3733
biofreeze.com

SCOPE-OF-PRACTICE LEGISLATION PROGRESSES IN SOUTH CAROLINA

Legislation to expand the scope of practice in South Carolina to include the ankle under podiatric medical care received a second read April 4 in the state House of Representatives. The measure was voted forward by a 71-42 vote. The legislation was supported by the South Carolina Podiatric Medical Association.

DENNIS FRISCH INSTALLED AS APMA PRESIDENT

Dennis R. Frisch, DPM, has been installed as president of American Podiatric Medical Association (APMA). In accepting the position, Frisch underscored APMA’s unique value to its members. “Every podiatric physician has earned one thing. No matter what state you practice in, your race, your creed, your political beliefs, we all share one thing—our degree. We all share those three letters after our name. We all earned the right to practice using our professional degree.”

FRACTURE SOCK TO REDUCE IRITATION

New from Advantage by Elite Orthopaedics Fracture Sock is designed to work with all ankle walkers and is sold individually. The socks are available in both high-top and low-top versions.

Advantage by Elite Orthopaedics
800/284-1688
elite-ortho.com/product-p/t1500.htm

AOPA POLICY FORUM MEETS WITH CONGRESSIONAL REPRESENTATIVES

Orthotic and prosthetic stakeholders met March 8 with members of Congress in Washington, DC, to discuss improving patient care and advancing other legislative objectives. Ninety-six patients and American Orthotic and Prosthetic Association members encouraged lawmakers in 500 appointments to support the 7 remaining provisions of the Medicare O&P Improvement Act. The clinical notes provision of the act had been approved earlier this year. Attendees also requested support for additional funding for O&P research and education, expressed the importance of veterans’ choice, and took the opportunity to share other issues facing their patients and their businesses.

OIG REPORT ON OUTPATIENT PHYSICAL THERAPY CLAIMS MAY BE FLAWED: CMA, APTA

The US Centers for Medicare and Medicaid Services (CMS) and American Physical Therapy Association (APTA) are challenging a recent Office of the Inspector General (OIG) report, pointing out how flawed processes and misinterpretations are coloring the findings. The OIG report identified 184 noncompliant claims, from a sample of 300 Medicaid outpatient claims made in 2013 for physical therapy, totaling $12,741. The report extrapolates that these patterns may show that Medicare paid out as much as $367 million in physical therapy claims that didn’t meet CMS standards. CMS argues that a more thorough analysis would be required to back up the OIG estimate. Further, CMS stated that the OIG misinterpreted CMS coverage policies related to the concept of “significant improvement.”

"Most of the findings identified by OIG are likely attributable to documentation errors as opposed to fraudulent activity,” according to the CMS.

The APTA supports the CMS position that the OIG’s analysis included a flawed in-

CHARLES SOUTHERLAND, DPM, RECEIVES HUMANITARIAN AWARD

Charles Southerland, DPM, received the Humanitarian Award at the 98th Annual American Podiatric Medical Association (APMA) House of Delegates meeting, held March 20 in Washington, D, in recognition of his medical missionary work. He serves as program director for the Yucatan Crippled Children’s Project. According to the APMA, The Humanitarian Award is presented to an institution/organization or individual member in good standing demonstrating truly outstanding humanitarian efforts that have had a profound impact on the public and a definable positive impact on podiatric medicine.
interpretation of the "improvement standard," adding that the OIG study panel did not include any physical therapist on the team that reviewed claims and documentation. "Given the potential for misinterpretation of Medicare policy on outpatient therapy services and the role of physical therapists, APTA supports the inclusion of a physical therapist as part of the team conducting such reviews."

**MASTERCARE MINI THERAPY TABLE**

Mastercare AB’s Swedish Back Care System Mastercare Mini is a professional therapy table that can be used to reduce injury risk for runners. The unit strengthens and decompresses the muscles of the back to relieve pressure on the lower extremity joints, as well as the back. The table is easy-to-use and folds away for convenient storage when not in use.

The Mastercare Mini allows both dorsiflexion and plantarflexion movements to avoid periositis. The table performs self-bracing of the deep muscles and improves blood circulation and nutrient input of joints and discs. The product adjusts to heights up to 7’5” and can take on weights up to 220 lbs. Mastercare has shown to be beneficial within physical therapy, athletic training, industrial rehabilitation, sports medicine, and home use.

Mastercare AB
+46 (0) 51-12108
Mastercare.se

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**SMU STUDENTS AND FACULTY SERVE SAN YSIDRO WITH FREE CLINICAL SERVICES**

Seventeen Samuel Merritt University (SMU) students and 5 faculty nurse practitioners undertook in March their 10th annual medical mission to San Ysidro, CA, located along the Mexican border.

The interdisciplinary team mission is to evaluate and treat foot and ankle conditions as well as conduct health screenings for diabetes and vascular disease in a clinic they set up at Centro Romero. The team also distributes donated shoes, socks, and orthotic inserts to the migrant community. Student participants are chosen by lottery to ensure that everyone who goes gains valuable clinical experience. For many, it is their first clinical experience with an underserved population in a different culture.

Over the past 10 years, SMU students have performed diagnostic evaluations on patients from young children to the elderly. California School of Podiatric Medicine students raise funds and collect donations to provision the mission.

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**ANKLE STABILIZING ORTHOSIS**

OPED Medical Inc. (dba Evenup) offers the Vacotalus for stable treatment of the ankle region. The ankle appliance is designed for treating acute ankle injuries, for use in aftercare for fractures of the ankle joint, preventing ligament lesions on the ankle joint, and for compensation of ankle joint instability. The unit is engineered to provide an optimized combination of effective stabilization while fitting comfortably around the ankle. It provides tangible limitation of talar shift through the Talusstrap. The orthosis offers space to provide optimized treatment of swelling.

A VACO12 cushion is included to offer grip around the ankle area. An overall slim design allows the orthosis to be worn inside a shoe. Elastic straps provide comfort. Natural flow of movement of the foot remains possible through planter/dorsal movement. An anatomically pre-molded outer shell offers rigidity for effective stability against pronation/supination. A Vaco pad adapts to individual anatomical requirements.

OPED Medical Inc. dba Evenup
770/945-0150
Opedmedical.com

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**PHYSICAL THERAPISTS INVITED TO DMU’S 2018 STROKE CAMP**

Physical therapists with post-stroke clients are invited to participate in Des Moines University (DMU) College of Podiatric Medicine and Surgery’s seventh annual stroke camp on the DMU campus August 20 to 24. Clinicians can earn 4 continuing education contact hours.

Patients may also participate in this free event, where they will work with a team of DMU physical therapy students, faculty and supervising physicians who will help plan therapy sessions customized to meet their needs. Each patient participant also will receive a home exercise plan.

DMU stroke camp is also looking for volunteer clinicians to supervise DPT candidates.

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**NYSPMA RELEASES REPORT ON VALUE OF PODIATRIC SERVICES TO PATIENTS**

A report funded by the New York State Podiatric Medical Association (NYSPMA) has found that expanding podiatry’s role may impact healthcare in the state by decreasing the number of hospital admissions, costs of long-term care, and prescription of opioids in target conditions: diabetes, obesity, substance abuse/back pain, and fall prevention.

Moreover, data analysis indicated potential reductions in adverse events related to the conditions.

According to the report, podiatry services and treatment may bring about notable decreases in opioid dispensing to patients with back- and podiatric-related pain diagnoses, falls in elderly and at-risk populations, and hospitalizations relating to obesity and diabetes, by 28%, 36%, 19%, and 37%, respectively. The study concludes that podiatry may provide key services for target conditions in New York’s Delivery System Reform Incentive Payment program, which is expected to shift up to 80% of Medicaid managed care provider payments from fee-for-service to value-based by 2020.
SUPINATOR PTT STABILIZER AVAILABLE

Med Spec introduces the new Supinator PTT Stabilizer, a comfortable and relatively low-profile brace for the treatment of posterior tibial tendon dysfunction (PTTD). With its patent-pending design, the Supinator reduces overpronation by applying a supinating force. The arch strap works in concert with a repositionable arch pad to lift the medial arch, and the heel strap restricts eversion of the calcaneus (heel). This innovative strapping system helps protect and support the posterior tibial tendon. The arch pad may also be removed if desired to allow the Supinator to be worn with an orthotic insole.

The Supinator features the unique Speed Lacer II closure system which allows for ease of application and provides equal tension across all laces. Indications: posterior tibial tendon dysfunction (PTTD), acquired adult flatfoot deformity, and posterior tibial tendon insufficiency.

Med Spec
800/582-4040
medspec.com

RECOVERY ANKLE BRACE

New from Advantage by Elite Orthopaedics’ line of foot and ankle products is the Recovery Ankle Brace, designed for acute and chronic sprains, ankle instability, syndesmosis sprains, and prophylactic use. The unit features an easy-to-use front closure for simple and secure application. The brace also features a functional hinge design which allows for prophylactic use during rehabilitation. The product’s rigid medial and lateral uprights prevent abnormal eversion and inversion. The braces fit right or left ankle and are available in small, medium, and large sizes.

Elite Orthopaedics
800/284-1688
elite-ortho.com/product-p/890.htm

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REVIEWED PAIN SCIENCE BOOK

OPTP has added the new “Explain Pain Supercharged” to its collection of pain science books. Written by David Butler and Lorimer Moseley, the book is a revised and enhanced version of the popular book “Explain Pain” released in 2003. The updated book contains new and expanded content on the neuroimmune science of pain. It can function as a practical textbook that pain professionals can use to expand their knowledge base and apply complex concepts effectively in their everyday practice. The book is designed for all health professionals treating pain, including those practitioners specializing in the lower extremities. Further, it is cross-reference with Explain Pain and the Explain Pain Handbook by the same authors.

Source

TRANSPANTATION MAY BE EFFECTIVE FOR SOME KNEE CARTILAGE REPAIR

Research presented March 10 at the American Orthopaedic Society for Sports Medicine’s (AOSSM) Specialty Day in New Orleans has shown that osteochondral allograft transplantation (OCA) is a valuable and successful approach for isolated femoral condyle lesions, which account for 75% of the cartilage repair procedures performed in the knee joint. Lead author Luís E. Tírico, MD, with the University of São Paulo in Brazil, stated, “Our study demonstrated that the modern OCA transplantation technique, which utilizes thin, dowel type grafts, was very effective in treating patients with femoral condyle cartilage lesions. In 200 cases, we noted an 89% satisfaction rate with those treated by this method, along with significant improvements in clinical scores and a low graft failure rate.”

The study is the largest reported cohort of isolated femoral condyle lesions treated with the modern, dowel technique for OCA transplantation. A total of 187 patients (200 knees) underwent OCA transplantation between June 1999 and August 2014.

At an average of 6.7 years of follow-up (minimum 2 years), International Knee Documentation Committee (IKDC) total scores improved from 43.7 to 76.2 on average, and Knee injury and Osteoarthritis Outcome Score (KOOS) for pain improved from 66.5 to 85.3, and 74.5 to 91.1 for activities of daily living. Further surgery was required in 52 knees (26%), of which 16 (8%) were considered failures, as defined by removal or revision of the allograft. “These results appear to be equal or superior to any other cartilage repair procedure for the treatment of femoral condyle lesions and leads us to consider whether fresh OCA should be viewed as the current gold standard in cartilage repair for focal femoral condyle lesions,” Tírico stated.

Source
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