Improving Physical Therapy *(from page 12)*

clinical, and elderly populations.

Although the exact mechanisms behind BFR and muscle adaptation are still not fully understood, several theories have been presented. One prevailing hypothesis is the recruitment of larger, fast-twitch motor units during the hypoxic state created by the tourniquet. This, in turn, creates a muscle metabolite milieu that signals downstream anabolic signaling including increases in muscle protein synthesis, myonuclei, growth hormone, and muscle and bone gene expression.

Although relatively new and novel in the clinical setting, the overall safety of blood flow restriction has been studied in both healthy and clinical populations with minimal side-effects. The majority of published and ongoing clinical trials have focused on sports medicine injuries; however, total joint, limb salvage, and muscle wasting disease populations have been studied without adverse events and with positive results. Although BFR research has focused primarily on muscle adaptations, recent studies have demonstrated the ability of BFR to improve tendon stiffness and tendon cross-sectional area similar to heavy-load training and reducing bone loss after ACL surgery. Ongoing and future trials will help identify which diagnoses are the most appropriate for BFR and establish best practice guidelines for early use of BFR, LOP, and dosing protocols post-surgery to maximize the response. Since the majority of orthopedic patients experience periods of disuse from injury or surgery, BFR appears to be a promising new technique to mitigate the loss of muscle that has historically been an accepted consequence of injury.

Exoskeletons for High Energy Lower Extremity Trauma

The decision to amputate or salvage a limb after high energy lower extremity trauma (HELET) remains controversial. Factors such as patient-perceived expectations, surgeon preference, and conflicting published trials have made consistent guidelines difficult to establish.

Although the LEAP study found no difference in functional outcomes at 2 and 7 years between open-tibia fractures who went on to limb salvage or amputation, a subsequent military study, METALS, reported overall improved functional outcomes in service members who elected amputation over limb salvage. The disparity in the results of these studies may be in large part due to the higher physical fitness and functional expectations in the younger and more active military population. In turn, this could lead to a loss of self-efficacy in the limb salvage military cohort from the inability to perform military tasks such as running.

With increasing numbers of service members undergoing limb salvage during Operation Iraqi and Enduring Freedom, more robust and aggressive rehabilitation programs began to develop to accommodate the prolonged circular ring fixation phase.

Unfortunately, the loss of plantarflexion force and pain that persisted despite bone union left the majority of the limb salvage patients unable to stay on active duty. To combat this, a custom energy-storing carbon fiber ankle-foot orthosis called the intrepid dynamic exoskeletal orthosis (IDEO) was developed. The IDEO utilizes a foot-plate with a rollover design to allow engagement from heel strike to toe-off to load posterior struts that simulate plantarflexion torque.

Additionally, minimal ankle and foot range of motion is allowed in the IDEO which helps reduce pain from sources like post-traumatic osteoarthritis. This allows individuals to tolerate high impact activities and if higher-level tasks such as running are desired then applying more force through the mid-foot of the device increases the strut loading with a subsequent increase in power. To aid service members in the utilization and optimization of higher-level function in the IDEO, a specialized rehabilitation program called the Return to Run (RTR) Clinical Pathway has been developed.

The combination of IDEO and RTR has led to reduced delayed amputation rates, improved self-reported scores, improved validated performance outcomes, and improved return-to-duty-rates.

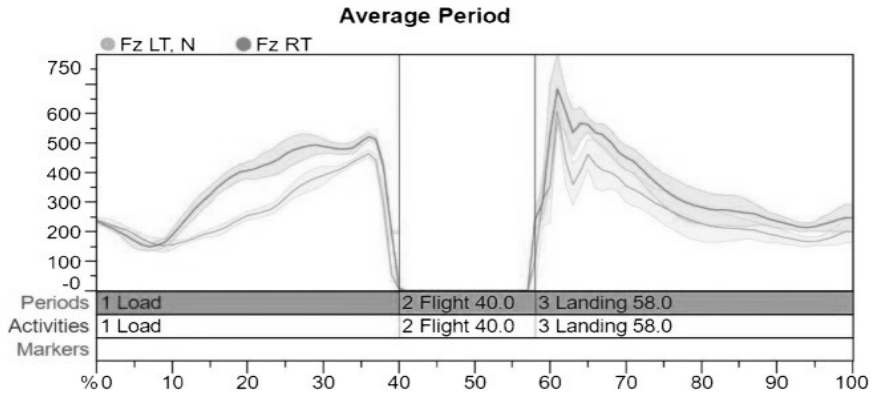
Furthermore, the results appear translatable across multiple military institutions. Although overall adoption outside the military setting has been slow, partly due to reimbursement rates, there has been a recent rise in civilian medical centers and prosthetic companies adopting an exoskeleton type device coupled with aggressive rehabilitation.

Force Plates

Force plates measure force production over time, providing insight into the kinetics of functional movement. Force plate manufacturers have produced affordable hardware and clinician-friendly software solutions that analyze and report kinetic performance with dual plates in real-time. We use functional testing batteries with bilateral comparison of kinetic performance in the clinical setting. These protocols take only a few minutes and can be analyzed without the assistance of a biomechanist. Applications include baseline kinetic profiling, a monitoring tool and outcome measure during rehabilitation, and to assess athletes' response to training.

Dual force plates can assess each limb's ground-based movements or can be used individually for single-leg movements. The most studied test batteries include the squat jump, counter-movement jump, and mid-thigh high pull. These provide reproducible performance metrics well suited for profiling and monitoring purposes.

The force-time curve is compared with the kinematics of the athlete to quantify force application during specific phases of the movement. Phase specific metrics are used to profile performance kinetics. During rehabilitation, deficits in kinetic performance are identified via a comparison of force during bilateral tasks. Video or motion capture synchronization allows the clinician to determine if deficits are specific to contraction type or joint position. These deficits are targeted in rehabilitation or training plans and



Force-time curve obtained from dual force plates during a counter-movement jump reveals asymmetry in force production during the propulsion phase of the jump

Holidays / Special Days Coming

Father's Day - June 16th

Independence Day - July 4th

Ashura - July 17th

September 2nd - Labor Day