PHYSIATRY IN MOTION

SUMMER 2024

RFC

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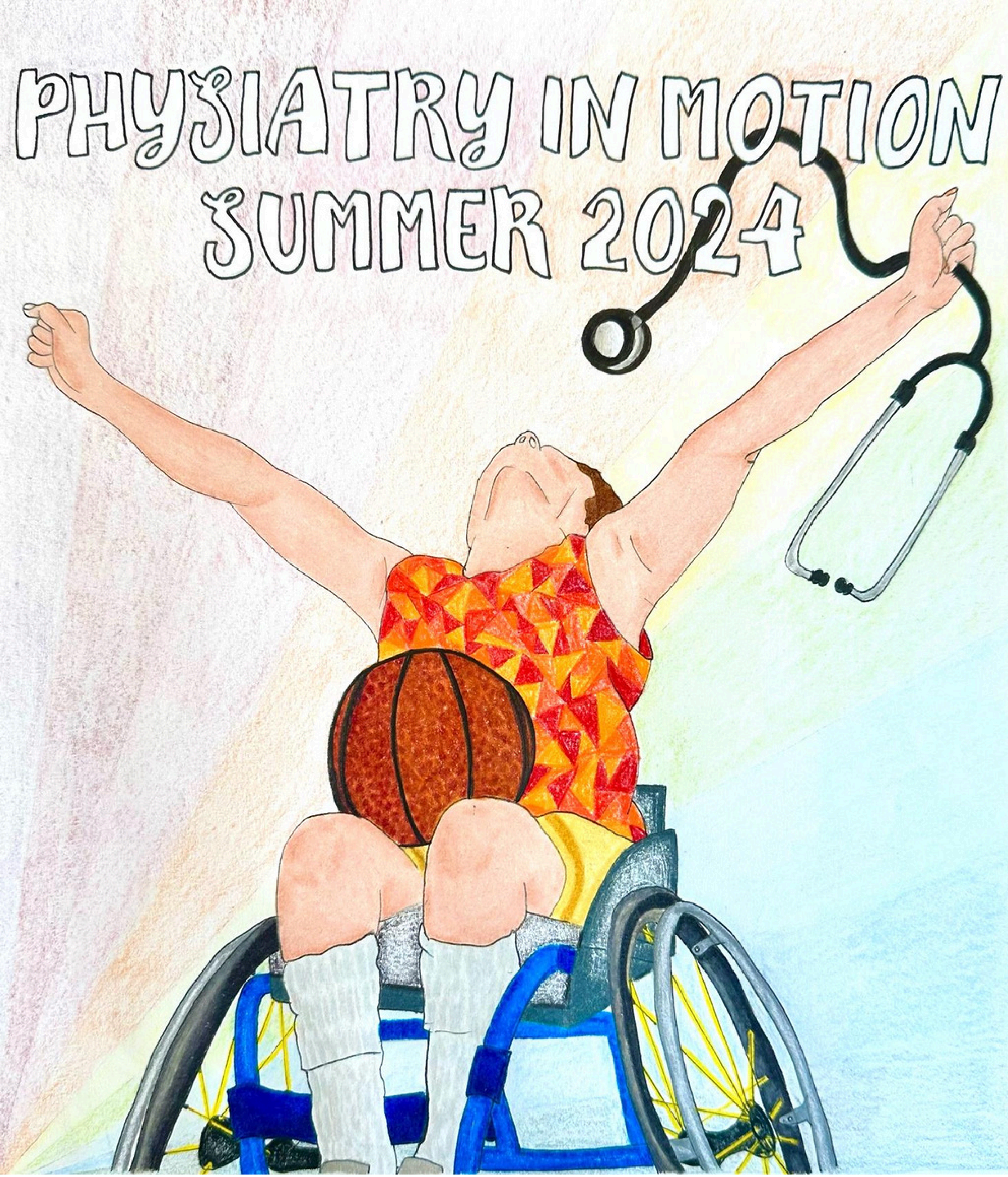

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A LETTER FROM THE EDITOR

Raj Banerjee, MD, PGY-3
RFC Technology-Digital Media Chair
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Dear AAP Community,

It is my honor to welcome you to the Summer 2024 issue of Physiatry in Motion, the official newsletter of the Association of Academic Physiatrists Resident/Fellow Council (AAP RFC).

The theme of this summer centers around activity with topics that include disability health, neuromodulation, the paralympic classification, emerging technology in spine care and sports, and lifestyle medicine. Enclosed, you will find a collection of powerful stories and ideas that we hope can give new insight into the field and the dynamic changes that we face as a specialty.

I would like to express my sincere gratitude to each of the contributors, artists, as well as the technology subcommittee who have worked tirelessly to bring this issue to life. Stay tuned for our winter edition later this year that will be focused on inpatient rehabilitation!

Regards,
Raj Banerjee, MD
Editor, Physiatry in Motion

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A CALL TO ACTION: THE VALUE OF EARLY EXPOSURE TO DISABILITY HEALTH AND ADAPTIVE SPORTS

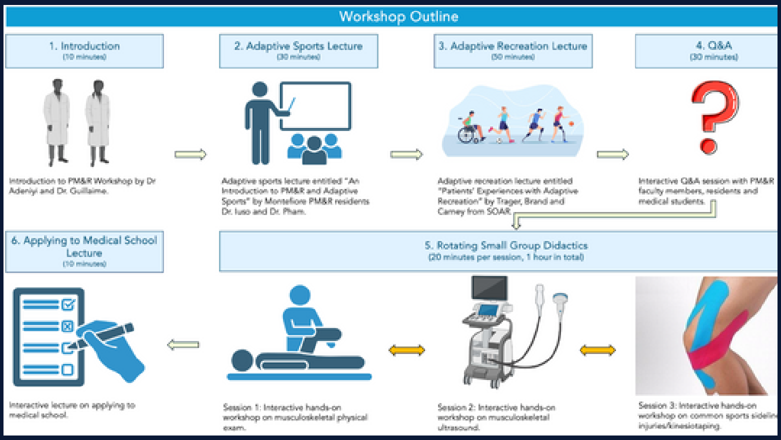
Adedeji Adeniyi, MD; PGY-1, University of Washington & Sean Nguyen; MS3, University of Missouri--Kansas City

The contemporary Olympic and Paralympic games garner considerable attention to the exceptional capability of athletes with and without disabilities. These games act as dedicated time in participating countries' calendars during which inclusivity is celebrated worldwide for two and half weeks. While the games mark a huge step forward every two years, the interim periods between the Olympic games symbolize a regression in achieving comprehensive support and inclusion for individuals with disabilities due to a lack of sustained action or exposure [1]. The concepts of disability health and adaptive sports lag behind the popularity of the current games. One likely reason is the limited exposure and emphasis on disability health, which may shape public perception and hinder opportunities for individuals with disabilities to explore adaptive sports [2,3].

A Workshop Dedicated to Adaptive Sports for Early Learners

To foster exposure to adaptive sports, we piloted a novel multi-institutional half-day workshop involving physicians and medical school students from Columbia University, Cornell University, and Montefiore dedicated to discussing and educating pre-medical students about topics related to PM&R and adaptive sports. In addition, we partnered with Specialized Outdoor Adaptive Recreation (SOAR) Experiences, a non-profit organization dedicated to adaptive sports and recreation. Pre-medical students were targeted based on our recent national survey of 1093 responses from 236 different colleges, which revealed that pre-medical students have limited exposure to disability health [4].

The workshop's comprehensive curriculum featured five interactive stations over 3 hours and 10 minutes, covering a range of topics. Students engaged in lectures and hands-on small-group sessions that included adaptive sports, musculoskeletal physical exams, ultrasound training, common sideline injuries, and kinesiotaping.



Ultimately, a diverse cohort of over 50 students attended the workshop [5]. Based on pre-workshop data from those who signed up (N=147), 78.2% of participants come from URiM (underrepresented in medicine), rural, and/or low socioeconomic backgrounds. Additionally, 81.0% identified as female, and 80.3% were prospective first-generation medical students. Students hailed from 16 different schools in the New York, New Jersey, and Connecticut tri-state area, including students from the public City University of New York (CUNY) system (25.6%), and private schools such as New York University (25.6%) and Columbia University (28.2%). The pre-workshop survey revealed that 53.5% of participants had no prior knowledge of PM&R, and 80.6% had never been exposed to adaptive sports.

The feedback was resoundingly positive, with 100% of participants indicating they would recommend the workshop to their peers. A pre/post- workshop comparative analysis highlighted a marked increase in pre-medical students' interest and understanding of PM&R and adaptive sports ($p<.001$).

To attract a diverse cohort of pre-medical students, our team partnered with a range of pre-health organizations. We collaborated with the American Medical Women's Association (AMWA), the Minority Association of Pre-Medical Students (MAPS), the Latino Student Medical Association (LSMA), the Pre-Student Osteopathic Medical Association (Pre-SOMA), the Association of Academic Physiatrists (AAP), PremedCC, StriveForDiversity, and Alpha Epsilon Delta (AED). These alliances were crucial in reaching a diverse audience and ensuring broad representation at our event.

Looking Ahead

It is essential to harness the momentum generated by the Olympic games to advance adaptive sports. We envision the workshop as the first of many, designed to offer pre-medical students structured mentorship with a distinct emphasis on disability health and adaptive sports. Looking ahead, we plan to extend these educational opportunities to pre-medical high school students, fostering even earlier engagement with PM&R, disability health, and adaptive sports.

Even for those who may not pursue a career in PM&R, exposure to adaptive sports and disability health could enhance awareness and reduce stigmatization. Moreover, our recruitment approach has the potential to be adapted into other programs, expanding the introduction of diverse students to adaptive sports and PM&R. This, in turn, could increase representation in the field and ultimately contribute to increased opportunities for adaptive sports.

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THE POTENTIAL ROLES FOR SPINAL CORD STIMULATION ON PHANTOM LIMB PAIN AND MOBILITY IN PATIENTS WHO HAVE UNDERGONE TRANSTIBIAL AMPUTATION

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It is estimated that over 150,000 people annually undergo a lower limb amputation [1]. A significant portion of these patients develop a chronic pain condition in the amputated limb referred to as phantom limb pain (PLP). PLP, defined as pain or discomfort in a limb that is no longer there, is poorly understood. For most of these patients, PLP is largely managed with pharmacologic options and a prosthetic limb. However, many ultimately endure chronic difficulties with balance, gait and mobility.

Spinal cord stimulation (SCS) devices are now used in up to 50,000 people annually to treat chronic pain [2]. Prior studies have also documented the use of nerve stimulation for improving tactile feedback in the missing limb, ultimately improving the patient's control of their prosthetic limb, balance and gait and reducing their PLP [3,4]. In addition there have been more recent studies highlighting cervical-implanted SCSs demonstrating improvement in somatosensory feedback of the missing limb in patients who have undergone upper limb amputation [5].

In this novel study [6], the investigators focused on the potential for lumbar-implanted SCSs to elicit sensations in the missing foot in patients who had undergone transtibial amputation, creating a closed loop feedback system. Like previous studies in patients with upper limb amputations, the aim was to correct the altered somatosensory feedback loop in hopes to reduce PLP, strengthen the use of their prosthesis, and improve their overall functional mobility. A unique aspect of this study was that the patients included were those who had suffered from either a traumatic amputation or one secondary to diabetic peripheral neuropathy. No study previously had documented improved somatosensation in those who had foot amputations secondary to diabetic peripheral neuropathy.

The three subjects included in this study underwent lumbar SCS implantation. The investigators located areas of the spinal cord that would elicit sensations in the missing foot and the three subjects completed psychosocial assessments to more accurately characterize the sensations. The three subjects included in this study underwent lumbar SCS implantation. The investigators located areas of the spinal cord that would elicit sensations in the missing foot and the three subjects completed psychosocial assessments to more accurately characterize the sensations. The subjects drew on an anatomic model where the sensations were perceived and each of them documented sensations in the toes and heel of their missing foot. The sensations perceived were characterized as a combination of "naturalistic" and "paresthetic." Interestingly, the magnitude of the perceived sensations increased nearly linearly with the amplitude of the stimulation for each of the subjects (R2 of 0.978, 0.854 and 0.952 for subjects 1, 2 and 3, respectively). What makes this study so intriguing is that attached to the plantar aspect of the prosthetic foot was a pressure sensor that was connected to the SCS via closed loop system, providing real-time feedback to the patient.

Fig. 1 | Schematic of the closed-loop SCS system used in this study. Electrical stimulation was delivered to the spinal cord via two or three 8- or 16-contact leads implanted percutaneously near the lateral lumbosacral spinal cord. The leads were tunnelled through the skin and connected to an external stimulation system. A sensorized insole was inserted into the shoe to measure pressure under the prosthetic foot, the signals from this insole were used to modulate stimulation amplitude for SCS electrodes implanted in the lateral thoracolumbar epidural space, and the stimulation evoked sensations that appeared to emanate from the missing limb. The purple region of the leg and foot shows the location of evoked sensation in one participant, and the red dotted line represents the end of the residual limb for this participant with left trans-tibial amputation.

Fig 1

In two of the subjects, there was a statistically significant increase in their stability while standing on an unstable surface with their eyes closed when the somatosensory feedback loop was stimulated. Additionally, there was a decrease of greater than 50% in PLP score in two of the subjects with stimulation compared to their baseline. Another notable finding is that when one of the subjects took a one-week holiday from SCS, the subject's pain rebounded, and their pain score increased by over 3.5-fold.

This study highlights the potential for utility of SCS for the treatment of PLP as well as the evolution and development of more advanced prosthesis which give patients more function and better quality of life. Limitations to this study include its small sample size and the lack of blinding of both the investigators and the subjects. Large randomized controlled trials are needed to draw stronger evidence-based conclusions for the utility of SCS in this patient population in the future.

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THE EVOLUTION OF THE PARALYMPIC CLASSIFICATION SYSTEM

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The 17th Paralympic Games commenced on August 28th, 2024, featuring approximately 4,400 athletes competing in 22 sports in 549 medal events. Following World War II, sports for athletes with impairments became widely introduced due to the amount of war veterans and civilians injured during the conflict. Dr. Ludwig Guttmann carved the path towards the Paralympic Games with the Stoke Mandeville Games of 1948, the first innovative approach to sports competition for athletes with impairments. It featured 16 athletes in wheelchairs that competed in archery. The first official Paralympic Games took place in 1960 in Rome, Italy, providing a competitive platform for 400 athletes from 23 countries. The Paralympic Summer Games evolved from its inauguration to the modern games it is today.

Despite the addition of many sports, the athlete classification system is one of the most significant game overhauls. The evolution from a system centred around medical diagnoses to a more functional and sport-specific approach is a testament to the continuous improvement and inclusivity of the Paralympic Games.

The classification system is designed to determine eligibility for competing in Paralympic sports and group athletes into sports classes, minimizing the impact of impairments. Initially, the classification system centred around patients' medical diagnoses. Athletes received a sports classification that covered them in all sports offered, which prevented athletes with spinal cord injuries affecting their lower limbs from competing against athletes with bilateral above-knee amputations in a wheelchair sport. In the 1980s, a shift began toward a second classification era from medical diagnoses to an athlete's functional classification. The systems were typically based on expert opinion without relevant scientific evidence. The current classification era moved towards sport-specific evidence-based functional classification.

The International Paralympic Committee's (IPC) 2015 Universal Athlete Classification code, aimed at being inclusive and comprehensive, is used for the Paris 2024 Paralympic Games. It includes 10 eligible impairments, including eight physical impairments, one for visual and one for intellectual impairment. Athletes must have an underlying health condition causing a qualifying eligible impairment. Athletes are then assessed for sport-specific minimum impairment criteria, and a sports class is allocated based on the execution of specific tasks fundamental to the sport. Some sports can accommodate athletes with all ten eligible impairments, like para-athletics or para-swimming. Others are more specific to one eligible impairment, like goalball, for athletes with visual impairments.

While a crucial aspect of Para Sport, the classification system has its challenges. Athletes with impairments face numerous barriers to sports participation, including access to proper equipment and the classification process, and many medical diagnoses are excluded from the accepted conditions. For instance, some athletes may need help to afford or access the specialized equipment needed to compete. Others may find navigating the complex classification process challenging without the necessary support. The classification process requires experienced staff, including at least one medical personnel and/or resources, to ensure the process aligns with the IPC code. Understanding these challenges is vital to fostering a more inclusive and supportive environment for all athletes.

The new classification code, approved in May 2024, took three years to develop and attempts to address many criticisms. It will be implemented in January 2025 for the 2026 Summer Games and in July 2026 for the 2028 Winter Games. The revised changes impact verifying an underlying health condition, eligible impairment assessment, minimum impairment criteria assessment, sports class assessment, and enhanced aspects across the classification process.

One of the most significant adjustments to the code was a new international standard developed to address intentional misrepresentation based on athlete feedback. Examples in the 2024 version of the code include consequences for submitting forged medical documentation; deliberately underperforming during an evaluation session; athletes deliberately tiring themselves out or deliberately tiring the athlete out before an evaluation session; intentionally undergoing an evaluation session without the sports attire or adaptive equipment that an athlete intends to use; failing to disclose the use of medication, medical device/implant and/or medical procedures.

The research section of the classification code outlines the IPC's dedication to re-evaluating the code to meet the goals of the best classification criteria and improve evidence-based assessments. Therefore, the classification code will be consistently re-evaluated as research and technology progress, ultimately attempting to create a more fair and inclusive Paralympic Games. The role of research and technology in shaping the future of the Paralympic Games cannot be overstated, as these factors will continue to drive the evolution of the classification code and ensure that it remains relevant and effective in the years to come. Physiatrists can play an exciting role in the development of the classification system through the management of underlying medical conditions as well as the unique perspective of their functional manifestations.

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BEYOND REHABILITATION: THE OVERLOOKED BENEFITS OF RESISTANCE TRAINING FOR PREVENTATIVE MEDICINE AND CHRONIC DISEASE PREVENTION

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The utility of a physiatrist not only lies in the unique prioritization of function, but the breadth of techniques used to address it. Of these, resistance training (RT) is commonly utilized as a therapeutic modality to address weakness, instability, or pain [1]. Often overlooked, however, is the widespread data in support of the benefits of RT in preventing and managing age-related chronic conditions across body systems [2]. While RT participation rates remain low, with only 28% of adults engaging at the minimum recommendation per national guidelines, educating patients on these widespread benefits can address this shortage in the population [3,4]. With training in preventative musculoskeletal medicine and therapeutic exercise, physiatrists are best equipped to address these areas of improvement. Embracing this role will further advocate for an individual's autonomy and establish habits that improve health quality in later stages of life.

RT specifically targets skeletal muscle hypertrophy, which is often overlooked in non-rehabilitation clinical settings until specific symptoms arise such as weakness, gait abnormalities, or mobility deficits [1]. However, there is widespread data in support for the benefits of RT amongst all patient populations as a highly effective modality of preventative medicine.

Like most body systems in chronic conditions, age-related musculoskeletal deficits often stem from inflammation. Cytokine signaling and dysregulation between anabolic and catabolic cascades result in increased lipid deposition and decreased lean muscle mass [5-7]. Studies have shown that the proportion of lean muscle mass declines after the third decade, and up to 10% per decade after 60 years old. 8,9.

With these changes, balance and mobility are increasingly compromised. Meta-analyses have suggested that approximately ⅓ of all adults greater than 65 years old will experience multiple falls yearly [10]. Poor mobility and sedentary behaviors can accelerate the risk of developing osteoporosis and fractures, and recovery can be limited in this population. The risk of sustained functional decline after injury in later decades of life significantly alters quality of life, community integration, and leads to increased financial burden to the patient and healthcare system [5,11,12].

Skeletal muscle also plays a crucial role in metabolic stability, as the primary tissue site for glucose and triglyceride metabolism. Studies have shown that both RT and aerobic exercise improve insulin resistance in skeletal muscle, in near equal levels even when performed separately [13,14]. Long-term RT (3 months or more, three days/week of >10 repetitions/set) has been shown to decrease whole-body insulin secretion by 25-30% and increase basal metabolic rates [15]. This is achieved by correcting fatty acid uptake and oxidation mismatch, glucose uptake in response to insulin, and glycogen storage. Conversely, these benefits are limited in muscle with high amounts of fatty infiltration. Declines in basal metabolic rates increase the likelihood of weight gain and developing chronic conditions, such as type 2 diabetes mellitus [5,16].

Metabolic syndrome (MetS) is diagnosed with five criteria; increased waist circumference, elevated blood pressure, blood glucose, triglycerides, and low high-density lipoprotein cholesterol (HDL-C) [16]. Studies have shown that 30-60 minutes of RT at least twice a week can reduce the risk and prevalence of MetS [17-19]. One study even demonstrated superior weight-control outcomes in adults with type 2 diabetes after 10 weeks of RT compared to aerobic exercise [20].

The intersection between musculoskeletal injury and cardiovascular disease involves a combination of malnutrition, physical inactivity, and psychological stress. Aging muscles affect arterial compliance and contribute to endothelial dysfunction, which can affect blood pressure and cardiac output. Decreasing proportions of lean muscle mass in relation to total body mass index (BMI) can lead to obesity and increased strain on the cardiovascular system to maintain functional independence and mobility [21-24]. These effects are compounded by the estimated 10% decline in oxygen capacity seen per decade [25,26]. Isometric RT reliably leads to reductions in blood pressure for patients with and without hypertension, as increased arterial compliance and enhanced nitric oxide bioavailability leads to improved vasodilation and reduced systemic peripheral resistance [5,21,22].

Additionally, RT has shown to have improvements in mood and psychological symptoms. A meta-analysis of 33 randomized controlled trials (RCTs) revealed that RT significantly reduced depressive symptoms, and a review of 16 studies reported a decrease in anxiety symptoms [27-29].

RT is crucial for maintaining whole-body health, with many studies depicting the effects of RT on preventing chronic conditions and improving all-cause mortality. The benefits of RT across body systems should be more readily discussed with patients to help justify increased participation and contribute to patient autonomy. Physiatrists should embrace this role in the healthcare system to identify when and where to utilize RT in the most efficacious way possible.

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THE YIPS IN SPORTS MEDICINE: IS IT PERFORMANCE ANXIETY OR TASK-SPECIFIC DYSTONIA?

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Introduction

The phenomenon known as "the yips" presents a compelling enigma in sports, characterized by the sudden and inexplicable loss of a previously mastered skill [1]. This disruption has been observed in sports where precision and repetition are key, including golf, baseball, tennis, and darts. The term 'yips' gained popularity through Scottish-American golfer Tommy Armour, whose career was affected by this condition. Initially described in 1977 as an occupational cramp in the report "Putting on the Agony," the yips have evolved into a recognized condition that transcends simple physical malfunction. Today, they are understood as a psychoneuromuscular disorder that disrupts the automatic execution of fine motor skills, impacting athletes across various sports [2]. The yips manifest as involuntary movements—such as jerks, tremors, or freezing of the affected limb—that interfere with the athlete's ability to perform routine tasks [3]. The yips have been linked to both psychological factors, such as performance anxiety, and neurological factors, such as task-specific dystonia [4, 5]. These two components may coalesce to create a complex interplay that varies in manifestation across different sports and athletes.

The Continuum Model

Recent literature has refined our understanding of the yips through the continuum model, which classifies the condition into three types:

Type I, known as focal dystonia, is characterized by involuntary movements resulting from neurological factors [6]. Research using electromyography has demonstrated that athletes with the yips often display abnormal muscle activity, even under low-pressure conditions [5]. For example, studies focusing on golfers and baseball players have revealed unique patterns of muscle coordination associated with focal dystonia. However, these patterns are not always consistent across affected athletes [5].

Type II, or performance anxiety, involves psychological factors such as heightened self-consciousness and perfectionism, which can exacerbate the yips [7, 8]. Athletes experiencing this subtype often report high levels of anxiety. Qualitative and quantitative studies have indicated that athletes with the yips score higher on anxiety and perfectionism scales compared to their unaffected counterparts [9, 10]. Addressing these psychological aspects through interventions aimed at reducing anxiety and restructuring cognitive patterns is crucial for managing this type of yips.

Type III represents the interaction between focal dystonia and performance anxiety. In this case, athletes may first experience focal dystonia, which can then be exacerbated by performance anxiety, or vice versa [11]. This overlap underscores the need for a comprehensive approach that addresses both neurological and psychological components to effectively manage the condition.

Diagnostic and Management Approaches

Diagnosing the yips requires distinguishing between its various types and understanding the specific manifestations in each athlete. This process relies on diagnostic tools such as electromyography and neuroimaging, which are crucial for highlighting the underlying causes and effects of the condition [5, 12]. An effective management strategy requires a multi-disciplinary approach, incorporating input from physicians, psychologists, and therapists. Physical interventions for the yips may include exercises designed to retrain motor skills, as well as stretching and strengthening routines [13]. For athletes with focal dystonia, targeted therapies can help reduce abnormal muscle activity and enhance motor function for athletes with focal dystonia [13, 14]. Psychological interventions are also essential, with Cognitive Behavioral Therapy, relaxation techniques, and other psychological strategies proving beneficial for managing performance anxiety [15]. Addressing negative motor imagery and obsessive thoughts can further alleviate symptoms [15]. Additionally, pharmacological interventions may also be used to tailor treatments to the specific needs of an athlete. Dystonia and anxiety have effectively been managed with botulinum neurotoxin type A and beta-adrenergic blockers, respectively [16, 17].

Conclusion

The yips represent a multifaceted challenge in sports, encompassing both neurological and psychological dimensions. Understanding the yips through the continuum model helps recognize the distinct yet interconnected nature of its manifestations. A holistic, multi-disciplinary approach that incorporates both physical and psychological strategies is crucial for accurate diagnosis and management. The complexity of the yips underscores the importance of a nuanced and individualized approach to treatment. By advancing our understanding of the yips, healthcare professionals can better support athletes in overcoming this condition and restoring their sports performance.

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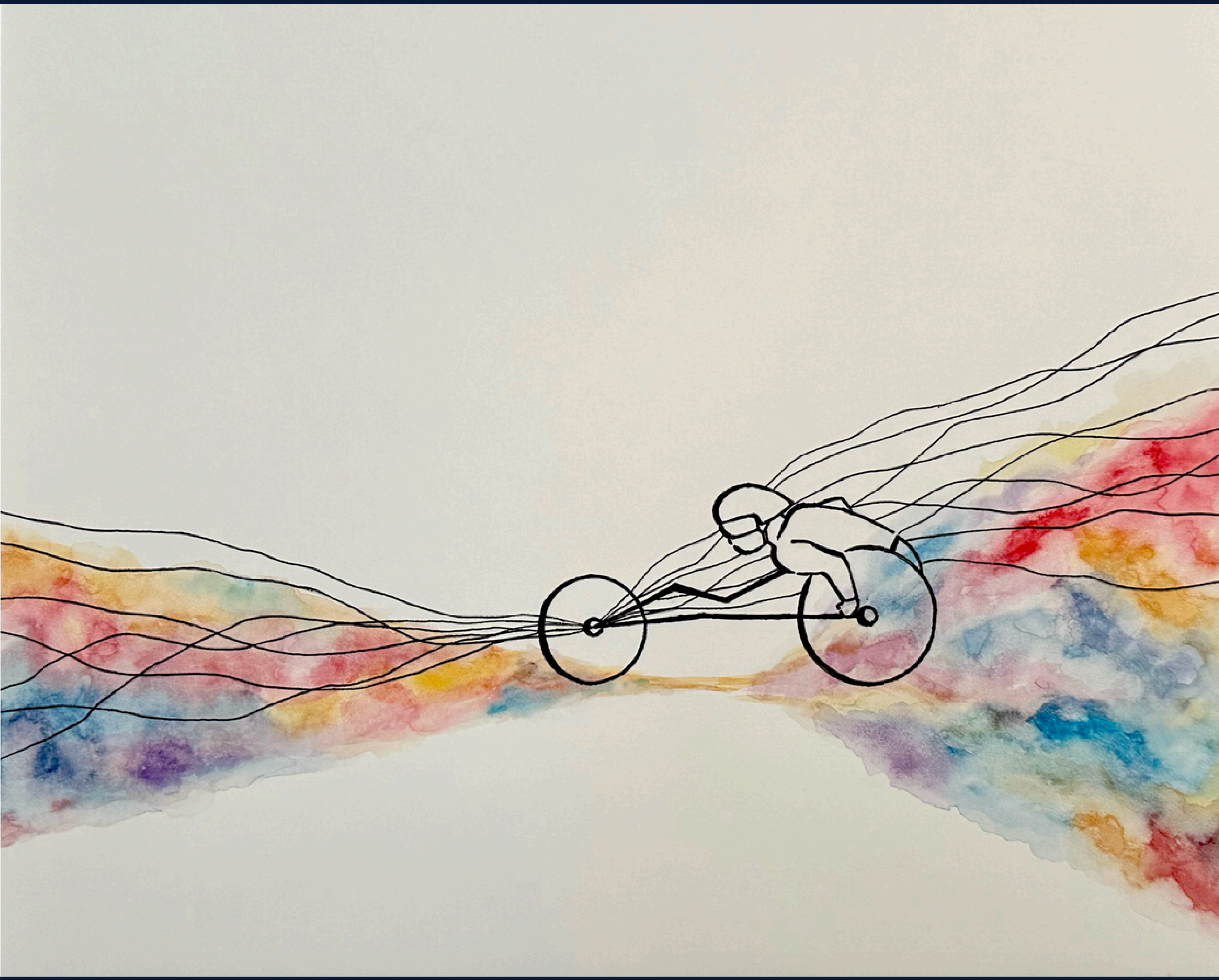
ARTWORK BY VANESSA MOLINA, OMS-3



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LEADING BY EXAMPLE – THE FORMATIVE ROLE THAT ATTENDINGS AND SENIORS PLAY IN DEVELOPING INTERNS

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There are many different paths that one can take to become a physician. Some know it is what they want to do from a young age and take a rather streamlined approach to the profession, while others make an enormous pivot towards medicine partway through an entirely separate career. Some come from generations of doctors, while others may have earned the first undergraduate or professional degree in their family. Some will enter a primary care role, while others may choose to specialize their skillsets. All these factors, and many more, create a widely varying educational experience. However, to ensure quality of training and competence of all doctors, there are many things that are standardized in our training. Everyone takes board exams, completes core rotations, must match into a residency, and subsequently get through intern year.

Intern year, the first year of residency, is infamous among the medical profession for being demanding, grueling, and equally transformative. The importance and difficulty of this metamorphic twelve-month period stem from the fact that one ceases being a medical student and takes their first steps as a physician. Expectations and responsibilities increase very quickly. The intern enters a system comprised of senior residents, learning their role and how to integrate into this complex system. These leaders will ask a lot of the intern and in return will imprint their knowledge and style of medicine onto the budding doctor.

Of course, the intern will be taught how to manage common medical conditions within their scope. This can be thought of as the scientific side of medicine. Equally as important, however, are the intangible topics taught during this first year of training. The attendings and senior residents will, perhaps unknowingly, provide an example of the human side of practicing medicine. How do you treat those around you, especially during a particularly stressful time? Do you take the time to speak with the patient's family when they have a long list of questions during a busy day of rounding? How do you address the staff member who has forgotten or is taking a long time to complete one of the requests you made earlier? How do you motivate and give feedback to the intern who is working hard to be successful in their important transition? These lessons will leave an impact on the trainee that can shape the type of physician they will be just as much, if not more, than anything else you teach them.

Protocols, algorithms, and best practices will continuously change over time and will be learned and relearned throughout one's career. Kindness, respect, leadership, and patience are values that are best taught by example early in training. Physicians in training are watching and absorbing more than just the medical decisions that are being made by their superiors. The composure of their leaders can carry far greater weight than word alone. Awareness and conscientiousness of the full spectrum of impartible knowledge is paramount to offering the best quality medical education to those you train.

EXPLORING THE INTERSECTION OF SPORTS MEDICINE AND LIFESTYLE MEDICINE

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It might seem counterintuitive to approach a patient with cholesterol goals and an athlete with speed goals with a similar algorithm. However, one medical board is teaching us that six pillars relevant to building a foundation for overall health coincide beautifully with enhancing performance: restorative sleep, proper nutrition, stress management, avoidance of risky substances, physical activity, and supportive relationships (1).

After an exciting Olympic season, it's easy to attribute blistering sprints, gritty endurance, and artistic jumps and twists to luck and genetics. However, those who were athletes, and those who work with them, may see the picture differently. One of the underestimated keys to athletic success is, ironically, health. Not getting injured is a skill. Staying healthy is a skill. Not to mention, many of the conventional treatments available to the public are largely unavailable to athletes. The World Anti-Doping Agency (WADA) list of banned substances is a 24-page long packet and includes many common medications such as painkillers, blood pressure regulators, and metabolic modulators (2). Working within the regulations of WADA means physicians are limited in what they can use, when, and why.

Interestingly, there has also been a rise in de-prescribing initiatives within the average population. Patients and providers are turning to lifestyle counseling and modifications to manage and treat conditions to reduce polypharmacy, medication cost, and unwanted side effects (3). Simply, athletes aren't allowed to be on meds, and patients just don't want them.

Taking a look at professional road cycling offers insight. The history of road cycling is tainted with tales of doping scandals. Nonetheless, many of the sport's key figures say the Peloton has cleaned up its act despite unprecedented increases in speed. How? Surely there are many reasons, but a key pattern that can't be ignored was highlighted in this year's Tour De France by the Norwegian rider Jonas Abrahamsen: we're starting to treat athletes as people. How are they sleeping? What are they eating? How is their mood? Do they need a break? For Abrahmsen, this meant fueling his training in a way that made him a complete oxymoron in the sport. He became one of the world's best riders when he gained 40lbs. The humanistic philosophy that supported his athletic development is exactly what Lifestyle Medicine is trying to bring to medicine—a customized approach evaluating the person as a whole, not a part (1).

Dan Buettner has been saying this for years through his popularized Blue Zones, areas of the world with the highest population of healthy 100+ year-olds (4). Prior to him, Dr. Andrew Weil, MD approached academic institutions to establish a residency in Integrative Medicine before partnering with the University of Arizona to create a fellowship (5). There's more to medicine than medicine. Patients want tools and education, and fortuitously, physicians often do, too. Nowadays, there are more than 230 Lifestyle Medicine residency programs (6)—we're seeing the trends and growing together, patient and provider. Meanwhile, PM&R can proudly say that as a specialty our very origins have been rooted in promoting quality of life and function all along (7).

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SHOULDER DIAGNOSTIC ULTRASOUND CRASH COURSE

Kyle Cullin, DO; PGY-1, Independent/Research

I recently attended a two-day Comprehensive Ultrasound Course taught by Dr. Jon Jacobson and Dr. Scott Weiss, where I learned how to approach the imaging of various muscle groups. My goal is to share the clinical pearls of performing a diagnostic ultrasound of the shoulder, a common yet complicated area of injury.

A comprehensive exam is imperative in the diagnostic process; and the first step is having a thorough understanding of the shoulder anatomy and its bony landmarks. Dr. Jacobson follows a stepwise protocol to ensure that no structures are missed on imaging. His approach is outlined below:

1. Biceps – 2 images, short and long axis.
    a. Shoulder in neutral position with supinated hand resting on patient's lap
2. Subscapularis – 2 images, long and short axis
    a. Externally rotate the humerus with elbow held at patient's side
3. Supraspinatus / Infraspinatus - 6 images, long and short
    a. Internally rotate for a modified Crass position, like the patient is trying to reach into their pocket, with elbow pointing out laterally
    b. Transducer in deltopectoral groove, aimed towards patient's ear for long axis start
4. Acromioclavicular Joint and Impingement – 2 images
    a. Neutral position, can be viewed dynamically to rule out impingement
5. Posterior Shoulder 4 images – Neutral Position
    a. Joint recess and spinoglenoid notch
    b. Infraspinatus and teres minor muscles
    c. Supraspinatus muscle and suprascapular notch

Pathology Identification:

When performing the diagnostic ultrasound, knowing where to look helps to identify the pathology. For degenerative tears in patients older than 40, the tendon insertions should always be the first place examined. It is important to note that there is no hyaline cartilage at joint attachment sites as they are not the joint's weightbearing surface. In addition, cortical irregularities can be indirect signs of tears and volume loss should raise suspicion for tears within the tendon itself. Because tendons are constant in size, any concavities may indicate a tear, while any thickening may be concerning for tendinosis. Furthermore, areas of edema or effusions should be examined more closely.

Pathology Confirmation:

Once the potential injury is identified, the next step is to confirm whether it is a true pathology or anisotropy that is causing an artifact. To avoid anisotropy, the ultrasound probe should be held perpendicular to the examined structure and the bone's surface, with the bone underneath appearing bright. If an area is questionable, you can toggle the probe side to side to see if the defect remains, separating pathology from artifact.

Communication & Correlations:

Once pathology is confirmed, knowing how to accurately convey the findings will allow for appropriate treatment and intervention. Stating articular vs bursal and intrasubstance vs full thickness will guide clinical rationale. Significant atrophy has also been found to be correlated with poor rotator cuff repair outcomes and this should be taken into consideration as well. Calcifications can provide hints to the etiology of the injury, with thin wisps generally denoting degenerative tears and globular appearances marking traumatic origins.

Clinical Pearls:

An important clinical pearl to keep in mind is that the bicipital groove is the most common area of glenohumeral inflammation. If inflammation is focal only to the biceps without involvement of the rotator cuff, then the differential is likely biceps tenosynovitis. To differentiate between supraspinatus versus infraspinatus, it is helpful to remember that the apex of the bone between the middle and superior facet is the area where the infraspinatus overlaps the supraspinatus. The facet anatomy of the greater tuberosity serves as such a key landmark because the infraspinatus will appear linear, striated, and hypoechoic in this area due to the orientation of the fibers.

Another pearl to consider is that the acromioclavicular joint is a common area of pain for patients due to its inherent nature of being the 1st joint to be worn out. Nearly everyone over the age of 40 has osteophyte formation on the articular disc due to wear and tear, leading to pain. Of course, it is equally important to always consider other etiologies that may be the cause of the patient's pain, such as infection, bony fracture, and nerve injury.

Takeaways:

I hope these takeaways will be useful in your future ultrasound endeavors. These basic principles can be applied to other musculoskeletal complaints and can provide a foundation to build upon. Understanding anatomy is key, and, when in doubt, always focus on the area where the patient endorses the most pain because even if it is not where the core pathology is, it is still a great place to start scanning.

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ARTIFICIAL INTELLIGENCE IN ULTRASOUND: HIGHLIGHTING CURRENT DEVELOPMENTS

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Artificial Intelligence (AI) captures the zeitgeist of current technological innovations – permeating into all fields and being regarded as an "industry disruptor." The conversations around AI and its threat to radiological imaging have been ongoing for over a decade, yet much nuance remains to be addressed. For physiatrists, one of the most commonly used imaging modalities is clinical ultrasound which provides easily accessible, fast and dynamic visualization of pathology. Although not fully developed, avenues in which AI can augment ultrasound include operator learning, image capture, and image analysis.

Ultrasound is highly operator-dependent, therefore obtaining the ideal image to visualize pathology requires standardization and practice. To assist with this, GE HealthCare's Verisound AI has developed "Caption Guidance" which provides real-time guidance in performing cardiac ultrasound. Currently there are thirty-two studies that show positive utility and clinical reliability of this software in conjunction with trained operators. The same company has also deployed automated labeling of organs, anatomical measurements and classification of endometrial thickness in ovarian cysts. Implementing these technologies has been shown to decrease interpretation time and allow for faster diagnoses [1].

Capturing consistent imaging with ultrasound is difficult due to operator skill set, patient anatomy, and varying standardization of image views. A notable company innovating in this space with artificial intelligence is Clarius. They have developed software that automatically selects appropriate imaging presets for the FAST Trauma examination and automatically adjust the gain of the image for ideal image brightness. The goal of improving image capture is to expand access of patients to ultrasound screening assessments while reducing the burden on nonspecialized operators. In the developing world, The Bill and Melinda Gates Foundation has sponsored bedside ultrasound enabled with technology that automatically provides fetal measurements and screens for high-risk conditions.

Many large technology companies have also entered the healthcare AI space such as Google. They have trained their artificial intelligence model on thousands of de-identified fetal and breast ultrasound images. Interestingly, data from three studied models showed higher accuracy in estimating fetal gestational age compared to standard biometry [2]. In a more specialized application, researchers at The Mayo Clinic have developed high-resolution ultrasound software known as quantitative high-definition microvessel imaging (q-HDMI) which combines with AI analytics to detect breast cancer masses as small as 3 millimeters across. This technology demonstrated a nearly 100% accuracy in differentiating malignant versus benign masses [3].

Relevant to physiatry, there has been significant research into integrating AI with musculoskeletal ultrasound.. For example, exploratory AI models are being trained to detect hypo-vs-hyper-echoic signals in joint imaging to classify synovitis in rheumatoid arthritis patients [4]. Although these models have not yet been clinically deployed, similar approaches are being explored to help diagnose tendon, cartilage, skeletal muscle and peripheral nerve pathology.

It is important to note that intelligence training and diagnostic accuracy are continually being improved. The physician's role is to contextualize findings and in conjunction with clinical presentation guide treatment. The goal of integrating AI into ultrasound is to increase screening access, simplify examination and increase diagnostic precision and accuracy. This technology still remains in development, but can be a powerful tool to increase physician efficacy against disease.

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REHABILITATION OF LOW BACK PAIN: MOVING BEYOND ANALGESIC NEUROMODULATION

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Introduction

The field of physiatry aims to restore function and activity and often a barrier to function and activity is pain. The goal of this article is to provide an introductory overview of pain, specifically low back pain, and traditional and restorative neuromodulation. Pain is a universal experience, but what is it? Pain is defined by the International Association for the Study of Pain (IASP) as "an unpleasant sensory and emotional experience associated with, or resembling that associated with, actual or potential tissue damage" [1]. Pain in the acute phase is often protective, a warning of tissue damage, and a sign to rest. However, when pain becomes chronic and pathological it loses it protective function, and instead begins to limit activity and function.

Chronic Low back pain

In the United States low back pain has a lifetime prevalence as high as 65% - 80%, with an annual cost of $43 billion [2,3] Low back pain is challenging to treat, often there are multiple pain generators, and reported symptoms are nonspecific. The objective of this article is to review the subtypes of pain contributing to chronic low back pain and their treatment options, and introduce functional spinal instability and discuss analgesic and restorative neuromodulation in the treatment of back pain due to functional spinal instability.

Types of pain: Neuropathic, Nociceptive, and Nociplastic.

<u>Neuropathic pain</u> – "Pain caused by a lesion or disease of the somatosensory nervous system." E.g. lesions on the nerve roots (radiculopathy), or peripheral nerves (diabetic neuropathy).
<u>Nociceptive pain</u> – "Pain that arises from actual or threatened damage to non-neural tissue and is due to the activation of nociceptors." E.g. injury to muscles, ligaments, tendons, or facet arthritis.
<u>Nociplastic pain</u> - "Pain that arises from altered nociception despite no clear evidence of actual or threatened tissue damage causing the activation of peripheral nociceptors or evidence for disease or lesion of the somatosensory system causing the pain." E.g. complex regional pain syndrome, fibromyalgia, irritable bowel syndrome [4].

General Treatment Options for Types of Low Back Pain

Given the distinct types of pain, treatment must be tailored to address the underlying cause. For neuropathic pain treatment options include SNRIs, gabapentinoids and epidural steroid injection. Nociceptive pain, depending on the etiology, may respond well to a course of NSAIDs, medial branch blocks to radiofrequency ablation, and physical therapy. For nociplastic pain – a pain psychologist may incorporate pain reprocessing therapy or cognitive behavior therapy.

Functional Spinal Instability

Functional spinal instability (FSI) is a derangement of normal neuromuscular control that maintains spine stability. This is different from structural instability, such as a fracture or degenerative spondylosis/spondylolisthesis [5]. Dysfunction of the lumbar multifidus muscle (LMM) is thought to be a main contributor to functional spinal instability, as it accounts for more than two-thirds of spinal stiffness [5,6].

FSI begins with a disruption of the sensorimotor feedback loop via a noxious insult leading to derangement of the signals from the spinal joint mechanoreceptors and muscle spindles. This derangement leads to the development of arthrogenic muscle inhibition (AMI) – where the abnormal signals lead to neural inhibition of the LMM. Inhibition of the LMM leads to an inability of the spine to maintain stability during movement and thus FSI. With the development of FSI the patient can develop compensatory movement patterns that lead to further strain and injury. As FSI becomes chronic neuroplastic changes (e.g. hyperalgesia or allodynia) can occur – reinforcing the compensatory movement patterns and leading to further weakness, disuse, instability, and reinjury [5].

The diagnosis of low back pain due to FSI is done with a combination of clinical history, physical exam and imaging findings. A hypothetical scenario might involve a patient with chronic low back pain that has failed to respond to conservative treatment options and presents with predominantly positional axial pain – aggravated by specific movements or postures and denies radicular symptoms. Structural abnormalities are absent on diagnostic imaging. Physical exam is positive multifidus lift test and compensatory/aberrant movement patterns [5].

Neuromodulation

Neuromodulation is defined as the "the alteration—or modulation—of nerve activity by delivering electrical or pharmaceutical agents directly to a target area.7" The traditional and the most common neuromodulation therapies is a spinal cord stimulator (SCS), which provides electrical impulses to modify or block pain signals traveling in the spinal cord to the brain [8].

A new form of neuromodulation aims to restore function. The ReActiv8 system aims to break the cycle of dysfunction. The system works by stimulating the efferent nerves that innervate the multifidus muscle – the dorsal rami of the L2 lumbar medial branch nerve, causing episodic contractions to overcome AMI and reengage the multifidus muscle to improve/restore spine stability [5,9].

A five-year longitudinal follow-up on a ReActiv8 clinical trial published earlier this year, showed the system was safe, effective and durable in the treatment of chronic low back pain associated with multifidus muscle dysfunction [9].

Conclusion

Chronic LBP remains a significant challenge due to its complex etiology and non-specific presentation. Understanding the different types of pain—neuropathic, nociceptive, and nociplastic—is important for tailoring effective treatment strategies. While traditional neuromodulation techniques like spinal cord stimulation provide analgesic relief, emerging therapies such as the ReActiv8 system represent a promising shift towards restoring function. By targeting the underlying neuromuscular dysfunction of the lumbar multifidus muscle, restorative neurostimulation offers a novel approach to addressing low back pain due to functional spinal instability. As evidence continues to support its safety, efficacy, and durability, there is hope for restored function in low back pain.

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