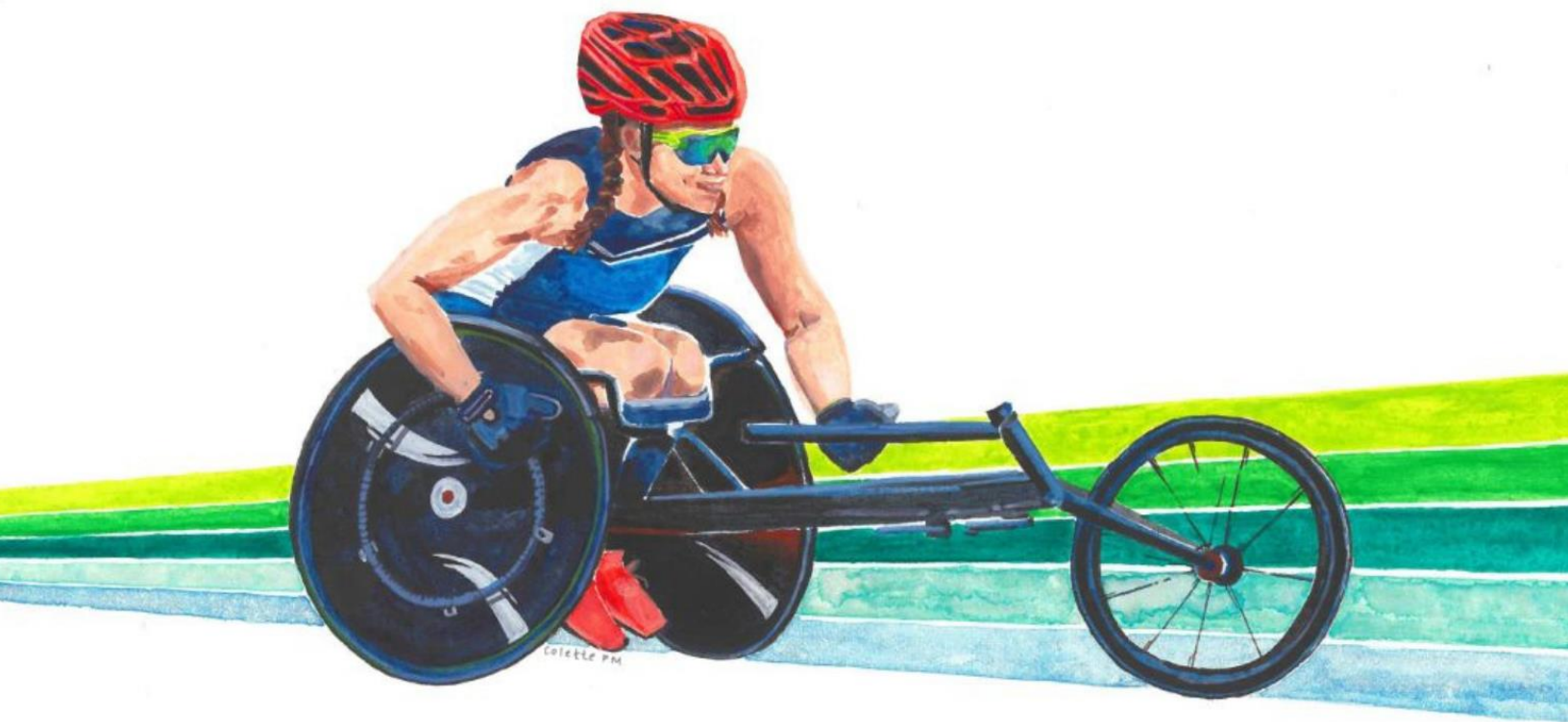


PHYSIATRY IN MOTION SUMMER 2023



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COVER ART: COLETTE PIASECKI-MASTERS, MD



Association of Academic Physiatrists

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A LETTER FROM THE EDITOR

S. RAZA HUSAIN, DO

Dear Readers,

It is my pleasure to welcome you to the Summer 2023 issue of *Physiatry in Motion*, the official newsletter of the Association of Academic Physiatrists Resident/Fellow Council (AAP RFC).

Our theme was “*Activity in Physiatry*” – inspired by both the title of this newsletter and our season of publication. Summer is a time that evokes feelings of happiness and adventure, and when we most often embrace new activities for both relaxation and recreation. In many ways, this reflects the spirit of our field, particularly with its focus on “return to function”. In this issue, we looked to capture the warmth of summer activity through the lens of incredible work being done in the field of Physical Medicine & Rehabilitation.

Enclosed, you will find a collection of articles that will we hope will inspire you and give you new insight into our field. From candid reflections on patient care, to stories of champion adaptive athletes, and advancements in the PM&R, there is sure to be something in these pages for everyone.

I would like to express my gratitude to each of our contributors for their time. Your passion for physiatry and commitment to improving the lives of our patients is what makes this field truly special.

I would also like to extend my sincerest thanks to the entire Digital Outreach Subcommittee for their work to help bring this issue to life, particularly Dr. Colette Piasecki-Masters for the incredible watercolor that graces our cover.

Thank you again for taking the time to join us for this issue of *Physiatry in Motion*. Whether you are in practice, in training, applying, or just someone interested the world of rehabilitation medicine, we hope you enjoy reading it as much as we did putting it together.

Warmest Regards,

S. Raza Husain, DO

Editor, Physiatry in Motion

Chair, Digital Outreach Subcommittee

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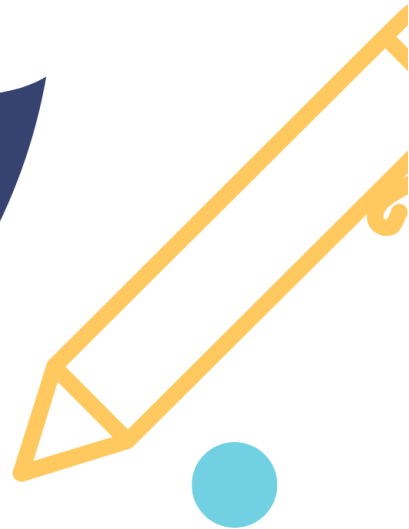
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Physiatry In Motion

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A NEW VIEW

ANTHONY M. IUSO, DO; PGY-2 MONTEFIORE-ALBERT EINSTEIN MEDICAL CENTER

CATEGORY: REFLECTIONS ON PATIENT CARE

My view upon entering work is typical for a job in New York City: tall buildings, street-food stands, gridlock traffic, and a blaring ambulance in the distance. Quite the contrary to the view I had during my prelim internal medicine year in northern New Jersey, which was full of suburbs, convenience stores, and lots of deer. However, this NYC metropolitan environment is not unfamiliar to me, as I completed both my undergraduate and medical school training in the area. Moreover, the pathology I am facing as a PGY2 in NYC is not significantly different from that which I encountered during my prelim year. What differs, though, is the overall patient population that I now am dedicated to treating.

The underserved minority communities of the Bronx have enabled me to see patient care from a unique perspective. Many of my patients are uninsured, and therefore their dispositions and management may differ from those insured patients that I had frequently encountered in the past. Arranging patient needs, including home therapy or subacute rehab, can be challenging for patients without health insurance. These situations frequently occur, forcing the team and myself to think critically about how to best manage and optimize our patients. Regardless of their insurance situation, however, I find it fascinating how impactful acute rehab can be on the trajectory of one's recovery.

Patients in acute rehab often present with significant deficits that impair their activities of daily living. Whether it is traumatic brain injury, stroke, spinal cord injury, orthopedic injuries, or any other debilitating pathology, these patients struggle to perform at their baseline. Previously working in internal medicine, I had not yet experienced acute rehabilitation, which instead involves medical management along with a plethora of physical, occupational, and speech therapies aimed at restoring patient function. Knowing that many of these underprivileged communities may lack sufficient or easy access to healthcare services makes being a part of their rehabilitation journey all the more profound. I can recall one prior homeless patient whom we had in acute rehab that unfortunately suffered a cerebrovascular accident complicated by right hemiplegia. This person, however, was showing great progress and was able to stand again and gain some function back in their upper extremity. Visualizing their improvement only reinforced the deep respect and gratitude that I hold for the dedication that my inpatient rehab team and I exhibit on a daily basis.

For these many reasons, I now have a new view on my approach and appreciation of patient care.

A PAIN IN THE JOINTS! SETBACKS ON THE ROAD TO RECOVERY IN A SCI PATIENT IN THE INPATIENT REHAB UNIT

ANDREW RIVERA, MD, MS; PGY-1 LAKELAND REGIONAL HEALTH MEDICAL CENTER

CATEGORY: CASE REPORTS

A patient was admitted to the inpatient rehabilitation (IPR) unit for spinal cord injury following elective spine surgery. The reason for admission to IPR was bilateral lower extremity weakness, a complication of the patient's surgery. His recovery became further complicated due to his obesity, which restricted mobility and hindered rehabilitation efforts. After his initial physical therapy evaluation, he was already experiencing significant pain from the therapy session. A day or two later, he complained of wrist joint pain, which raised concerns for both the patient and the medical team, as a significant part of the initial therapy focused on using his upper extremities for transfers. X-rays showed no acute wrist trauma, and we provided the best possible treatment. His wrist pain improved with reduced physical activity, but this setback delayed his therapy progress.

It seemed that as one issue improved, a new challenge arose. The patient soon began to report right medial knee and ankle pain, without any specific traumatic incident. Our physical examination revealed joint line tenderness in the knee and suggested tendonitis in the right ankle. Swelling and pain limited the range of motion in these joints. Bilateral knee X-rays confirmed significant osteoarthritis, which the patient was already aware of, while the right ankle showed no fractures or dislocations. We managed his pain to allow him to continue with therapy, even though the relief was suboptimal. Simultaneously, we explored other pain management alternatives to support his full participation and recovery from therapy.

Each day, we conducted thorough examinations. While checking his wrist for range of motion and pain, a previous complaint, we noticed swelling in his index finger (DIP joint to the nail bed). When questioned, he mentioned possibly injuring it on his wheelchair wheel. However, due to a history of reduced sensation in the finger and no open wound, he had not been concerned. We became alarmed, suspecting cellulitis. Monitoring the swelling, we ordered an X-ray to rule out trauma. The X-ray revealed no fractures but raised the possibility of gout in the joint. We consulted Rheumatology, and after evaluating the patient's clinical history, they decided to perform joint taps on the right medial knee and index finger. Surprisingly, the results indicated an acute gout flare. Armed with this new knowledge, we promptly initiated appropriate gout treatment. As his pain gradually subsided, his hope for recovery was rekindled.

Reflecting on this experience, I am reminded of the intricacies of medicine and the significance of intuition and meticulous observation. Notably, the patient had previously mentioned a history of mild gout but had not received treatment for it in years and had never experienced such symptoms before. This underscores the importance of a comprehensive medical history to proactively address or mitigate potential complications.

You can follow Dr. Rivera on social media at @AndrewR7793.

CAMP MITIOG: FOSTERING THE RELATIONSHIP BETWEEN RECREATION AND PHYSIATRY

TANNER KIMBALL, DO; PGY-1, UNIVERSITY OF MISSOURI

CATEGORY: ADAPTIVE RECREATION

In the serene landscape of Excelsior Springs, Missouri, a remarkable event takes place every summer that seamlessly adjoins adaptive recreation and healthcare. Camp MITIOG, a week-long retreat for children aged 8-16 living with spina bifida, is a testament to the profound impact of recreation and adaptive sports in those with differing abilities.

Since its inception in 1969, Camp MITIOG has been a haven for young individuals with spina bifida, offering an escape into the beauty of nature and an opportunity to engage in various activities tailored to their unique needs. Accredited by the American Camp Association, the camp's setting at Lake Doniphan Conference and Retreat Center embodies inclusivity, with a wheelchair-accessible environment fostering a sense of belonging and empowerment.

The heart of Camp MITIOG lies in its emphasis on recreation and adaptive sports. In this week-long journey, each camper is paired with a counselor to partake in diverse activities - from swimming and fishing to canoeing and arts and crafts. However, it's not just about the festivities but the thoughtful adaptation and inclusion that make these experiences possible. The impact of these activities extends far beyond the camp's perimeters, opening the door to the endless possibilities of what physiatry.

Physical medicine and rehabilitation have a practical focus on function and overall well-being. Camp MITIOG serves as a living embodiment of this philosophy. The camp promotes physical wellness and nurtures psychological and emotional growth through collaboration, camaraderie, and self-discovery. The campers learn to see their abilities instead of their limitations, where they gain a sense of independence, resilience, and self-confidence. Additionally, Camp MITIOG offers campers the opportunity to return year after year, which allows a

profound sense of community for campers and staff alike. Also, the rehabilitative benefits are reinforced annually, allowing campers to exercise their newfound abilities in a safe environment. These invaluable life skills mirror the tenets of physiatry, where empowering patients to actively engage in their rehabilitation is essential.

The ripple effects extend further. These experiences at Camp MITIOG and other similar camps inspire conversations around the significance of hobbies in the lives of individuals with disabilities. Physiatrists witness firsthand the transformative potential of such initiatives and, in turn, incorporate innovative approaches into their medical practices. The camp's model reiterates the importance of these principles in the doctor-patient relationship: fostering compassion, open communication, and patient-centered care. Further exposure to these unique opportunities will only continue to benefit those with special needs and shine a light on how impactful this experience can be.

In a world where medical advancements often steal the limelight, Camp MITIOG is a gentle reminder that healing is multi-faceted. The stories shared over the campfires, laughter echoing across the lake, and the essence of togetherness cultivated through shared experiences all leave a lasting impact on those who get the opportunity to participate. The experience creates a community dedicated to exploring new ways to enhance the lives of those they serve. Camp MITIOG bridges the gap between recreation and physiatry, leaving an enduring legacy that redefines what it means to heal - not just the body but the soul.

Learn more about Camp MITIOG at: <https://www.campmitiog.org/> and follow Dr. Kimball on social media at @tannerkimball_.

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CAREER CHATS – DR. BRYAN MURTAUGH, ACADEMIC SPORTS MEDICINE PHYSIATRIST, NBA HEAD TEAM PHYSICIAN

DEREK DAY, MD; PGY-4, MEDSTAR HEALTH, GEORGETOWN/NATIONAL REHABILITATION HOSPITAL

CATEGORY: INTERVIEWS

This is a partial transcript of an episode of the AAP Career Chats Podcast, a series created to help PM&R trainees as they embark on their career path through the insight and wisdom of experience physiatrists from a variety of backgrounds and sub-specialties. Edited for clarity and brevity. Listen to the full episode, available now on all AAP podcast platforms!

Dr. Bryan Murtaugh is the Director of Sports Medicine as well as the Primary Care Sports Medicine Fellowship Program Director at MedStar National Rehabilitation Hospital and Georgetown University Hospital. He is an assistant professor in the Department of Rehabilitation at Georgetown University School of Medicine. He is also the head primary care team physician for the Washington Wizards of the National Basketball Association, in addition to serving as a team physician for the Catholic University of America and Trinity University athletic programs. Dr. Murtaugh received his medical degree from Georgetown University School of Medicine, completed his internship at MedStar Georgetown University Hospital, and then both PM&R residency and sports and spine medicine fellowship at the Northwestern McGaw Medical Center and the Rehabilitation Institute of Chicago. He is board certified in PM&R and sports medicine.

Derek Day, host, PGY-4 PM&R Resident, MedStar Health Georgetown/National Rehabilitation Hospital: To start off, I have a description here from the AMSSM website of what a sports medicine physician is and does. I'll read that and then ask you to comment on what you might clarify or add to their description.

Dr. Murtaugh: Sounds good.

Derek: The AMSSM website says “a sports medicine physician has significant specialized training in both the treatment and prevention of illness and injury. They are ideally suited to provide comprehensive medical care for athletes, sports teams or active individuals who are simply looking to maintain a healthy lifestyle. Sports medicine physicians specialize solely in non-surgical sports medicine and serve as team physicians at the youth level, NCAA, NFL, MLB, NBA, WNBA, MLS, and NHL”, as well as with Olympic teams. From that, anything that you would clarify or add?

Dr. Murtaugh: Well, one of the exciting things about sports medicine is that it's a broad field, and I see it as treating and preventing illness and injury for anyone who really wants to be active. So that can encompass a large, diverse patient population, and directing care towards their goals. That could be a high-level athlete and navigating them towards return to play. It could be injured police and fire personnel and guiding them back to their job, or it could be an older individual with knee osteoarthritis, someone who wants to be able to enjoy their activities of daily living with less pain. So, I really see a large, diverse patient population from adolescents to individuals well into their 90s. Having that diverse patient population and being able to guide them towards their goals and do various procedures, it makes it a really exciting field.

Derek: That's a really helpful clarification that you, despite being a team doctor for a professional basketball team, you're still seeing patients from every age group and level of activity and ability. Then beyond primary care sports medicine in general, what does being the head team physician for a professional basketball team look like?

Dr. Murtaugh: Well, looking at it from a bird's eye view, you could split up the year into preseason, which includes pre participation physicals, getting their baseline labs, and screening for injuries; then you have the season which includes game coverage and treating and preventing illnesses and injuries during the season; and then you have the postseason where you're evaluating your college athletes that may be drafted, you're doing the NBA combine and evaluating the players there, doing screenings for those players. So, you really have to be able to be accessible throughout the year through all those things. On a more practical level, it's really understanding that you're part of a larger team and you're working closely with the rest of the medical staff. That includes the other team physicians, specialists, your athletic trainers, physical therapists, and strength and conditioning coaches. So, you really have to coordinate your care through them. Along those lines, you also have to be really in tune to being able to communicate with them, and not only those individuals, but others throughout the organization. That could include team executives, coaches, agents. So, you really have to be able to effectively communicate with them. It's really important that everyone is on the same page. And then lastly, it's about availability. You always want to be available to take calls and texts and have access because there's an understanding that things need to be done fast for a professional organization. Timing is really of the essence in pro sports.

Derek: So, you're kind of always on call?

Dr. Murtaugh: Pretty much, you could say that, yeah.

Derek: Sounds like more than a full-time job. Now, Dr. Murtaugh, in addition to being the team physician for the Wizards, you also have the role of Director of Sports Medicine and the Fellowship Program director here. Can you tell us more about what those roles entail?

Dr. Murtaugh: Yeah, so, with regard to Director of Sports Medicine, that's a number of different roles. One of them is overseeing the program and providing leadership for it. It's strategic planning and recruitment of new physicians. It's developing and updating protocols, quality and safety procedures, etcetera. Its advocacy for the PM&R Sports program

within the larger health system and representation at meetings and committees. And then it's also mentoring and junior faculty.

Derek: Excellent, Thank you. Now back to the field of sports medicine in general, what changes do you anticipate over the next 10 or 20 years?

Dr. Murtaugh: I feel like the field is going to continue to grow, and I think it's going to be more and more collaborative. We see this with other disciplines and healthcare professionals. Here at MedStar, you see it with us incorporating athletic trainers into our clinic. And I think that dynamic is going to continue to evolve for sure. I think orthobiologics are going to continue to play a larger and larger role going forward. I think ultrasound will continue to allow us to do more advanced procedures as technology gets better. And I think there's still room to grow within the field with regard to lifestyle medicine, exercise, nutrition, and disease prevention. I think that's even somewhat of an untapped market that can be fostered and developed going forward.

Derek: Sounds like a lot of potential exciting and positive changes, things to look forward to. We'll flip now to the second purpose of the interview: what was the pathway for you to land in the roles that you have?

Dr. Murtaugh: Well, when I was in residency, I just remember that I really liked the aspect of being able to diagnose and assess a patient's complaint and come up with the treatment plan according to their goals; being able to have a positive impact on their lives. That was something really tangible, and it really resonated with me, and I found that I was able to do that within sports medicine. That's why I chose to go into it.

Derek: Then after you had already gone into sports medicine, you'd finished fellowship, what was the path from there to where you are now as the director of Sports Medicine and as a head team physician for the Wizards?

Dr. Murtaugh: When I came to MedStar, one of the things that attracted me here was that it was a growing program and that I would have a mentor as I got settled in my career. That was important to me when I was looking at jobs. That mentor was Jason DiLuigi at MedStar. At the time, he was the director

of Sports medicine and also the team physician for the Wizards. So, I worked closely with him, and he really showed me the ropes. That allowed me to build my practice, develop over several years, and take on more responsibility over time. And then, when he left to take on his position at Mayo Clinic, I was able to step in and fill in some of those roles. That's what allowed me to develop and be in the current position that I'm in now.

Derek: Got it. Now, were there any points, and we can even go back to medical school or before, that you considered alternative career paths, and if so, what were the things that tipped the balance in why you went the direction that you did and not with any of those alternative paths?

Dr. Murtaugh: So, within med school I didn't really know what I wanted to go into, and I really didn't decide to go into PM&R until pretty late. It was early into my 4th year that I decided to go into PM&R. So, I really thought about a number of different fields. I thought about Orthopedics; I thought about neurology; I thought about internal medicine. Really, PM&R kind of encompasses a lot of those fields. And one of the things that I really liked about PM&R is that it allows you to tailor your career the way you want to. You could do all inpatient if you wanted to; you could do all outpatient; or you could do a combination of both. You could specialize in one area like sports medicine, pain medicine, spinal cord injury, or traumatic brain injury. You could do many procedures if you want to, or you could do no procedures at all. That really appealed to me that you were able to tailor your career the way that you wanted to. And so that was one of the deciding factors of why I went into the field.

Derek: Excellent. Now when you were a PM&R resident, were there other paths after residency that you had considered, or how did you land on sports and spine medicine as a resident?

Dr. Murtaugh: Well, I was pretty open to any area within PM&R during residency. So, you know, I was open to doing inpatient as I was rotating through my first year, and then, when I got into my second year, I thought about maybe doing pain. Then I did my sports rotation, and that just kind of felt right. I really like the patient population, keeping an individual

active, assessing and treating them, and really making a positive impact on their lives. I like the dynamics of being able to do a number of different procedures. It was really interesting to me that ultrasound was something that was fairly new when I was in training. So, there were a lot of dynamics that were really exciting, and that's why I chose sports.

Derek: So, you mentioned it before as well: your mentorship relationship with Dr. DiLuigi. I do want to go back to that: whether more with him or any other mentors that you've had along your way, how you developed those mentorship relationships.

Dr. Murtaugh: So, I was really fortunate to be at a program in Northwestern during my residency and fellowship, and I had a number of different mentors there. To name a few: Joel Press, Joe Ihm, Monica Rho, Ellen Casey, Andrew Hendrix. You know, I really take a piece of all of their practices and have incorporated them into the way I practice.

Derek: As you see trainees seeking out mentors, looking for people that they can pattern their career path off of and learn from, what would you recommend as the best approach to reach out to those people/develop those relationships?

Dr. Murtaugh: Well, I think you can first network within your own program, find a mentor that you have at your own program, and use those resources, but then also feel free to reach out to any of us within the PM&R Sports Medicine community. I mean, it's a fairly small, tight-knit community still. And so, I think any of us out there are willing to share our thoughts or ideas, to mentor someone or give advice, so don't be afraid to reach out.

Derek: That's helpful. That has been my experience so far. Now if you were talking to a resident who is undecided at this point about what they want to do next, what tips would you give them to help them figure out what career path to take?

Dr. Murtaugh: Really, I think the biggest advice that I would give is to be open-minded. At the start of my residency, I hadn't really decided what I wanted to do, and so I was really open to doing any part of PM&R that was available. Then, over time, you figure it out. But having an open mind affords you opportunities, so I think that's the biggest advice that I could give. So, for residents that is what they should do when

they first start out. Now, for fellows coming out, I think it's important when they're taking their first job to say yes to opportunities that they get offered. That's particularly important early on. So, let's say if you get offered a sports coverage opportunity, and it could be something as simple as a high school sports program, taking on that responsibility can show your program that you're interested, that you're willing to buy in, that you're committed, and that could afford you opportunities down the line. You really want to keep things broad initially, say yes to opportunities, and doors will open up in the future for you.

Derek: We'll wrap up the discussion about sports medicine and mentorship, but I did want to give you

a chance also to give one recommendation: one book, movie, TV show or whatever it may be to those who are listening.

Dr. Murtaugh: A book: *Good to Great* by Jim Collins is a good one. I think that's a classic one. TV show: I like traveling, so I would say *Stanley Tucci: Searching for Italy* is a good one.

Derek: Awesome. Well, again, thank you, Doctor Murtaugh, I really appreciate it. Thanks for taking the time and for sharing your wisdom and advice with us.

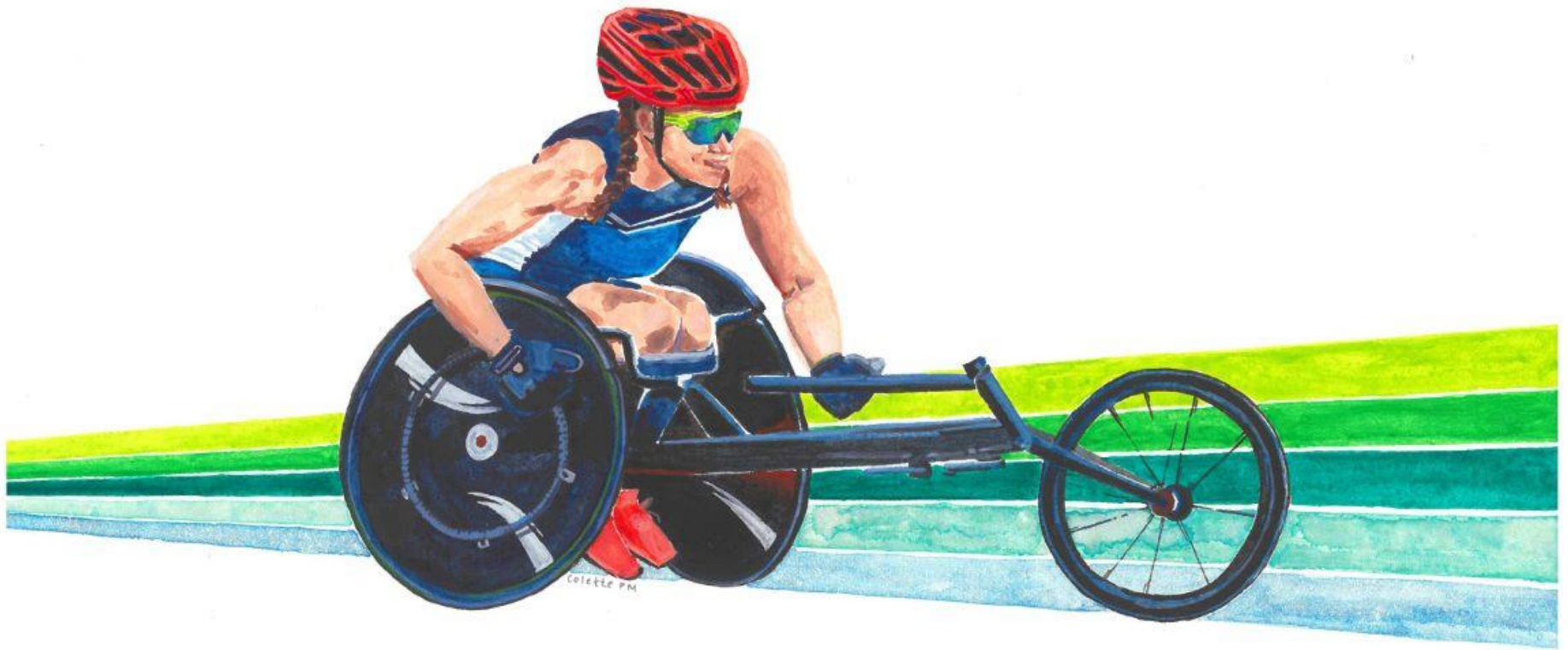
Dr. Murtaugh: Thanks for having me.



Once you are Board-certified as a physiatrist, there are many paths you can take with your career. Do you want to be fellowship-trained? Do you want to work in a traditional clinical setting? Do you want a career in academia? Explore all of this and more in the AAP Career Chats series.

PORTRAIT OF A CHAMPION: RYEN REED

COLETTE PIASECKI-MASTERS, MD; PGY-1, HARVARD MEDICAL SCHOOL/SPAULDING INSTITUTE FOR REHABILITATION



Ryen Reed is a Team USA paracyclist and 2023 Women's H4 Paracycling Road/Time Trial National Champion.

PORTRAIT OF A CHAMPION: KATIE LADLIE

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Katie Ladlie is a forward on the USA Women's Sled Hockey Team.

OP-MED: WHY ARE PHYSICIANS AFRAID OF IRON?

RAGAV SHARMA, DO, CSCS; PGY-2, MEDICAL COLLEGE OF WISCONSIN

CATEGORY: SPORTS MEDICINE

This piece was originally published as an Op-Med on the Doximity Network

No, not the element Fe, but the iron that makes up dumbbells, plates, barbells, and other equipment found in gyms. More than likely, you have heard or experienced a physician somewhere say, “Be careful lifting weights, don’t hurt yourself.” Unfortunately, resistance training maintains a stigma due to a perceived injury risk that is shared by both the public and physicians alike. Given the inadequacy of most in reaching physical activity guidelines, we as physicians cannot be the nail in the coffin in stopping our patients from lifting weights.

The current physical activity guidelines set forth by the American College of Sports Medicine (ACSM) and echoed by WHO are as follows:

“Moderate intensity aerobic physical activity for a minimum of 30 minutes on five days per week, or vigorous intensity aerobic activity for a minimum of 20 minutes on three days per week AND activities that maintain or increase muscular strength and endurance for a minimum of two days per week.”

Currently, about eight out of 10 adults within the USA aged 18–80 do not meet the physical activity guidelines set forth by WHO. Even worse is the proportion of those completing the muscle strengthening portion, with an estimate of roughly between 10% and 30% of adults meeting this guideline. This means that 70% to 90% of the population is missing out on the unique benefits provided by lifting weights.

What benefits? Improved insulin sensitivity, better weight management, increased bone density, and overall reducing the morbidity and mortality in many other ways. There is a lot to gain with benefits for every age group, with no differentiation as to the starting age. Surely, we as physicians should help our patients receive these benefits. However, how many times do you think a physician has recommended

(appropriately loaded) deadlifts to a 70-year-old patient? I would wager not many.

As a Physical Medicine and Rehabilitation resident, I see patients with a broad array of musculoskeletal, neuromuscular, and cardiovascular diagnoses and have seen how these diagnoses can drastically affect a patient’s quality of life. In my experience, those with exposure to training tend to have less severe injuries with a lower impact on quality of life. Conversely, those with minimal to no exposure are more likely to sustain severe injuries with a massive impact on quality of life. For example, I am much more likely to see a hip fracture, which carries a 16.6% mortality rate within one year of surgery, in someone who has never squatted versus someone who has squatted consistently for many years.

My experience in medicine thus far has led me to understand that physicians have an irrational fear of lifting weights due to some perceived injury risk. Whether due to previous biases and stories we have heard growing up, a simple lack of knowledge, or plain inexperience, we are always scared of telling our patients to lift weights. Instead, we hide behind the guide of “recommending exercise.” When pressed further by patients, that recommended exercise more than likely ends up being walking, jogging, playing a sport, etc., which are all thought of as “safe” exercises.

I heard many of these same statements from my PCP and endocrinologist as I became engrossed in weight training to overcome childhood obesity due to hypothyroidism. My journey started near the end of high school, and as my body weight dropped, not only did the total weight lifted go up but so did the comments about safety and injury. Now, as a drug-tested state record holder, I have deadlifted over 700 pounds and sustained no more injuries than anyone else would have at my age. I continue to hear words of caution but can now break the chain in passing down this fear to my patients.

In reality, the incidence of injury risk is 0.31 and 0.05 per 1,000 hours of weight training for men and women, respectively. Thus, the average person is likely to sustain one injury over 3,000 hours of training, and the average woman will likely sustain one injury in 20,000 hours of training. Assuming two hours per week of muscle-strengthening exercises, per the guidelines, that is one injury every 28 and 192 years for men and women, respectively. Compare that to running, which has an injury risk of 2.5 to 33 per 1,000 hours in long distance and novice runners, respectively.

As physicians, we must recognize the unique benefits of resistance training and recommend it to our patients whether young, old, relatively healthy, or with multiple comorbidities. This does not mean suggesting Mr. Olympia-worthy routines or deadlifting 700 pounds, but starting at an appropriate level, just like for anything else. Let us stop the fear-inducing statements and avoidance of weight training and help deliver the multitude of associated benefits to our patients!

Follow Dr. Sharma on social media at @_ragavsharma_.

PHYSIATRY AND THE UPWARD PLATEAU

AGAM JAGOTA; M4, SAM HOUSTON STATE UNIVERSITY COLLEGE OF OSTEOPATHIC MEDICINE

CATEGORY: REFLECTIONS ON PATIENT CARE

Rehabilitation is a journey of resilience, determination, and unwavering commitment. For patients recovering from traumatic injuries, progress can be a complex and emotionally charged concept. Three months after relocating to a new country, our patient, Mr. D, experienced an unexpected turn as he endured a partial transection of his spinal cord at the level of C6. Due to his status as an immigrant, he was left without insurance and was referred to a free outpatient rehabilitation clinic where a multidisciplinary team of rehabilitation specialists volunteered their time to help patients that may not be able to afford care otherwise. Over eight months of rigorous therapy and unending support from his wife, he defied the odds, transitioning from utilizing a wheelchair for transportation to walking with minimal assistance. However, even as his physical abilities improved, a sense of defeat began to overshadow his progress.

During a recent physical therapy session, the patient voiced his frustration and disillusionment. He confided that the strides he had made felt insignificant compared to the immense effort he invested daily. The enthusiasm that once fueled his progress had been replaced by a sense of weariness and stagnation. He felt as though he had hit a wall in his progress, and he was tired of pushing so hard. Recognizing that progress is not solely about physical achievement but also about emotional well-being, we sought to change his perspective.

To help the patient grasp the magnitude of his accomplishments, we utilized a simple yet powerful tool: a video clip from six months earlier. In this video, he was learning to perform a seemingly mundane task – turning himself on a bed by grabbing his wrist. At that time, this action was a remarkable feat, considering his initial loss of motor and sensory function in his arm. See, when you turn your body in bed, you will reposition your arm placement without

much thought. With a near-total sensory loss in his right arm, he would not know if his arm was turned in an awkward or structurally dangerous position. This exercise was crucial to his safety at home and a stepping stool in his recovery. I watched his face change from exhaustion to amazement as he watched his past self-struggle to grab his own wrist and turn his body repeatedly. Without finishing the video, he put the phone down and smirking said, “Let’s keep going. I’m a lion but don’t worry, I don’t bite.”

There is an undeniable disparity between perceived progress and objective achievement. What appeared to be monumental strides to the medical team might feel like minor victories to the patient grappling with the daily challenges of rehabilitation. An upward plateau. We cannot forget to only celebrate objective progress but also address patients' perception of their own achievements. Although we may acknowledge the profound efforts patients invest in their recovery, we need to make sure periodically that they are doing the same for themselves.

It is the duty of the physiatrist to bridge the gap between what we perceive and what our patients feel. If we recognize these “upward plateaus,” we can empower patients to overcome their self-doubt and see the progress they might not fully appreciate. By validating their feelings, we encourage them to embrace their journey with optimism. Our patient’s experience serves as a reminder that progress is multi-dimensional, encompassing not only physical milestones but also emotional resilience. By recognizing the challenges patients face and fostering empathetic communication, we can help them appreciate their achievements and continue their journey toward recovery with renewed determination.

Follow Adam on social media at @AgamJagota.

PIONEERS OF PLAY: INTERVIEWING A PGA PROFESSIONAL ON BECOMING AN ADAPTIVE GOLF COACH

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CATEGORY: INTERVIEWS, ADAPTIVE SPORTS

“Golf is a game for everyone.” That’s what Professional Golf Association (PGA) pro David Kulla-Mader had to say during our recent interview where we discussed his experience, motivation, and passion for coaching adaptive athletes in the game of golf. David has been golfing and coaching professionally for 10 years and was recently promoted to head professional at Westchester Golf Course in Los Angeles (LA), California where he’s based. It’s also here that he’s been sharing his love and knowledge of the sport with people with disabilities for the past 5 of those 10 years.

As a PGA board member on the diversity, equity, and inclusion committee, David has always believed in a mission to make golf a more welcoming and accessible sport for everyone. Looking for a way to give back to his community, he got his start giving free lessons to adaptive athletes in collaboration with Angel City Sports, an LA-based nonprofit organization that hosts various athletic events for people with physical disabilities and visual impairments. While adaptive golf now possesses a momentum like never before – with more and more professionals dedicating their time and facilities to growing the game – this was certainly not the case 5 years ago. Back then, only a few students would show up consistently, and David found it difficult to recruit coaches to donate their time as he quickly realized that he was “the only pro doing this stuff west of the Mississippi.”

Today, however, times are different at Westchester Golf Course’s free adaptive golf clinic. Held once a month, one can expect to encounter a large group of unique athletes that you will not find anywhere else. These golfers range from young to old, from brand new to very experienced, all of whom with varying

levels of function due to a wide array of acquired or congenital conditions. Over the years, David and his team of volunteer coaches (many of whom have learned to play through their own disabilities) have mentored players living with spinal cord injuries, multiple sclerosis, intellectual disabilities, visual impairments, residual weakness after cerebral vascular accidents, and all forms of amputation, to name a few. To David, his lessons are hardly different from those given to able-bodied players, and his focus is on the fundamentals. “The golf swing is a circle,” he says. “Without even thinking of physical ability, we have to hit the ball in the center of the [club’s] face, and we’re going to need speed if we want distance...[Just like with any athlete], we find the parts of the body that don’t work. Then, we delegate roles to the parts of the body that do work to get the ball to fly...”

The success of David’s free adaptive golf clinics did not come without years of unlearning and relearning in order to navigate through the many restrictions that presented themselves. When asked to reflect on his initial experiences as an adaptive golf coach, David said that he had to start from scratch, recalling that trial and error became his best friend on his journey. “There’s no book on teaching people in wheelchairs how to play golf,” David commented. Since then however, David has written many of his own chapters into the adaptive golf playbook. He has since optimized the golf swing for seated, standing, one-handed, and two-handed players alike. He has acquired specialized equipment like the ParaGolfer, which gives immobilized golfers (i.e. spinal cord injury) the ability to hit shots from a standing position and to generate a longer and faster swing via greater range of motion of the shoulders. He has witnessed athletes make small, functional gains through the

rehabilitation of this sport, and he has even worked alongside athletes while they have rehabilitated themselves into full, functional recoveries from illness or injury. Now, David feels confident in his coaching abilities and continues looking forward to work with any student who has an interest in picking up a set of clubs, however best they can.

While David's passion for sharing this sport with so many people comes with its own rewards, David lastly emphasized the sense of community that this game has created for people with disabilities as well as the impact that this community has had on their mental health. By giving people with similarities a safe place to get together outdoors, participate in physical activity, and celebrate new accomplishments, David has witnessed first-hand how this game changes, and sometimes even saves lives. "Some people wait all month for this, and they tell me it's the only thing that gets them out of the house...the only thing they look forward to...it means so much more to affect positive change in that way than to get them to hit the ball a little farther," David says. "First and foremost, it's community. Golf is secondary."

Regarding what comes next, David envisions a future where any person with a disability can go online, type in their area code, and be presented with a national database of communities, coaches, and equipment to get them connected to the game. He also hopes that more professionals throughout the country begin hosting adaptive golf clinics of their own. David has therefore founded his own nonprofit organization called Los Angeles Adaptive Golf (LAAG). Through LAAG, a national adaptive golf portal is made accessible in just a few simple clicks. Although this organization is in its infancy, it joins an existing

conglomerate of programs that also support adaptive golf in their own ways. These programs include the U.S. Adaptive Golf Alliance (USAGA), U.S. Disabled Golf Association (USDGA), and North American One-Armed Golfer Association (NOAGA), as well as other recognized programs that span all adaptive recreation such as the Triumph Foundation and Challenged Athletes Foundation (CAF). You can find out more about LAAG through David's website at dkm.golf/laag.

Golf is a game that is becoming more accessible than it ever has, with new leaders who are expanding the game and innovative technologies that reduce the physical barriers to play. Just as golf is as much of a game that we play to get outside and have fun, it also bears resemblance to life in many ways. It teaches its players to be patient with themselves, to accept setbacks and manage expectations, to celebrate every well-struck ball no matter how insignificant it seems, and to do it all in good company. Taken directly from David's website, "Golf is first and foremost about learning how to adapt to life's situations when things don't turn out the way you expect them to." For these reasons, adaptive golf and the field of physical medicine and rehabilitation (PM&R) share the same goals for the adaptive community, constantly seeking improvement in daily life through mentorship and innovation. In turn, it's professionals like David Kulla-Mader who deliver an excellent option to do so, providing not only exercise and competition to our patients, but also community and hope for a greater quality of life.

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REASSESSING CHRONIC TRAUMATIC ENCEPHALOPATHY AND REPETITIVE TRAUMATIC BRAIN INJURY

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CATEGORY: SPORTS MEDICINE

With the ever-increasing national participation in combat sports, it is important to revisit the conversation of repeated Traumatic Brain Injury (TBI) leading to Chronic Traumatic Encephalopathy (CTE). In recent years, this topic has been linked mostly with American football, but it is important to note that the advent of this phenomenon was with the sport of boxing. Initially coined as “Punch Drunk Syndrome”, CTE was studied in boxers back in the 1920s by Dr. Harrison Martland who noted boxers displaying parkinsonian gait, tremulousness, vertigo, and cognitive symptoms (Changa et al). Due to the derisive nature of the name, this condition was rebranded as Dementia Pugilistica in 1937 and is currently a subtype of CTE.

Based on research conducted by Statista, 2.52 million Americans participated in mixed martial arts in 2022, an increase of 7.9% from the year before. With such large numbers taking part in the delivery of neurotrauma, it is safe to assume that cases of CTE will increase considerably as well. It is important to note that even if the increasing participation in combat sports is ignored, there is still a significant prevalence of brain trauma in the general population. Daugherty et al conducted a cross-sectional study where out of 6427 American adults, 28.9% reported experiencing at least one concussion in their lifetime. Similarly, based on annual reports from the CDC, a 15% increase in TBIs can be noted from 2018 to 2022 with the number of TBIs sitting at 70,155 reported cases that year.

But to contextualize these numbers, it is important to understand the fundamentals of CTE - which we now define as a delayed neurodegenerative disorder caused by repeated head trauma leading to degeneration of brain tissue and deposition of tau

protein in the brain that can yield a variety of symptoms. Esteemed neuropathologist Dr. Ann McKee is known for her groundbreaking work in the field of CTE. In recent research, Dr. McKee and their team noted symptoms of CTE to be initially insidious presenting with deteriorations in attention, concentration, and memory, leading to poor judgment, lack of insight, and overt dementia. Severe cases can present with progressive slowing of muscular movements, staggered gait, masked facies amongst other behavioral and personality changes. Imaging, blood tests, CSF readings can all be suggestive of CTE, but there is no one test that is specific. Due to the overlapping nature of CTE with many other disorders, it is important to note that presently only the perivascular accumulation of neuronal tau proteins seen postmortem is the pathognomonic finding for CTE. Dr. McKee also notes CTE is referred exclusively to tissue-based neuropathological diagnosis detecting tau protein deposition after death. However, there is a clinical syndrome related to CTE called Traumatic Encephalopathy Syndrome (TES) which can be diagnosed using a diagnostic criterion created in 2019 by the National Institute of Neurological Disorders and Stroke. (McKee et al) This detailed criterion can be simplified into 3+1 points for our purposes: 1) substantial exposure to repeated head injury; 2) core clinical features of cognitive impairment or neurobehavioral dysregulation, or both; 3) clinical features not fully accounted by other disorders; 4) a level of functional dependence/dementia. Hopes are to use this criterion in conjunction with newly developed and validated biomarkers detecting underlying neuropathologic changes of CTE to increase diagnostic specificity.

From a Physical Medicine and Rehabilitation perspective, interventions and treatments are targeted towards symptomatology of TBIs that lead to CTE rather than the disorder itself. Per the American Congress of Rehabilitation Medicine, a mild TBI is manifested by: 1) any period of LOC; 2) any loss of memory for events immediately before/after incident; 3) any alteration in mental status at time of accident; 4) focal neurological deficits that may or may not be transient (Cuccurullo). With this definition in mind, combat sports athletes who suffer “knockouts”, or loss of consciousness from blows to the head suffer a TBI. They will often exhibit memory loss for events before and after the incident. Rarely, combat sports athletes will suffer severe TBI needing neurosurgical intervention, hospitalization, and admission to a TBI-rehab service. In that case, their rehab course is handled like any other TBI course focusing on (but not limited to) agitation, headaches, vision changes, seizure prophylaxis, autonomic instability and dystonia, neuroendocrine disorders, cognitive dysfunction, while working with physical therapy, occupational therapy, and speech language pathology to limit other conditions. (Cuccurullo, Frontera) To test cognitive function, the Ranchos Los Amigos Scale can be used. To test for posttraumatic amnesia, the Galveston Orientation and Amnesia Test, and/or O-Log can be used. Chronic management include assessment of depression, anxiety, ongoing cognitive impairment, while making sure the patient can gradually return to life roles and vocation if able, with the help of support/counseling, driving evaluations, outpatient rehabilitation. (Smith et al)

As it stands, there are significant gaps in our understanding of this condition that we need to fill

before achieving a full understanding of CTE, but there is enough groundwork done to appreciate the intricacies associated with it. With increasing popularity and participation in combat sports, it is important to revisit repetitive traumatic brain injuries management and the resultant neurobiological sequelae contributing to chronic traumatic encephalopathy.

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STATIC VS. DYNAMIC STRETCHING

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CATEGORY: GENERAL PHYSIATRY

I remember the days of youth when I thought a warm up was a silly waste of time. My coaches would gather my teammates and I in a circle to stretch but I was more eager to skip this routine and play. However, as I get older, my body is a constant reminder of the prospect of injury. A tight muscle teases me with a muscle strain and I am reminded that one wrong move can lead to a week of pain and recovery. A pick-up flag football or soccer game is no longer a spontaneous recreational activity as my friends and I spend a good 30 minutes trying to loosen up.

So what should us retired athletes do to lubricate our joints so we can still enjoy our childhood pastimes? There has been a paradigm shift away from static stretching (SS) towards dynamic stretching (DS) as a body of literature suggests that SS may impair performance such as sprint velocity, jump height or knee extensor maximal voluntary contractions [1-5]. DS on the other hand may even augment performance with some studies demonstrating improved range of motion (ROM) compared to SS [6-7]. The benefits of DS may be attributed to increased muscle spindle reflex and corticospinal activity, amplification of motor nerve output, and increased enzymatic cycling during muscle contraction [8-9].

DS involves controlled movement through active joint ROM with repeated muscle loading and unloading [10]. Examples of such movements are shoulder rotation, hip abduction, or knee lifts all through full ROM. With regards to injury prevention, DS may be preferable over SS due to training specificity, whereby the movements performed in DS are similar to those that occur exercise or game play [11]. Especially in sports that involve high intensity muscle stretch-shortening cycles (e.g. soccer, basketball, football), the muscle tendon unit (MTU) must be sufficiently compliant to store and release elastic energy and thus reduce injury [12].

To date, there are only two studies that investigated the effect of DS alone on injury prevention. However,

there are many multi-faceted warm up programs which include DS that have been implanted to decrease injury among athletes. A well-studied program among soccer players is the FIF11+, which involves DS, jumping, running, bounding, agility, balance, and core stability. Several randomized trials have demonstrated and approximately 50-60% reduction of lower extremity injuries among youth and adult soccer players [13-17]. Importantly, one author found that multi-faceted protocols that included strength, balance, plyometrics and DS were more effective at reducing lower extremity injury compared to single-component protocols [18].

The mechanisms by which DS reduce injury is still under debate. It is possible that DS may reduce MTU stiffness. Matsuo et al. reported an increase in passive resistive torque at the end ROM following a single bout of DS, thus indicating a reduction in MTU stiffness [19]. Chronic DS training may alter angle-torque relationship within the MTU to allow more myofibril crossbridge attachments. Since most injuries occur when the muscle is at lengthen position, these changes allow greater relative force production at longer muscle lengths and may reduce injury [20].

DS may also reduce injury rates due to increased flexibility. An increased ROM would be expected to decrease the stress and strain on muscles and tendons at extended positions. One study evaluated DS of the plantar flexors and reported increased ankle dorsiflexion ROM [21]. The applied tension throughout dynamic movement may have thixotropic effects, thus leading to less resistance to movement [9]. An increase in pain and/or stretch tolerance might be another contributing factor to the increase in ROM [22].

Regardless of the mechanism, DS, especially when incorporated to a multi-faceted routine, appears to have a benefit to reducing injury. Although my old coaches had the right intention, gone are the days of

huddling in a circle and counting to 12 while stretching consecutive muscle groups. However, I reserve 15-20 minutes in my workout routine to perform a dynamic warm up prior to exercise.

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THE POWER OF CONNECTION: SOCIAL MEDIA'S ROLE IN ADVANCING PHYSIATRY

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CATEGORY: TECHNOLOGY

In a world that is increasingly powered by digital threads, the implications of social media extend far beyond casual connections. Within the realm of physiatry, platforms such as Twitter and Instagram have evolved beyond leisurely scrolling. For many, they represent doorways to discovery and collaboration, becoming lifelines, amplifiers, and windows into a world of opportunity.

Consider a medical student or an aspiring physiatrist, like myself, navigating the vast expanse of medical fields. A retweeted success story or an Instagram post highlighting the transformative power of rehabilitation medicine might serve as a compass, guiding them toward a potential calling.

The strength of social media is not solely in its ability to spark interest; it holds the power to democratize information. Gone are the days when learning about residency programs requires extensive travel or tedious searches. Virtual residency fairs and announcements illuminate our feeds, inviting students from all backgrounds to connect and share experiences.

As an international medical graduate, I have discovered invaluable touchpoints on these platforms. What could have been potential challenges transformed into sources of resilience and connection. Last year, I faced the hurdles of not securing a PM&R match, but the online physiatry

community offered solace. Instead of isolation, I found camaraderie. These platforms became sanctuaries of support and avenues for practical opportunities. Direct messaging, sharing publications, or collaborating on projects has become more seamless than ever, bridging gaps and fostering connections that would have been hard to imagine a decade ago.

Yet, the potential of social media in physiatry is not limited to networking. It serves as a collective megaphone for our field. We celebrate patient success stories, disseminate breakthroughs, and amplify the essence of physiatry, elevating its profile to wider audiences. Recognizing this potential, organizations like the Association of Academic Physiatrists (AAP) have dedicated subcommittees to nurture an online community that is both dynamic and supportive.

As the intersections of aspiring physiatrists and seasoned experts expand on these platforms, the narrative of physiatry unfurls one pixel at a time. For all who engage on these digital landscapes, the promise is clear: a community eager to support, share, and inspire. As we navigate through these digital paths, the future of physiatry gleams brighter and more promising than ever.

THE TRANSFORMATIVE POWER OF THE ATHLETE MINDSET: EMPOWERING INDIVIDUALS WITH DISABILITIES

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CATEGORY: ADAPTIVE RECREATION

Athlete (ath•lete), *noun* - a person who is proficient in sports and other forms of physical exercise. *"he had the broad-shouldered build of a natural athlete"*

If you look at the Oxford Dictionary, the insert above is what you will find as the definition of an athlete. It takes a very literal interpretation of the word, but in the realm of medicine, more specifically, PM&R, we understand that being an athlete is more than just how well you can play a game.

Each person may have a different definition but to me, an athlete means dedication, perseverance, and camaraderie. The beauty of this mindset comes with its potential to extend past the realm of sports and into the daily life. In the field of PM&R, these traits are something that we all wish to instill within our patients to help them better achieve their goals for recovery or adjustment to life with disability.

Here are some quotes from renowned athletes with disabilities and how their mindset has helped them overcome the immense challenges that life put in their way:

"By releasing control over circumstances, you gain more control over your life." – Kyle Maynard, mixed martial arts athlete.

Kyle Maynard was born with congenital amputation and was left with arms that end at the elbows and legs that end near his knees. However, this disability did not stop him from becoming an entrepreneur, speaker, author, mixed martial arts athlete, and the first man to crawl to the top of Mount Kilimanjaro (19,340 feet) and Mount Aconcagua (22,838 feet). His amazing accolades were a result of his mindset. By being at peace with his situation, he was able to focus more on the things within his control, such as the pursuit of his goals. This mindset shift can make a big

impact in the lives of not just those struck with misfortune but anyone that is going through life's challenges.

"I'm not disabled, I'm just differently abled." – Tatyana McFadden, twenty-time Paralympic medalist.

Shortly after being born with spina bifida, a congenital disorder that caused paralyzed her from the waist down, Tatyana McFadden was abandoned by her mother at an orphanage. Her financial circumstances prevented her from affording a wheelchair and forced her to walk on her hands for the first six years of her life. However, her interest in racing and sports changed her life. She began racing at eight years old and the rest was history. Her quote challenges the conventional notion of disability and emphasizes the unique potential that each person has. By learning how to maximize her physical performance through her sport, she was able to understand her capabilities and make the most out of life.

"I've learned life is a lot like surfing. When you get caught in the impact zone, you need to get right back up because you never know what's over the next wave... and if you have faith, anything is possible, anything at all." – Bethany Hamilton, professional surfer.

At age 13, Bethany Hamilton was attacked by a shark that bit off her left arm and left her handicapped. However, this did not stop her from pursuing her passion for surfing. She also wrote about her experience and created a film that inspired many to pursue their dreams regardless of any disabilities they may have. Her quote emphasizes an important lesson that sports has taught her: pushing past the bad days and looking forward what may come. Patients may

have bad days but understanding the inevitability of that is important in allowing them to continue focusing on their goals of recovery.

“At every level, I remember having self-doubt...and every time there was always somebody there who told me that I could do it.” – Jim Abbott, Major League Baseball pitcher.

Baseball is a game of accuracy – including not only how well a player can hit and catch the ball, but also how fast and precise a player can throw the ball. This makes Jim Abbott’s achievements even more astonishing. Jim Abbott was born without a right hand but still became a professional pitcher in the Major Leagues for ten years. And whenever asked about his accomplishments, his response always revolves around one word: teamwork. The beauty of team sports, such as baseball, is the family that you are able to have with individuals sharing the same goals and visions. Healthcare is a reflection of that. Providers and patients both share the same goal and at times, when patients are doubtful, we are always there to provide support and encouragement. By joining a sports team, individuals with disabilities can develop a network and provide support to one another.

“The only disability in life is a bad attitude.” – Scott Hamilton, four-time world champion and Olympic gold medal winner in men’s figure skating.

Lastly, we have this simple but beautiful quote from Scott Hamilton. Scott Hamilton is a world-renowned figure skater that was plagued with a congenital brain

tumor that caused him to stop growing when he was a child. He was bullied due to his short stature but that did not stop him from chasing his passions and maintaining the positive and charismatic personality that he is known for. His quote holds so much impact. Patients with disabilities often feel restricted and limited by their diagnosis. But by having a positive and optimistic attitude, they may find themselves exceeding the limitations they once thought they had.

The athlete mindset stands as a beacon of inspiration and empowerment for individuals with disabilities. As demonstrated by the words of athletes who have faced and conquered obstacles, this mindset instills a profound sense of determination, resilience, and purpose. By embracing the principles of unwavering belief in oneself, continuous self-improvement, and the pursuit of dreams, individuals with disabilities can rewrite their narratives just as these athletes have. Through the power of sports and the adoption of the athlete mindset, patients with disabilities can unlock their potential to surpass expectations, redefine success, and make lasting contributions to themselves and to their community.

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THERAPEUTIC HORSEBACK RIDING: A PROMISING APPROACH FOR IMPROVING OUTCOMES IN NEUROREHABILITATION PROGRAMS

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CATEGORY: ADAPTIVE RECREATION

Introduction and Background:

Hippotherapy, also known as therapeutic horseback riding, has been identified as a promising intervention in the rehabilitation of patients with neurologic impairments. This article aims to highlight evidence supporting the benefits of hippotherapy for patients affected by diagnoses such as cerebral palsy, stroke, spinal cord injury, as well as traumatic brain injury.

Cognitive and emotional benefits:

Therapeutic horseback riding refers to all equine-oriented activities to achieve therapeutic goals, including physical, social, cognitive, and behavioral goals [1]. These experiences begin, quite literally, from the ground up. Groundwork activities include grooming, tacking up, and leading the horse. Communication with horses can be complex utilizing several modes of communication: vocalizations, body language, and touch. It is important to understand that these are animals with a strong instinct to exhibit “flight” behavior. Patients electing to participate in equine-assisted therapies learn to practice mindfulness, emotional regulation, and self-esteem building skills. [2]. During groundwork activities, patients can learn how to communicate verbally and, most importantly, nonverbally with their horse. This type of communication can be achieved by engaging motor, emotional, social, and sensory processes such as vestibular, proprioceptive, tactile, visual, and auditory. Developing this bond, in and of itself, can be immensely therapeutic for patients who may have cognitive communication limitations. The horse-human relationship is one that fosters trust and was reported to catalyze emotional rehabilitation and reduce stress levels in veterans with post-traumatic stress disorder and traumatic

brain injury [2]. A similar pattern was observed in patients with cerebral palsy who participated in equine assisted therapies. These patients were observed to demonstrate improved socialization, self-esteem, as well as improved concentration and attention over the course of their therapies [3]. Patients typically respond to this treatment modality with greater compliance and enthusiasm when compared to traditional therapies because it is not only entertaining but is also empowering and allows the patient to develop new skills.

Physical benefits:

In addition to the cognitive and emotional benefits of hippotherapy, this intervention has also been shown to improve balance, gait, and postural control of the patient through slow, rhythmic movements of the horse. The swinging rhythm of the horse gait produces an effect twice as strong on the patient’s pelvic girdle when compared to the gait of the patient in traditional physical therapy [1]. In a study comparing stroke rehabilitation treatment groups, divided into hippotherapy and treadmill therapy, the Berg Balance Scale score, gait velocity, and step length were all significantly improved in the group receiving hippotherapy training [4]. The improvements in gait velocity and step length asymmetry seen in the hippotherapy group compared to the treadmill group were both statistically significant thus suggesting that hippotherapy training may have more powerful effects on improvement of balance ability, gait velocity, and step length asymmetry when compared to treadmill training [4].

In patients with cerebral palsy, there were also observed physical benefits in balance,

posture, as well as a significant reduction in spasticity. Highlighted in a recent study was the reduction in spasticity at 3 muscle groups: elbow flexors, plantar flexors, and hip extensors [3]. It was, however, indicated by the authors that in order to maintain these improvements in spasticity, the patients should continue to undergo hippotherapy in regular intervals. Another study investigated the immediate and long-term effects of hippotherapy on adductor symmetry and functional status for patients with cerebral palsy. Patients were divided into a treatment group (hippotherapy) or control group (stationary barrel-sitting) and observed for 12 weeks. There was a significant decrease in adductor symmetry in the treatment arm of this study. This is hypothesized to be due to the rhythmic, left-right symmetrical movement of the horse versus the control group only undergoing sustained stretch across the spastic adductor muscles [5]. According to this study, hippotherapy may be a more effective therapy in order to reduce adductor asymmetry which in turn can improve overall functional mobility.

Neuroplasticity:

Neuroplasticity is defined by the ability of the nervous system to reorganize its structure, function, and connections in response to stimuli. Stimuli in this context can be intrinsic or extrinsic. The degree of neuroplasticity achieved is time sensitive and can be strongly influenced by features of the patient's environment. Motivation and attention can be critical modulators of plasticity as well. Skills training, such as horseback-riding, can improve behavioral outcomes of neuroplasticity. Increased motivation and participation are hypothesized to be beneficial for maintenance of behavioral gains in the setting of ongoing therapeutic exposure [6].

It is thought that the degree of change in neuroplasticity through hippotherapy is linked to both the relevance of the activity, intensity, and frequency [7]. A hippotherapy session is typically one hour per day but during that short time it is estimated that there are between 3,000 and 4,500 contractions of postural muscles [7]. This is well beyond what a conventional rehabilitation session can offer during the same amount of time. In addition to increased frequency as compared to

traditional rehabilitation, the swinging gait of the horse produces an effect on the pelvic girdle that is twice that of the patient's own gait.

Conclusion:

There is a clear benefit to adding hippotherapy as an option for appropriate patients enrolled in neurorehabilitation programs. The impacts of the activity are not limited to improvement in postural control, spasticity, and gait; there is evidence of significant social and emotional benefits as well. Neuroplasticity is hypothesized to be improved with hippotherapy when compared to traditional therapies and more research is being conducted to support that hypothesis. Improved participation and self-esteem in patients participating in hippotherapy certainly amplify and facilitate the sustained maintenance of positive outcomes achieved via therapeutic horseback-riding programs.

Follow Dr. Potts on social media at @BeccaKPotts.

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UNLEASHING POTENTIAL: THE TRANSFORMATIVE POWER OF ADAPTIVE SPORTS

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CATEGORY: REFLECTIONS

Throughout medical school, mentors, professors, and colleagues have often told me, "The journey is a marathon, not a sprint." Being a distance runner for over half of my life, I have found this analogy to be true. Furthermore, this comparison reminds me of the fortitude and strength I have witnessed in several disabled Veterans and athletes during my time working as a Clinical Dietitian in Spinal Cord Injury (SCI) at multiple locations within the Department of Veterans Affairs (VA) both before starting medical school and while currently volunteering for two non-profit organizations.

As an athlete myself, the thought of losing the ability to move my body or a part of it in a controlled manner is terrifying. I cannot imagine not being able to participate in sports or other forms of exercise. This was my mentality before I was introduced to the world of adaptive sports and met some of the Veterans and athletes with SCIs and neurological diseases who participate in these sports. They showed me that their injuries do not define who they are and that even though an injury or disease has affected their lives, it has not limited them in the way most people would think. Some of these athletes did not even play sports before their injury; it was their injury that led them to the sports they participate in today. They have shared with me that sports have immensely improved their quality of life because they no longer feel like isolated individuals with disabilities, but rather functioning members of a community with a purpose.

Some of my initial experiences of being a spectator and handler to athletes participating in adaptive sports were at a hand-cycling race in Wisconsin in 2018 and at the USA Paratriathlon National Championships in Long Beach, California, in 2019. I had seen several Veterans participate in cycling camps/clinics at the VA while I was working. I assisted many of them with their nutrition to help optimize

their performance. For example, the energy, fluid, and protein needs of those with SCIs differ from those without. Yet, this was the first time I had witnessed these athletes compete in sports in which I regularly participate, but in a much different way.

There are three sports in which your legs are your most significant asset: cycling, running, and swimming. Without the ability to use and train the legs, how does one compete in these sports? As a paraplegic, a triathlete uses adaptive equipment such as a racing wheelchair, hand-cycle, and ankle straps for swimming to aid in training and completing the race. The upper body muscles in these competitors (and the core in athletes with lower injuries) become their ultimate and sole source of physical strength.

Overall, observing the community, support, and camaraderie that athletes can provide one another is by far the most eye-opening part of being involved and volunteering with this group of people. As a part of the interdisciplinary team in SCI, we all promote optimal function and independence with the patient, and we do everything we can to provide a positive and encouraging atmosphere. However, there is something to be said about someone "running" the marathon alongside you, experiencing similar types of challenges throughout the journey. These patients and athletes have shown me how one can turn an unfortunate occurrence into an incredibly enriching and fulfilling life. They are proof of the power of positivity, community, and determination. I have seen individuals' self-confidence rise, mental health improve, and harmful habits fade due to involvement in adaptive sports. In conclusion, working with these athletes has led me to appreciate my life, abilities, and blessings much more than I ever have before. Nothing is more powerful than being in a field that changes lives, yet feeling that the patients have changed my life the most. *Follow Danielle on social media at @Mrs_DBroussard.*

UNLOCKING WELLNESS: THE TRANSFORMATIVE HEALTH BENEFITS OF ADAPTIVE SPORTS

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CATEGORY: ADAPTIVE RECREATION

On Thursday nights, both comradery and joy are felt in Pittsburgh, PA as individuals come together at a local bowling facility to partake in some friendly competition. Through volunteering with Three Rivers Adaptive Sports (TRAS), I have been able to support and coach individuals with disabilities while forming lasting relationships. Typically, there are about 15 athletes with a wide array of disabilities to which we provide adaptive equipment to ensure accessibility and increase participation.

Individuals with disabilities frequently face barriers to accessing sports and recreational activities, leading to limited opportunities for physical activity, social interaction, and personal growth. This lack of inclusivity can result in a decline in physical health, self-esteem, and overall well-being for people with disabilities (1). The health benefits from physical activity are numerous and include lowering cardiovascular disease in individuals' with stroke or spinal cord injuries (SCI), improved blood pressure, and body mass index (BMI) (1).

Beyond the physical benefits, the mental shifts I saw in the athletes after bowling was most meaningful to me. The sense of accomplishment the competitors felt after they got a strike or beat their personal best score illuminates the importance of adaptive sport communities and their impact on athletes' self-esteem.

Engaging in regular physical activity offers many benefits that can significantly enhance mental wellness for individuals with disabilities. The sense of achievement derived from participating in these sports boosts self-esteem and confidence, leading to an overall improved self-image (2-3). Adaptive sport programs provide a sense of belonging to a supportive community combating feelings of isolation that can often accompany physical limitations (1-2). The empowerment gained from

adaptive recreation activities plays an important role in helping individuals regain control over their bodies and lives, promoting a sense of agency. The distraction from daily challenges that adaptive sports provide allows individuals to focus on positive experiences, which can contribute to an improved mental state.

Unfortunately, there are many personal and environmental barriers that prevent individuals from participating in adaptive sports (cost, transportation, accessibility) (1,5). In my experience, the lack of awareness of the different programs is a major obstacle to participation in adaptive sports, but it is one of the most addressable issues (4-5).

PM&R, as a medical specialty, specializes in restoring functionality and improving quality of life for individuals with disabilities or injuries through tailored treatment plans. When creating a holistic treatment program for a patient it is important to consider the role that recreational activity can play in a patient's recovery. By leveraging their expertise, physiatrists are in the perfect position to promote benefits and inclusivity of adaptive sports through advocacy, patient education, and recommendations when appropriate. *Follow Alex on social media at @AlexFazioli.*

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UNRAVELING THE KNOT OF SPASTICITY: RECENT INSIGHTS INTO PATHOPHYSIOLOGY, ASSESSMENT, AND MANAGEMENT

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CATEGORY: PHYSIATRY IN PRACTICE

The definition of spasticity has evolved over the years to better reflect the structural body and functional changes resulting from upper motor neuron injury. Since the description of spasticity established by Lance in 1980, other definitions have been proposed. In 2021, a new definition of spasticity was put forward by Sheng Li et al. The authors describe spasticity as an increase in resistance dependent on both movement speed and muscle length when subjected to external stretching. They explain that this motor impairment is due to the hyperexcitability of the excitatory descending brainstem pathways and the resulting exaggerated responses to the stretch reflex. In this definition, they also include other motor changes in light of current pathophysiology knowledge, including altered motor control (muscle hyperactivity), synergistic activation (patterns of involuntary muscle activation), abnormal coactivation, synkinesis or associated reactions (interlimb coupling), and neuromechanical sequelae (muscle weakness, immobility, soft tissue contractures, and stereotyped postures), all of which coexist with spasticity and share similar pathophysiological traits related to an emergent maladaptive neuroplasticity mechanism in the early recovery phases and persisting into the chronic stage.

Spasticity occurs due to an imbalance between excitatory and inhibitory signals in the central nervous system (CNS) at both supraspinal and spinal levels. At the supraspinal level, spasticity is linked to a loss of inhibitory input from subcortical nuclei. Meanwhile, at the spinal level, it is connected to the disruption of descending pathways responsible for regulating the inhibitory modulation of α and γ motor neurons. The specific location of the injury within these affected pathways further contributes to

differences in the pathophysiology and clinical manifestations of spasticity.

It's important to note, however, that there are additional factors at play. Get ready to dive deeper into the complexities of spasticity pathophysiology.

Upper motor neurons have both excitatory and inhibitory efferent pathways and are responsible for controlling the activity of spinal motor neurons, pre-motor neurons, and spinal reflex activity. At the supraspinal level, there are corticospinal (or pyramidal) pathways, where most fibers originating from the primary motor cortex, pre-motor area, and supplementary motor area are found. Lesions limited to the pre-motor cortex result in flaccid paralysis on the opposite side of the body, accompanied by muscle hypotonia and abolished reflexes. However, as it will be further discussed, if the corticoreticular collaterals are affected, spasticity may manifest. The fibers from the pre-motor and supplementary areas, being vicarious, may prevent this phenomenon. Additionally, lesions restricted to area 6 of the cortex cause spasticity without notable paralysis. On the other hand, pure lesions of the corticospinal pathway result in mild motor deficits but do not cause muscle stiffness or hyperactivity.

Collateral fibers of the corticospinal tract extend to various nuclei in the brainstem, forming the extrapyramidal system. Part of these fibers are directed toward the reticular formation of the medulla. This structure corresponds to an inhibitory center that regulates muscle tone, including the stretch reflex and the withdrawal reflex. The lateral reticulospinal tract is the main pathway that inhibits the activity of spinal reflexes and originates in the bulbar reticular formation and descends in the lateral

funiculus, close to the lateral corticospinal tract, while the medial reticulospinal tract involves an excitatory pathway originating from the pontine reticular formation. The bulbar reticular formation is under continuous facilitatory control of the motor cortex, which enhances inhibitory signaling of muscle tone to the spinal cord in parallel with voluntary motor commands.

As briefly mentioned above, somatotopy at the spinal level associated with the location of fiber injury will be reflected in the spastic patterns most frequently observed. Neurons in the pontine portion send axons through the anterior/medial reticulospinal fascicle which has an activating effect on motor neurons of the extensor axial musculature, while neurons in the bulbar portion inhibit extensor motor neurons of the lateral fascicle, contributing to an antigravitational postural contraction. Thus, lesions that affect the corticobulbar fibers (motor cortex or internal capsule) or the lateral funiculus of the spinal cord may interrupt inhibitory influences, leading to complete disinhibition of distal spinal activity with signal hyperexcitability. These changes will result in hyperreflexia and spasticity.

In spinal cord injuries, spinal reflex circuits lose all higher control, both inhibitory and excitatory, and become hyperactive to stimulation. Indeed, the neuronal transmission shifts within the spinal level are influenced by changes in the supra-spinal drive and cellular adaptations below the injury level. The hyperexcitability of α motor neurons following a CNS injury occurs due to the persistent activation of Na^+ and Ca^{2+} channels, generating *plateau* potentials independent of the descending monoaminergic modulation pathways. There is also spinal reflex hyperactivity due to the loss of inhibitory control mechanisms in the dorsal horn. This pathophysiological change means that a slight stimulus (e.g., skin touch or painful stimuli) perceived by the III and IV afferents can trigger muscle spasms or the withdrawal reflex due to the hyperexcitability of propriospinal interneurons. Some common clinical signs of these phenomena include the Babinski response (upward movement of the hallux), triple flexion of the leg (simultaneous flexion of the hip, knee, and ankle), and exaggerated spasms of the flexor or extensor muscles. Remember that these

responses are triggered by simple, non-painful stimuli on the skin.

Regarding inhibitory spinal mechanisms changes, it is important to understand the stretch arch reflex. In fact, muscle stretching causes the excitability of primary (Ia) and secondary (II) receptors of the muscle spindles, which conduct impulses to the spinal cord, where, from monosynaptic and oligosynaptic reflexes, they produce the excitation of homonymous motor neurons. Thus, spasticity may result from the hyperexcitability of the stretch reflex that occurs due to changes in inhibitory mechanisms. There is afferent II facilitation due to loss of descending inhibitory control from the locus coeruleus, presynaptic afferent Ia disinhibition with reduced release of inhibitory neurotransmitters and resultant input potentiation, and reciprocal Ia disynaptic disinhibition with consequent alteration of agonist/antagonist muscles co-contraction and spasms. These changes ultimately cause increased muscle tone and hyperreflexia. Renshaw's recurrent inhibition does not appear to play a role in the pathophysiology of spasticity. Autogenic Ib inhibition occurs at the level of Golgi tendon organs and may be preserved when the clasp-knife reflex is present.

Finally, let's address the intrinsic changes associated with muscle paresis and immobility. Muscle paresis and consequent immobility increase the risk of soft tissue contractures. Furthermore, muscle shortening promotes reduced muscle mass, loss of sarcomeres, accumulation of connective and adipose tissue in the muscle, increased muscle rigidity, and reduced mechanical properties of the extracellular material. A new type of slow and fatigable motor unit may emerge, along with a redistribution of muscle fibers with a predominance of type II muscle fibers. These changes may be observed on ultrasound as abnormal muscle echostructure with a size and volume reduction and increased heterogeneity along with hyperechogenicity.

Spasticity is a common sequel of CNS pathology with wide clinical and analytical variability. Therefore, it is important to know the incidence and prevalence of spasticity by diagnosis to correctly assess the socio-economic and healthcare dimensions, anticipate the individual needs of patients and caregivers, and ultimately plan for appropriate resource allocation.

Individuals who have survived strokes and have spastic hemiparesis often present a typical posture that includes shoulder adduction and internal rotation, forearm pronation, and elbow, wrist, and finger flexion. In contrast, those with amyotrophic lateral sclerosis may show more subtle signs of spasticity, such as spasticity in the trunk or bulbar regions leading to trismus, while those with spinal cord injuries or multiple sclerosis may experience spasticity linked to specific activities, like transferring from one place to another, or occurring at specific times of the day, such as at night, which can condition objective assessment during the physiatric consultation. Any patient with spasticity as their primary symptom and no known underlying cause should undergo a complete neurological assessment to determine the primary neurological disorder, as well as the structural and functional changes it entails. In fact, spasticity leads to range of motion limitations and to mobility, posture, and gait impairments, which may increase the risk of falls and greater energy expenditure. There may also be restrictions in terms of hygiene, bathing, eating, and communication, ultimately affecting overall functional capacity and independent participation in activities of daily living (ADL) and instrumental activities of daily living (IADL). Indirectly, spasticity can cause sleep disturbances (e.g., painful nocturnal spasms), pressure ulcers in decubitus positions, and soft tissue retractions.

During the clinical and functional assessment of the patient by the physiatrist, it is important to distinguish spasticity from other hypertonic states, such as dystonia and rigidity. Indeed, rigidity refers to resistance to movement regardless of speed and direction, whereas dystonia involves intermittent or sustained involuntary muscle contractions that cause repetitive movements and/or altered postures, particularly aggravated with voluntary activity. The Hypertonia Assessment Tool (HAT) was developed to help differentiate between the various types of hypertonia: dystonia, spasticity, and rigidity. Specific scales for the pediatric age group were developed, as assessing movement disorders can be more challenging due to difficulties in following instructions.

Spasticity, as a component of the Upper Motor Neuron Syndrome, is accompanied by other positive signs such as hyperreflexia and associated reactions, as well as negative signs such as paresis and decreased motor coordination. These pathophysiological changes should be considered in the clinical and functional assessment of the physiatrist through medical history and physical examination. Ultimately, attention should be paid to muscle tone and strength, the presence of soft tissue contractures, muscle spasms, pain, fatigue, nocturia or urgency (for indirect assessment of bladder tone), changes in sleep quality, recent intercurrent events (e.g., hospitalizations, infections, etc.), functional status, and information provided by caregivers. A thorough evaluation helps identify the spasticity pattern and determines how it affects function. It is also essential to consider associated reactions and motor synergistic patterns, which are automatic responses and stereotyped movements in the affected limbs, usually triggered by challenging tasks or anxiety, and/or involve the loss of independent joint control, respectively. These phenomena amplify the spasticity impact on functional tasks. Hence, after introducing the best therapeutic option at an early stage, it is vital to measure and quantify spasticity for tailored patient assessment and ongoing monitoring.

There are various scales for evaluating spasticity, both directly, such as the Modified Ashworth and Tardieu Scales, and indirectly, including the Spinal Cord Assessment Tool for Spastic Reflexes (SCATS), Penn Spasm Frequency Scale, and Visual Analogue Scale for Pain. However, physiatrists should exercise caution when using these scales to categorize muscle spasticity severity, as their perception might not align with the patient's experience in terms of daily activities, sleep disturbances, or mood impacts. These functional variables can be more accurately captured using patient-reported outcome measures like the Goal Attainment Scale or the SCI-Spasticity Evaluation Tool, among others.

Finally, the assessment of gait is an essential aspect that should not be neglected, as it can serve as an indicator of the suitability of therapeutic interventions and orthotic prescriptions. Spasticity in the lower limb muscle groups often leads to altered walking patterns, which can result in premature

fatigue and increased risk of falls. The degree of flatfooted support at midstance phase is correlated with the severity of lower limb spasticity, muscle weakness, and/or myotendinous contracture, and can be used to track its progression and the effectiveness of antispastic treatments. As an example, when dealing with spasticity in the triceps surae muscles complex and posterior tibialis, the patient tends to adopt an equinovarus foot posture, causing initial ground contact with the forefoot instead of a heel strike. In this initial support phase, compensatory strategies such as early heel raise, knee recurvatum, or forward trunk lean may be observed. During the swing phase, steppage or circumduction of the affected lower limb may be needed to ensure proper foot clearance.

Guided by the International Classification of Functioning, Disability and Health (ICF) developed by the World Health Organization (WHO), the physiatrist is now capable of characterizing neurological diseases manifesting spasticity in terms of changes in body structure and function, as well as limitations in participation in activities of daily living (ADL), considering personal and environmental factors. With these methods, it is possible to understand whether the functionality of muscle spasticity is present. Indeed, spastic muscles do not always have negative effects. Spasticity allows support in walking, transfers and transitions between decubitus positions, trunk balance, urinary and fecal continence, prevention of muscle atrophy and bone demineralization, prevention of peripheral edema and deep vein thrombosis. However, when spasticity impedes everyday activities, complicates caregiving, causes postural instability, makes orthotics intolerable, leads to pain, disrupts sleep, or results in pressure ulcers, targeted therapeutic approaches should be considered, depending on the specific areas affected by spasticity and the reversibility of the proposed treatment.

First-line interventions, however, are non-pharmacological and may be used along others as maintenance treatment. These approaches involve patient and caregiver education regarding positioning and transfers and maintaining passive/active-assisted joint range training in a gentle, slow, and progressive manner within the permitted range of motion and

anti-spastic muscle stretching. The muscle stretching should be done for at least 1 minute with rotation of proximal joints in short lever arms to avoid excessive tension. During periods of rest or inactivity, orthotics or serial casting may be employed to preserve joint range of motion, prevent muscle shortening, and reduce the sensory input that triggers spasticity. Neuromotor methods such as Bobath, Kabat, and Brunnstrom, as well as sensorimotor techniques like Perfetti and Rood, can be beneficial when applied through physical therapy. However, none of these techniques are more effective than others, and critics point out that these methods are fundamentally based on theoretical rather than scientific concepts, with little real benefit. Massage, on the other hand, stimulates cutaneous mechanoreceptors, and the use of circular pressures seeks to reduce muscle tone through nerve inhibition.

Regarding the use of physical agents, heat therapy has no evidence of benefit in spasticity and should be used with caution due to altered superficial sensitivity in these patients. Despite descriptions of activity suppression in muscle spindles and Golgi tendon organs, electrodiagnostic studies have shown that cryotherapy results in temporary muscle hyperexcitability. Therefore, it makes sense to apply it to antagonist muscle groups. Extracorporeal shockwave therapy uses acoustic pulse waves to apply transient pressure changes with high pressure peaks in short cycles and rapid propagation. The therapeutic efficacy of extracorporeal shockwave therapy appears to be comparable to botulinum toxin intervention, with a similar duration of effect of 12 weeks. The optimal definition of parameters is, however, yet to be established.

Transcutaneous Electrical Nerve Stimulation (TENS) and Functional Electrical Stimulation (FES) can be used to reduce pain and spasticity, improve muscle tone and joint range of motion, as to enhance the functional benefits of therapies. Furthermore, multiple randomized clinical trials have demonstrated the benefit of acupuncture in spasticity, likely due to GABA modulation with presynaptic inhibition.

Regarding pharmacological intervention, various oral formulations are available. The most commonly used drugs include Baclofen, the treatment of choice for

generalized spasticity. Baclofen is primarily effective in treating spasticity of spinal origin, and it also has analgesic effects, which are attributed to the suppression of substance P release. Therefore, it is useful for cases of painful spasticity, painful spasms, or pain of central origin. It may also improve speech, reduce symptoms of dysphagia associated with spasticity, and improve symptoms of esophageal reflux. As a side effect, it may cause more generalized muscle weakness than Tizanidine.

Tizanidine, on the other hand, despite significant sedative effects and dry mouth, can be useful in treating spasticity where drooling is also present. This drug also provides analgesia in states of central pain but should be avoided in TBI patients due to negative effects on attention and memory. Furthermore, one study found that Tizanidine, which is an α_2 agonist, can lessen the noradrenergic descending drive and significantly reduce the expression of flexion synergy, commonly observed in the upper limb. This effect seems to be linked with monoaminergic-driven recruitment of contralateral corticoreticulospinal motor pathways after damage to the ipsilesional corticospinal tract. Nevertheless, due to the drawbacks of oral medications, including their side effects, there has been a growing interest in intrathecal baclofen administration and minimally invasive treatments like chemodenervation.

Intrathecal administration of baclofen is an alternative that allows for dosages four times higher at the sites of GABA-B receptors with a lower risk of central adverse effects. Due to the drug's flow dynamics favoring caudal distribution, its efficacy in controlling spasticity is higher in the lower limbs. However, it is not without the risk of complications, which can include infection, pump dysfunction, and CSF leakage, with these being more frequent in the pediatric population. Patients should be then educated about warning signs of withdrawal syndrome.

Botulinum toxin is the primary minimally invasive intervention for focal spasticity. This substance blocks the release of acetylcholine from the presynaptic plate at the neuromuscular junction, promoting selective partial or total muscle weakness. There are three type A formulations and one type B formulation approved for spasticity. A new type A formulation was

recently approved for treating cervical dystonia. Each of these formulations has specific recommendations and dosage units. These variables, as well as the dose, dilution, muscle selection, administration method, and the number of sites, will affect the clinical and functional outcomes of the intervention. Ultimately, targeted botulinum toxin injections are recommended in upper limb muscles to alleviate spasticity, increase both passive and active range of motion, and facilitate dressing, hygiene, and limb positioning, while in lower limb muscles, these injections are advised to reduce spasticity that negatively affects gait function (Evidence Level IA). The efficacy of a botulinum toxin intervention should last for about 12 weeks, at which point a new administration may be considered. During this period, non-pharmacological approaches mentioned above should be maintained to enhance the intervention effectiveness.

Various other minimally invasive intervention techniques are available for focal spasticity, such as neurolysis with 2-5% phenol, 35% alcohol, or cryoneurolysis. These strategies induce degeneration of both axons and myelin sheaths via a process referred to as Wallerian degeneration. Conversely, radiofrequency thermal ablation facilitates extended neuronal regeneration (ranging from 3 to 36 months) as a result of intra-axonal protein thermocoagulation. Applying this electromagnetic wave to nerve tissue induces thermal damage when temperatures exceed 149°F/65°C for a minimum of 60 seconds. These interventions offer immediate relief from spasticity and can enhance the benefits of non-pharmacological approaches.

Finally, surgical interventions for spasticity target either the nervous or musculoskeletal systems and can involve selective dorsal rhizotomies and neurectomies, or orthopedic procedures such as muscle lengthening, tendon transfers, osteotomies, and arthrodesis to optimize the alignment and performance of limbs affected by spasticity, respectively.

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