

EMG Biofeedback: Kaysha Bates, DPT (sports specialization)

Intro

My name is Dr. Kaysha Bates. I'm a sports specialty physical therapist, and I do a lot of return to sport rehab and a lot of athletic surgical injuries and rehabilitation for performance and getting back onto the field.

Why is it important to know which muscles are activated?

When we're going through the rehab process and I have someone doing an exercise, I've selected that exercise because I know that research says that's what exercise activates a specific muscle the best. Now, just because they're doing that exercise, our bodies are designed to really compensate and move in whatever way we ask it to, that's not necessarily the ideal way. So it's really important to be able to figure out what muscle is activating during an exercise because I want to make sure that if that's what I'm targeting, I want to make sure that that's what I'm getting. Otherwise, what my exercise program is or what I've designed for an athlete isn't necessarily going to be effective if they're not able to do it in the manner in the correct way that I'm looking for.

How do you evaluate muscle activity?

That's a good question because it's hard- sometimes it's really hard depending on what muscle we're looking for. If it's something a little more superficial, you can palpate it. Which means like put your hands on it, touch it. Can you feel it activating? Can you see it activating? Things like that. That's one way to do it. When we're looking at muscles that are deeper, potentially in the hip, deep in the foot, hidden behind some other bones, muscles, whatever it might be, it's really hard to know if that muscle is activating. There's not like a sure way to do it besides just palpating, watching, assessing strength-- certain movements really target certain muscles, so we can assess strength testing that way, whether it's with a dynamometer or just manual muscle testing. But that's kinda all we really can do in order to feel it necessarily, is just watch how they move and then palpate that muscle.

Why do you use sEMG?

When I would use it is when I'm looking to see if a muscle is activating-- whether it's for my own benefit as a therapist because I need to know are they doing this correctly? Do I need to keep working on it? Are they strong enough? Are we doing it in the proper timing, right? So one muscle before the other and things like that. Why I would use it is a similar answer, but to really enhance the strength of contraction, the patterning of muscles that are happening during an exercise, as well as the timing of it. So one then the other or both together, things like that.

Why do you use wearable EMG biofeedback devices?

Honestly, the easiest answer is that they're more usable. They're more portable. You can move around. If I have an athlete that I'm trying to get back onto the field, their exercise program is not going to be stationary on the table. They're going to need to be up, they're going to need to be moving, running, cutting, jumping, landing. And if I'm going to try to use surface EMG, I need something that is very portable and very easy for them to maneuver around with. So that's one of the huge benefits and most appropriate applications for having that sort of portable EMG device is just being able to be active and be moving and assess the movements that we need to assess in the most- the most like way to what they would do on the field.

Describe the first time you used the mTrigger.

I actually was exposed to it when I was a student. And as a student, you don't have maybe the experience or the dialogue and the verbiage that's most appropriate for helping patients to understand how to move their body in the way that you're looking for. So not only was I struggling as a student, but I was very new, had very little experience and that's when I saw the device and started observing and working with it. And it was-- it didn't matter what I had to say. The device kinda spoke for me in the sense that if someone was trying to learn proper scapular activation and movement patterns, I didn't really have to say much. I just had to set it up and basically, more or less, say, okay, this green meter, this meter here needs to go to green. When it's green, you did it right. And just watch. I remember feeling like man, I don't need to say very much if I can have a way to teach them and they can visually see what you're looking for. And that was very impactful because it happened very quickly that they were able to pick it up.

Which features of the mTrigger do you like?

The old school kind of initial research biofeedback devices were- they were large, they're hard to set up, they are complicated. They didn't move very well which is-- It still gave good information, but it was very limiting. So one of the best things about the mTrigger device is that A- it's portable, it's easy to use and setup, and I can take it with me wherever I go. So I treat in a lot of different locations. I treat in a clinic, I treat like in an athletic training room. I treat in a sports complex. So I'm all over the place, and it's really awesome to just be able to pull this device out and use it with a variety of athletes in a variety of settings. And they- honestly know technology better than I do in a lot of ways. So they can set it up, they can put it on their own device. They know how to get it ready so that I can place pads where I need to. And they can have that immediate feedback in a very quick, easy set-up way. To know like, hey, I have to do these ten exercises today before I can go to practice. Am I doing them to the best of my ability in a way that's going to help me to perform better, get over this injury and really rehab correctly? So it's great in terms of versatility and buy-in. They love using it. And things like that. Really getting engagement, essentially, with patients and clients.

When is EMG not useful?

So this is one of the limitations, right? When we're talking surface EMG, it's going to be most accurate on surface muscles. So if you think like your thigh muscle, your quad is pretty superficial compared to several other muscles. So if I'm looking at quad activation in say a squat, that's an excellent application of being able to use surface EMG. Now the limitation could come if I'm looking at say like a deep core muscle or something really deep underneath the spine that I really can't get to from a surface EMG level. Now, I'm going through way more layers of bigger muscles and soft tissue and it's just- it's very hard to pick up a very small muscle on surface EMG. So that's kinda where it gets limited is- one where it's a very it's a deep muscle or two, or where you have multiple muscles layered on top of each other, you're gonna get a lot of noise in that sense. So if I were to put it on the shoulder, I'm not going to be able to isolate exceptionally well like just this one muscle. It's going to-- things are overlaid and that's just how our bodies are designed. So you are gonna get a little bit of like, Hey, I'm also getting this muscle and I'm also getting this muscle in addition to maybe what I'm targeting-- and sometimes that's okay, you just have to be aware of that. But it does limit a little bit what we're looking for sometimes.

How do you target the smaller or deeper muscles?

So a big part of it is, I need to know what the muscle is gonna do. So, for example, in the shoulder, if I'm looking at doing some rotator cuff exercises, and I really want to target external rotators, and I'm looking to put EMG pads on infraspinatus. Now, infraspinatus is- I know where it is, and I need to know that my pads are on the right location. So having them go through an exercise that I know will activate that muscle or it should activate that muscle is the first thing to do. So then you know, you can palpate the muscle you should feel it activating. That tells me that I'm where I need to be, I can place my electrodes accordingly.

And will I have- do lats run over the top of that? Is there a little bit of other stuff in there? Sure. But if I've palpated it and I know where my location is and I find my anatomical landmarks, that helps me know that I'm in the right position for that exercise.

What are your frustrations in working with these devices?

So some of the frustrations come with- I work with a lot of athletes and they're very sweaty- is getting these things to stick. That becomes a big problem, is the pads are great maybe the first time and then that's all you get out of it depending on how large, how sweaty, how humid it is outside, things like that. So sometimes that just creates this-- It's really a frustration for either myself or the athlete because they get it set up. We get it set up and they get through two reps and the pad falls off. Or they're getting really weird noise. The biggest thing I hear is, they say, "I'm not moving, but it's registering feedback" or it's registering something that's happening, and it makes them frustrated, makes them confused. They don't understand because it's supposed to help them move better. But when it's giving them mixed information, they don't understand how to move better. So that's one of the biggest things is the-- I don't know if you'd call it connectivity or just the adhesion or whatever it is with that surface EMG electrode is that does cause some frustration for sure. That's the big one. Another one is just figuring out how to isolate, in a sense. Like if I really want a small muscle-- in the forearm, for instance, I'm trying to do some wrist stuff with a throwing athlete or a baseball player or gymnast who's on their wrist a lot—I need to do isolated wrist stuff. The electrodes can become too big and that looks-- depending on how you space them. You can't fold them, obviously. Cutting them gets-- some people say you can, some people—it just depends. That can sometimes cause some issues when we really want to target some of these smaller muscles in the forearm or even in the ankle. I work with a lot of small athletes, and I need, I have to have small electrodes. Otherwise it gets really noisy essentially, because I'm picking up too many muscles because it's just too large.

How do you achieve correct electrode placement and sizing for smaller areas?

This is where it's like you problem solve, and you get as good as you possibly can. Now, is it ideal? No. But as a clinician, my goal is to help my patients feel better and be able to move and perform at the level that they want to. So we sometimes have to compromise a little bit, I guess you could say. But two things I've done is- almost tried to create a ground electrode. So like for the shoulder, for instance, is put one electrode on the back of the hand because you really shouldn't get- there's not a ton of muscle bulk in the back of the hand, so you shouldn't get a lot of feedback from that one. And then if they're really tiny, you just put the one other electrode on the back of the shoulder. So I've been able to do that. The other thing I've tried to do, and it's hard—is just tape it to itself so that it cancels in a sense which isn't super accurate and that's where you should, you guys can talk more about that, so I've tried that, that's hard. The other thing that probably works the best, that again, it's not ideal but it's just cutting them down. So trimming the corners and taking what was a one inch by one inch square and turning it into a small circle on both electrodes so that I can get two of them onto the muscle belly that I'm targeting.

What improvements do you suggest?

I think the pads is the big one, and I know that's been kind of a- for a long time. But the accuracy in which getting data from the electrode in the muscle it's reading. So being able to get a consistent read on that is very important. Just because of continuity, especially for the patient when they're doing the same exercise every week, and all of a sudden three weeks in and they're like, "Well, I don't understand why I can't do it anymore." And it's because there's something going on from a connectivity issue. That gets really frustrating for them and they feel like they've lost progress. So that's probably one of the biggest things. The second would be-- being able to kind of track data a little bit more. I know that mTrigger is working on upgrades here, but as a clinician, I love the data side of it. So maybe the patient doesn't really care what their millivolts of activation was from one week to the next, and how that changed throughout the

course of a three-minute exercise from beginning to end. What was their fatigue life? How is their power output? Stuff like that. They may not care, but as a clinician, that's stuff that's really helpful for me to see and to know and to be able to go back and refer to. Especially when we're looking at like return to sports stuff. What's their force absorbing capacity? What's their force and power output capacity? Things like that, that really make a difference when you're talking about dynamic, powerful sports that we would want to be able to track and have knowledge of in terms of being able to train them and prepare them appropriately.

Can you give an example of the differences between the data needed by patients versus clinicians?

A good example is I had a girl, she was a lacrosse player, had a knee injury, and we were working on that return to sport phase. So she was doing a drop jump-- like a drop off a box and try and land it. Her goal was to watch the biofeedback device and really try to get the activation meter all the way into the green zone on her surgical side. Her tendency was to kind of shift off of her surgery side and be lopsided, which she obviously- we don't want. So her goal was to use that biofeedback to work on activation of the quad in weight shifting, which was great and she did a good job and was very helpful. But what I did was I went in and I looked, what's my peak? What was my peak? Because if I'm landing, and it looks even, but she's got twice as much activation on her nonsurgical side as her surgical side, that's something that I want to know and observe and use as a clinician to then go back and program. Okay. We need to do more single leg strength. We need to do more single leg power. We should do more single leg landing formwork and really help with deceleration for your quad so that when you go back to sport, it's safe. So that's an example where it was the same exact thing. I'm just using the data a little bit differently than potentially the patient is in order to kinda look forward to the next step.

How has the adoption of this device influenced your practice?

It's changed it in a lot of ways. It changes buy-in. So I get people who are willing to do exercises more because they feel confident that they're doing them correctly. A big issue, especially when there was some fear avoidance behind exercises, people would come in and say, "I just don't know if I'm doing them right, so I'm not doing them because I don't want to do it wrong." And having this biofeedback device allowed them to really feel in control and like they had some knowledge of, okay, this is what I do when I go home. I see how it feels. I feel how it feels. I know I can do this safely, appropriately, and it's going to help me get better. So it greatly helped with exercise buy-in, in terms of what people were willing to do on their own. And because of that, on the flip side, is now they're doing the exercises correctly. And so when I send them home, I feel way more confident that they're going to come back in a couple of days or in a week or whatever and still be able to do it correctly-- or at least a lot more correct than they perhaps would have done without that biofeedback. So those are two really big pictures of like people are more willing to do things at home on their own and they're doing them correctly, which is helping to improve. They start feeling better. They start moving better. They start doing things a little bit faster in the process because they do have that feedback and that information for themselves.

What role does patient compliance or buy-in have?

I mean, it's like anything, right. When we have routine, it tends to go over better. And I think that's where- - one of the biggest barriers with this device, with any other devices that I've used in practice of physical therapy, is if the barrier to entry is too large, if it's too complicated and it's too hard for a patient. And that's even in terms of like the exercise I provide them-- if it's too challenging, and I give them too many things to focus on, they're not going to do it because it's too much, and it's too overwhelming. So I think that being able to simplify things without-- like, I love the nerdy science stuff and I'm like, I want more, and I'm going to share more with you because I think you should like it just as much as I do, but that's not the case. And if I overshare or over-correct or give them too much to do or it's too complicated of a device or a program, they're just not going to do it. And that doesn't help them. And that doesn't help me.

Something that-- the simpler it is, the easier buy-in and compliance and outcomes has been for me in terms of the devices I use, the exercise program I give, or anything like that.

Based on your clinical experience, what should biomedical engineers know?

On this side of things-- So I have zero engineering background; I didn't take any engineering classes. But now being on this side as a provider and working with athletes, that's-- it's one of the things that I wish I had learned more about and done more classes and more education in, because the more I understand about the mass stuff, the force plates, all of this stuff that I wish I understood more of, instead of just being able to take this simplified data and look at it from a biomechanical perspective. I wish I understood more of what you guys are learning and what you guys are doing because I think it makes it a huge, huge difference in how we approach clients, how we treat clients, and the resources and tools we give them to really advocate and take care of themselves.