

What Every Guitarist Should Know: A Guide to the Prevention and Rehabilitation of Focal Hand Dystonia

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Disclaimer: This article is not intended to diagnose or to definitively prevent or cure any form of injury, including focal dystonia. The author drew from recent medical publications and personal discourse with medical professionals, but he is not a medical doctor. Any person with any type of injury, including but not limited to focal dystonia, should consult a health care professional.

Approximately six months after having successfully performed my Master's recital, and having begun a Doctoral degree in Classical Guitar Performance, I was performing Ponce's Sonata III one afternoon in a lesson with my instructor, John Sutherland. John noticed the thumb of my right hand pulling in toward the palm. After he brought this to my attention, I realized that I was having great difficulty preventing my thumb from flexing into my "i finger space." I began a practice regimen aimed at correcting what I assumed was merely a technical problem. However, the more I focused on controlling my thumb, the more difficult it became to manage. For more than a year, I did virtually nothing but right-hand-alone exercises: single finger strokes, double and triple finger combinations, block chords, arpeggios, etc. My situation only got worse. I also developed problems writing and typing. It seemed that the harder I worked, the more difficulty I had controlling my hand. The frustration and agony that ensued is completely indescribable. I had already devoted so much of my life to the guitar—what if this was the end? I knew that I would be unable to complete my performance degree. Worst of all, my ability to communicate musically through the guitar—something that I valued more than just about anything—was compromised and in danger of vanishing completely. My greatest fear was that I would no longer be able to play my part in the Georgia Guitar Quartet, with whom I have performed since the ensemble's inception in 1996. Apart from being my partners in music, the other three quartet members are my greatest friends, and the thought of having to let them down haunted me to no end. Over the course of two years, I saw doctor after doctor in an attempt to figure out what was wrong with my hand (I still presumed that the problem was *in my hand*). I saw doctors of sports medicine, an orthopedic surgeon, traveled to New York City to visit an

acupuncture specialist, and went through months of physical therapy. Nothing seemed to help, and nobody could tell me what was actually wrong with my hand.

I ultimately realized that I would have to diagnose myself. The Internet can be a wonderful thing when one is trying to give a name to a physical malady. After extensive googling, I finally deduced that I had *focal dystonia*. I learned that many musicians—guitarists and pianists in particular—are affected by this disorder. I read the personal anecdotes of such prominent musicians as pianist Leon Fleischer and guitarists David Leisner, Kevin Gallagher, and Dominic Frasca, all of whom are afflicted by focal dystonia and have found different ways to deal with it. (I owe each one of them a great debt of gratitude for the examples of inspiration they have set.) I was alarmed to discover that this condition is neurological—stemming from the brain! The problem was, literally, “all in my head.” I went to see a neurologist who officially confirmed my amateur diagnosis. I was not thrilled by the recommended option for treatment: injections of Botox® into the muscle that is flexing uncontrollably.

Dystonia: The What and the Why

Focal dystonia of the hand is a complex movement disorder that medical science has only recently begun to understand with some degree of certitude. It is characterized by the unwanted and involuntary contraction of certain muscles or muscle groups, and it affects individuals who perform repetitive, highly attended activities with their hands. It is most commonly a painless disorder, but one that obstructs regular movement, thus hindering one’s ability to accomplish important tasks (such as playing a musical instrument). The problem is generally *task specific*, meaning that it only occurs when one is performing certain fine motor skills. Therefore, it may only be evident when the affected musician is playing his musical instrument and might not be apparent at all when he is shaking someone’s hand or eating with chopsticks. Usually, the wrong muscle(s) flex simultaneously with other muscles that are willfully activated. At first glance, this problem appears to be located strictly in the muscles of the hand, since this is indeed where the symptoms of the disorder emerge; however, brain-imaging techniques (such as MEG) have confirmed that the condition arises in the sensorimotor portion of the *cerebral cortex* (the thin layer of neural tissue that covers the brain). Basically, on the

very top of your brain lies a “map” of your entire body (this is called the *homunculus*). This map is responsible for the reception of tactile sensory information (the sense of touch) as well as the implementation of fine motor movements, such as those necessary for playing a musical instrument. Each body part is supposed to have a discreet and well-defined place on this map. In the brain of someone with focal hand dystonia, the homuncular organization of the individual fingers becomes blurred, or smeared. The brain therefore has difficulty distinguishing between the separate fingers. In my case, when I would play with my i finger, I would unintentionally activate my thumb—as if the two fingers were attached and trying to function together as one mega-finger. In a sense, my fingers *were* attached—only not by the musculature or skeletal structure of the hand. They were attached by the erroneous neural connections in my brain. It is these faulty connections that are ultimately responsible for the muscular malfunctioning of the hand: the brain tells the wrong muscles to contract.

So, the big question is: what causes this to happen? Or, more personally: “why me?” It is likely that some people are naturally predisposed to acquire focal dystonia. This does not, however, mean that the condition is unavoidable. (As I shall discuss below, I firmly believe that dystonia can be prevented via the adoption of proper playing techniques and practice habits). The human brain is highly dynamic and extremely adaptive. It is constantly rewiring itself in response to sensory input—creating new neural connections that will usually benefit the person to whom the brain belongs. The ability of the brain to reconfigure itself is called *neural plasticity*, which is—ordinarily—a very good thing. Without it, we would not learn new things, create memories, or evolve as a species. Some of us, however, have too much (or, overactive) neural plasticity. Unfortunately, this does not necessarily mean that we learn faster, remember better, or enrich the gene pool. It *does* mean that our brains might be prone to maladaptive changes. By playing the guitar with too much tension, repeating difficult technical exercises to excess, and playing very fast configurations over and over again, the brain might begin to change in ways that it “thinks” will be helpful. Often called a “learning catastrophe,” focal dystonia results, in part, from the poor homeostatic regulation of neural plasticity. In other words, too much of a good thing is *not* always a good thing.

So, the medical evidence suggests that some of us might be more inclined than others to develop dystonia. But this does not mean that those less-inclined individuals are totally immune to this career-threatening condition. It could affect anyone. Below I talk more about the personal details of my affliction and offer some important points that every guitarist should consider in their approach to playing the instrument. These practical considerations are offered to those with and without focal hand dystonia. Those with the condition will find them helpful on the long and arduous path to recovery, while those without the condition might find them useful in preventing the onset of the disorder. Prevention is always easier than recovery.

Methods of Treatment

After discovering that I had focal dystonia, I began looking into the option of Botox injections. Botox is a commercially prepared and diluted form of *botulinum toxin*, which causes botulism—a potentially lethal form of food poisoning. Many people get Botox injections for cosmetic purposes to reduce wrinkles and frown lines, but the drug also has important medical applications. It essentially paralyzes any muscle it is injected into by degrading the protein responsible for releasing acetylcholine at the *neuromuscular junction* (the point where the nerve-endings relaying messages from the brain meet the muscle). *Acetylcholine* is the neurotransmitter that causes muscle contraction. (A *neurotransmitter* is essentially a chemical “messenger” that travels between nerve cells.) If acetylcholine is not released between the nerve cells and muscle fibers, the muscle will not contract. This is how Botox can prevent muscles from contracting involuntarily. However, until it is properly “rewired,” the brain will continue to send messages through the nerves telling the wrong muscles to contract. These messages simply get blocked in the hand by the presence of Botox. For this reason, Botox injections are a treatment for the symptoms of focal dystonia and not a cure for the cause of the condition.

At first, I was hesitant to inject Botox into my hand. I was not worried about the pain of the injections, but I questioned the validity of the treatment. I thought it would be futile to merely target the symptom of the problem rather than attack its source. One of my neurologists informed me that there is a “feedback loop” between the hand and the

brain. We feel with the hand, and this “input” information is relayed from the hand to the *somatosensory cortex* of the brain via *afferent* nerves. The *motor cortex* (which lies in close proximity and is connected to the somatosensory cortex through a neuronal interface) directs the movement of the hand—this “output” information is transmitted through the *efferent* nerves. If Botox prevents the muscle from flexing, the brain will not feel that it is flexing and will not continue to reinforce this unwanted movement. This explanation convinced me, and I began to receive the injections (which, by the way, are indeed quite painful and extremely expensive if not covered by your insurance plan). I must confess that the Botox has helped, and my right hand is remarkably wrinkle-free and youthful in appearance! ☺ However, it is important to remember that Botox is merely a treatment and is not a cure, either for dystonia *or* for aging. The secret to effectively curing focal dystonia, I have come to believe, lies in *learning-based sensorimotor retraining*.

Sensorimotor retraining, developed primarily by Dr. Nancy Byl in the Department of Physical Therapy and Rehabilitation Science at UCSF, is a means of “retuning” the brain that essentially entails going through each and every day touching and feeling a variety of objects in a variety of ways. Sounds simple, doesn’t it? Well, fortunately, it is. The trick—and this is very important—is to touch and feel with the individual fingers of the dystonic hand *one at a time*, for an extended period of time. If I touch an object with only the thumb of my right hand, the brain will only receive sensory input from that one digit. This can help to “remind” the brain that the thumb is, indeed, anatomically and functionally separate from the first finger as well as the other digits of the hand. This activity can instigate plastic changes in the sensorimotor portion of the brain—causing it to redifferentiate the individual fingers of the dystonic hand. Luckily, you can use overactive neural plasticity to your advantage—it was plasticity that got you into this mess (in part), and properly guided plasticity can help to get you out of it.

In order to change the brain, it must be learning. Therefore, it is critical that you pay attention to and actively focus upon what you are touching. If you do not attend to the stimulus, the brain will ignore or habituate to the stimulus. In other words, it does little good to touch something while you are deeply enthralled watching a television program or listening to a CD. Create sensorimotor retraining tasks that require highly

focused attention. It is also very helpful to begin with simple activities and to gradually increase the difficulty of each activity. This is how the sensorimotor retraining process should be effectively “learning-based”: the retraining tasks should be highly attended, repetitive, and progressive.

Generally, sufferers of focal dystonia only experience the problem in one hand. However, if your dystonia is currently localized solely in one hand, it is reasonable to assume that your other hand could be equally susceptible to acquiring the disorder, because excessive neural plasticity is a global problem affecting the whole brain. Therefore, I recommend that while the sensorimotor retraining activities are directed to the dystonic hand as a means of rehabilitation, they also be applied to the non-dystonic hand as a means of prevention. Recovering from dystonia requires an enormous amount of patience and persistence. It took me years and years to develop focal dystonia, and it might take me just as long or longer to fully recover from it. However, I am making significant progress, and I am confident that I will eventually succeed in putting this problem completely behind me. If you suffer from dystonia, so can you.

I use different everyday objects to stimulate the touch receptors on my fingers. It is best to use both *active touch* (feeling an object with the dystonic digits) and *passive touch* (stimulating a static dystonic digit with another source, such as an object held by the nondystonic hand). For example, with my nondystonic hand, I poke and scratch (lightly!) the skin surface of my thumb with a toothpick—this is an example of passive touch. After 5-10 minutes, I switch to my index finger. I then rub the fingers individually along the teeth of a plastic comb, an example of active touch. I occasionally use an electronic, vibrating massager. Whenever she is willing and able, my wife gently caresses one finger at a time. Incorporating a variety of tactile stimuli (in both active and passive activities) is important because there are several different types of mechanoreceptors in the skin that sense different kinds of cutaneous stimulation, such as light brushing, deep pressure, vibration, stretching, etc. Touching different things in different ways will trigger the various receptors. All such “touching exercises” should be repeated as frequently as possible at different times throughout the day. (Dr. Byl recommends 1-2 hours a day for retraining activities). Remember: stimulate only one finger at a time, concentrate on the stimulus, and spend at least 5-10 minutes on each

finger. Be creative and learn to use downtime effectively: you can rub your index finger across your pant leg while riding a bus—who cares if you get strange looks from other passengers? Do, however, make sure it is your own leg that you are rubbing. Also, be sure to pay more attention to your motor activity and sensory stimulation than to the ever-changing view from the bus window. Good luck not missing your stop...

I now offer 13 guidelines for practicing and playing the guitar in an ergonomic fashion. Most of the guidelines are kept general to make them easily accessible and applicable to guitarists of diverse technical and stylistic approaches. This list is not exhaustive, and holistic health considerations such as regular exercise, a healthy and balanced diet, good posture, and getting enough sleep (among others) are important factors as well. While Dr. Byl's aforementioned sensorimotor retraining exercises are primarily useful to those already afflicted with focal dystonia, I believe the below considerations (many of which are informed by Dr. Byl's research) can aid every guitarists in the prevention and rehabilitation of dystonia and other repetitive strain injuries. Many of these suggestions require you to reconceptualize how you approach producing sound on the instrument. For example, I no longer think to myself: "I will now practice the guitar." Instead, I think: "I will now *touch* my guitar." I consider practicing to be a form of sensorimotor training. I firmly believe that success in playing any instrument begins with a proper physiological understanding of exactly how it is that you draw sound from the instrument. None of these concepts depart radically from "standard" guitar technique, whatever *that* may be...

- 1) **Stay hydrated.** Dr. Byl states that the intake of water is essential for proper muscle function. Just as the engine in your car needs oil to remain lubricated and to work efficiently, so too do your muscles and joints need water to function optimally. Drink water all throughout the day, but particularly before, during, and after your practice. Remember that coffee and alcohol will dehydrate you.
- 2) **Stretch, stretch, stretch!** Stretching before practice helps to warm-up the muscles and conditions them for work. Develop a variety of stretching

exercises to stretch all the muscles of the fingers, hands, arms, shoulders, and upper/lower back (you might want to consult a professional to develop an effective and safe stretching program). Be sure to hold each stretching position for 20-30 seconds to ensure the effectiveness of the stretch. It is also very important to stretch during breaks and after finishing your practice.

- 3) **Take frequent breaks.** It is necessary to rest frequently to avoid both physical and mental fatigue. Muscular exertion depletes the muscles of much-needed oxygen. Rest, along with hydration, allows for the restoration of oxygen. Practice for 45-50 minutes, then rest for 10-15 minutes. While resting, get up and walk around while shaking the arms and hands lightly to restore blood flow. Take slow, deep breaths. Breathe from the abdomen, using the diaphragm. You will likely find that these breaks help to clear your mind, allowing you to resume and maintain focus when you return to your practice. Most importantly, listen to your body. It will tell you when it needs a break. Believe it or not, it *is* possible to practice too much. Remember that the quality of your practice is more important than the quantity of practice. 30 minutes of carefully controlled and focused practice is more beneficial than 3 hours of rigorous, careless playing. Try to disperse your daily practice activities throughout the day—practice some in the morning, some in the afternoon, and some in the evening.

- 4) **Avoid excess tension.** It is impossible to play the guitar without some degree of tension. However, I would argue that most of us use more tension than is necessary to accomplish the task at hand (pun intended). Many guitarists labor under the misconception that the hands must continually be strengthened to improve technique and enhance playing ability. Indeed, some degree of hand strength is required to carry out even the most basic activities on the guitar. However, becoming more proficient on the instrument is *not* a matter of developing stronger hands. Rather, it is a matter of developing the proper *motor programs* between the brain and the hands that enable you to execute

different patterns and techniques with maximum fluidity and efficiency. You should not “muscle-through” the music but should essentially activate the proper motor programs for performing the music. It is likely that child prodigies of any instrument are born with—or are naturally adept at attaining quickly—the motor skills needed to play their instrument with great facility. They certainly are not born with “Schwarzenegger hands.” That being said, an effort should be made to minimize tension and keep the hands as relaxed as possible *at all times*—even when they are playing music that is loud, fast, and difficult. Relaxed muscles simply function better than tense muscles.

Generally, the left hand experiences the most surplus tension. You should not “squeeze” the strings into the fretboard with the left hand—using the thumb to vigorously oppose the depression activities of the first through fourth fingers. The left hand thumb should only lightly rest on the neck of the guitar to provide some stability and a point of reference. Learn to use the full weight of the entire arm to draw the string to the fret. This strategy is useful with chords, particularly with bar chords. Many left hand activities can be practiced without allowing the thumb to touch the neck at all. This can help you get accustomed to not applying too much counterforce with the thumb during normal practice/playing conditions. Depress the string only with enough force to avoid a buzz, and immediately relax unused fingers. When feasible, do not leave multiple fingers down. For instance, if playing a melodic fragment such as the sequence B-C#-D in seventh position on the first string, relax the first finger (B) when you depress the third finger (C#), and likewise release the third finger (C#) when you play D with the fourth finger. When you initiate a stroke with a finger of the right hand, you should instantly release the finger—do not allow it to remain tensed in the palm of the hand. Keep all unused muscles throughout your body completely quiet. Tension even in your face or foot can be harmful. Periodically conduct a mental check to detect encroaching tension.

- 5) **Vary your practice activities.** Develop a wide variety of activities that you work on each day. Devote x amount of time to single finger strokes, x amount to arpeggios, x amount to scales, x amount to learning new repertoire, etc. Focus on each hand separately, then combine and coordinate their respective efforts. Spend some time simply touching the strings of the instrument with one finger at a time (particularly with the left hand fingers) without even depressing the string to the fretboard. This is a type of sensorimotor training. To this end, it is favorable to keep the calluses of your left hand fingers filed down—just don't file them off completely! A thick callus is like a shield of armor that blocks the tactile receptors at the tip of the finger, thereby reducing the sense of touch.
- 6) **Avoid excessive repetition.** Do not spend too much time on any one exercise. Practicing a C Major scale for five hours a day will *not* result in the ability to execute a C Major scale perfectly. Set a limit on the amount of time you will spend on one activity, and force yourself to accomplish something in that timeframe. For instance, allow yourself six minutes to get a C Major scale at sixteenth notes from quarter = 40 to quarter = 130. If you get it done in five minutes, try to get it to 135 in the remaining minute. If you fail to get the scale up to 130 in the allotted six minutes, move on to another activity and try again tomorrow. This is not accepting failure—it is smart practicing.
- 7) **Use reasonable fingerings.** Every guitarist knows that there are multiple positions and fingering combinations that may be used to realize a given passage of music. I have always admired Andrés Segovia and Christopher Parkening for their fingering choices because they make their decisions based on musical rather than technical concerns. They might choose an extremely difficult fingering in the face of a much simpler alternative because it falls in a “warmer” register of the guitar or allows them to utilize vibrato more effectively. While I favor choosing the most musically pleasing fingering over always gravitating toward the simplest fingering (which might actually

be the most musical in some instances), I believe that this must be done within reason. Sometimes concessions must be made in the realm of color so as to preserve one's ability to play the instrument for the long run. Try to avoid those fingerings that strain the hands and cause pain. Use open strings as much as possible.

- 8) **Avoid planting.** It is common to plant unused fingers of the right hand on the strings of the instrument. It is especially common to plant the thumb on one of the bass strings while playing scalar passages on the treble strings. Planting can give you a sense of stability and perhaps a heightened frame of reference. However, doing so means that the brain is receiving continuous sensory information from the thumb concurrent to incoming stimuli from the other fingers. I suspect that my long history of thumb planting is partially (if not largely) responsible for my own dystonia. I no longer plant, and I've come to the conclusion that planting was not all that necessary to begin with. If you find it too difficult to give up planting (and you very well might), then make sure that any planted finger is only slightly contacting and just lightly resting upon the string. For example, if you are playing i-m rest stroke scales on the treble strings while planting p on the sixth string, be sure that you are not actively flexing your thumb into the string. In short: planted fingers should not be "gripping" the strings. The easiest way to prevent gripping is to avoid planting altogether.

- 9) **Practice at all tempos, especially slower tempos.** Playing fast is an ambition of most guitarists. Technical facility and speed are indeed important goals to strive for. Most of us, myself included, frequently make the mistake of trying to play faster than our hands are currently capable of playing. It is also quite easy to make the mistake of playing fast, perhaps too fast, all the time. Rapid figurations likely contribute to the onset of focal dystonia. If you are playing a very fast scale passage, alternating i and m of the right hand, your brain is receiving sensory information about each finger in such rapid succession that

it cannot tell the difference between them. The areas of the body's map on the brain ordinarily devoted to each individual finger are excited simultaneously. Since "neurons that *fire* together, *wire* together," such passages—particularly if repeated over and over again—could contribute to the dedifferentiation of the sensorimotor cortex that results in dystonia. When you practice slowly, you allow each finger to function more independently, and this independence is important for maintaining the segregation and individuation of the fingers on the cortex. Of course, you must practice at faster tempos if you ever wish to play at faster tempos, but do so sparingly and in as relaxed a manner as possible. When we play fast, we tend to use excessive, unnecessary, and detrimental tension. Working a passage or exercise gradually from a very slow tempo (and I mean *painfully* slow!) to faster tempos can help your hands to stay relaxed as they progressively move faster and faster. Use a metronome and "sneak up" on those fast tempos. The transition from slow to fast speeds entails a shift from deliberate, conscious mental activity to more unconscious and programmed mental work. When you play slow, you have ample time to concentrate on every single movement that you make with your hands. The faster you play, the less you can think about each individual movement and the more you are focused on the whole of what you are doing—you think in larger gestures, each gesture being composed of multiple, discreet parts. The gesture, or "whole," is a kind of mental program. Slow work will ensure accurate programming—all of the component parts must be correct so that the program as a whole will be correct. Additionally, working repertoire at all tempos can help to reduce memory slips.

- 10) **Use larger muscle groups as much as possible.** The larger muscles of the arm and the intrinsic muscles inside the hand are stronger and less susceptible to injury than the small tendons that flex or extend the middle and tip joints of the fingers. For the right hand, I endorse a high approach with the wrist flexed (but not overly so), such that the fingers are just slightly curled. Since I have rather large hands and long fingers, I place a small pillow between my

right forearm and the guitar so that my wrist is not bent too much. The primary motion of the fingers should be from the large joints where the fingers meet the hand. There will certainly be some residual movement in the middle and tip joints of each finger, but they should not be the most active joints. When feasible, the arm can swing from the elbow in a motion toward the face to initiate a powerful stroke (what Christopher Parkening calls the “slice,” and the type of stroke favored by David Leisner). This is optimal, since it primarily involves the larger bicep muscles of the upper arm (not to mention the fact that it produces a beautifully round and loud tone), but this motion is not always possible—particularly in rapid arpeggio or scalar passages. A variation of this stroke that involves less movement of the entire arm is simply to rotate the forearm such that the palm of the hand faces your face (supination). You might combine flexing the bicep and rotating the forearm to slice the finger through the string.

As far as the left hand is concerned, do not choke the palm of the hand up to the back of the neck of the guitar. This causes the fingers to curl too much and necessitates incorporation of the small tendons that cause the tip joints to bend. Allow the palm to extend slightly away from the neck so that the fingers are naturally bent. You should still be able to use the tips of the fingers as the points of contact with the strings. I have drastically reduced the amount of descending slurs (or, “pull-offs”) that I use when playing. Such slurs require flexion of the small tendons that activate the tip joint. I try to use cross-string slurs and trills whenever possible. This is another example of making musical concessions—this time in the realm of articulation—for the sake of rehabilitation or prevention of physical injury. In general, with the fingers of *both* hands, try to feel all movements originating in the palm of the hand or in the forearm. (When you are able to pivot from the elbow and swing the forearm to activate the strings with the right hand fingers, you should feel the motion initiating in the upper arm.)

11) **Avoid the unnecessary activation of extensors.** When you make a fist or bring the fingers into the palm of your hand, you are using the flexors that originate on the bottom side of your forearm. When you flatten-out your hand or move the fingers away from the palm, you are using the extensors, which are located on the topside of the forearm. In general, you should not use the extensors very much at all. Imagine the following scenario: with your right hand in proper playing position (as described above), you bring your i finger through the third string in a free stroke. The initial flexion of the finger brings it through the string in a motion toward the palm. Immediate relaxation of the flexor allows the finger to naturally relax back toward the string. You **should not** activate the extensors of the index finger to force it back toward the string. Everything is a matter of flexion-relaxation-flexion-relaxation. Of course, some techniques, such as rasqueado, will require use of the extensors. The important point is that you want to avoid the rapid succession and/or co-activation of antagonistic flexors and extensors.

Rest stroke activity affords an opportunity for prolonged tension. Many pedagogues teach the “walking” technique, in which the alternation of i and m fingers resembles two legs passing one another in a walking motion. At fast speeds, this analogy holds. However, at slow tempos, it can lead to problems. When you bring the i finger through the third string and allow it to rest on the fourth string, it is not really resting. (The term “rest stroke” is actually a misnomer.) You must make a physical effort, in the form of prolonged flexion, to keep the finger in contact with the string. Ideally, you should immediately relax the finger after it has made contact with the fourth string. So, when you go to activate the third string with the m finger, the i finger has already rebounded to its “prepared” position. In performing a rest stroke, the finger’s motion through the string, to the adjacent string, and its subsequent relaxation should always occur at lightning-fast speed, even at those agonizingly slow tempos. As you increase the speed of the rest stroke alternation between i and m, all you are really doing is decreasing the temporal space between the consecutive activities of the two fingers.

The same concept holds for the fingers of the left hand. Flexion will bring the finger to the string, and the finger lightly presses the string to the fret. Simply releasing this flexed finger will cause the finger to elevate naturally from the string, ideally to a position where it floats quietly above the string—poised and ready for re-activation. Again, you should not use the extensors to pull the finger away from the string. As discussed in suggestion # 4 above, try to use the weight of the entire arm to bring the fingers into the string. Work with gravity—not against it.

12) **Practice with your eyes closed.** Always remember that you are creating, refining, and maintaining *motor programs* when you play your instrument. These programs are stored in the brain, and they control the activities of the hands. (In fact, some people use the term “muscle memory” to explain this concept.) Your sense of touch plays a critical role in designing these programs. By practicing certain activities with your eyes closed, you eliminate any sensory input from vision. This helps you to concentrate more fully on what you are feeling and doing with your hands; you can attend more to your senses of proprioception and kinesthesia. *Proprioception* is sensing (without seeing) how your body is oriented in space based on feedback from the nerves in your muscles, tendons, and joints. *Kinesthesia* is perceiving the movement of your various body parts with the same nerves. Both of these “other” senses help in developing the proper motor programs. I don’t recommend playing without sight all the time—just close your eyes every now and then so you can “feel” your way through the music.

13) **Practice without your instrument.** The famous concert pianists Vladimir Horowitz and Arthur Rubenstein favored mental practice. It can be extremely beneficial. When you imagine a movement, you activate many of the same neurons in the brain that fire when you physically produce the movement. However, you will not receive sensory feedback information since you are not actually initiating a movement. This allows you to focus exclusively on the

motor portion of the sensorimotor feedback loop. As you think through a piece of music, imagine your hands functioning perfectly and effortlessly—even if they cannot yet function so in actuality. It helps to conduct mental imaging in a quiet space with your eyes closed to reduce aural and visual distractions. Be sure not to let the feeling of dystonic movements creep into your mental practice. I primarily recommend that you use mental imaging to correct or to “unlearn” problematic, dystonic movements; however, mental practice can also help you to memorize repertoire. You can mentally practice anywhere—while riding in a car (not while driving!), lying in bed, or attending a boring lecture. Again, you can make use of otherwise unconstructive downtime.

I have revised my technique of playing the guitar by applying all of the above suggestions to my own practice. Along with the learning-based sensorimotor retraining activities and regular Botox injections, these modifications are helping me to resolve my dystonia. At times I still get frustrated and wish I could progress at a faster rate. There was a time, in the not so distant past, when I could hardly play anything at all on the guitar. I gradually regained the ability to play my part in quartet repertoire, and I have recently reached the point where I can once again approach more complex, polyphonic solo compositions. So, I do see progress being made, and I am wholly confident that I will emerge from this condition a stronger player than ever before. While this positive attitude is not always easy to maintain, I believe it is absolutely necessary for a successful recovery.

We play the guitar so that we can make music. The music matters more than the instrument on which we play it. You can have music without a guitar, but without music, a guitar would be utterly useless. My most cherished experiences of guitar music are those moments when the performer makes me forget all about the guitar—the music transcends the instrument as well as the physicality involved in playing it. We feel music with our hearts and minds, but we must feel and activate the guitar with our hands. Therefore, we must attend carefully to both the physiological and sensational aspects of

playing the instrument. Ideally, we master the technique of the guitar so completely that physically playing the instrument is no obstacle to making music. Sometimes, a physical or neurological injury may arise—creating an impediment to the ultimate task of transmitting art through sound. However, we must truly embrace the idea that such an impediment is merely a temporary hindrance and an ephemeral obstacle to be overcome—it is *not* an impasse. When the drive to continue making music surpasses the disappointment and uncertainty of physical incapacitation, the injured musician *must* find the resolve and the means to remedy the situation. Having personally found the resolve, I am still seeking and finding my way to total recovery. If you are involved in a similar search, I sincerely hope that some of the concepts outlined above will help you in finding your way. If you are currently free of injury, I hope that the application of some or all of these concepts will help you stay that way. Good luck, and good music.

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