



THE MASSACHUSETTS GENERAL
PARALYSIS CENTER

LEADING THE WORLD IN PARALYSIS REVERSAL

MEDIA KIT

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WHAT IS PARALYSIS?

Paralysis is the loss of ability to effectively control the limbs. This can render one unable to walk, reach, grasp or carry out other basic functions. Common injuries resulting in paralysis are strokes, spinal cord injuries and nerve injuries.

Paralysis comes in 2 flavors: upper motor neuron and lower motor neuron. The upper motor neuron refers to the primary neuron which lives in the brain that initiates the command to move. The axon of this neuron travels down the spinal cord and synapses with the lower motor neuron in the spinal cord. This lower motor neuron extends its axon out of the spinal cord and through the peripheral nerves that reach into the arm or leg and connect to skin or muscle.

Lower Motor Neuron Injury

When a peripheral nerve in the arm or leg is injured, that is an injury to the axon of the lower motor neuron. The axon is cut and separated from the cell body within the spinal cord. This portion that has lost connection to the spinal cord disintegrates by a process called Wallerian degeneration. The muscle fibers therefore lose their axon connection and can no longer receive a signal to contract. That muscle will become flaccid. Over time the muscle will atrophy and lose its potential for recovery. After a year or two it is irretrievably lost. This is the case with injuries to the nerves within the limbs. This also accounts for an important part of paralyzing spinal cord injuries. Injuries to the cervical spinal cord often destroy the lower motor neurons that supply the muscles of the arm and hand. Patients with injuries to the lower

thoracic and lumbar spine may have a predominantly lower motor neuron injury. Many of these people are told that they have suffered a spinal cord injury, but, in fact, the cauda equina, is the primary site of injury. These are actually peripheral nerves that live within the spinal canal and as a result, the muscles become flaccid and are eventually irretrievably lost.

In these cases, the upper motor neuron (the one that lives in the brain) is still alive and well, but it can no longer talk to the muscles because it doesn't have a lower motor neuron with its axon by which to get that information to the muscle.

Upper Motor Neuron Injury —

When the central nervous system is injured, we primarily think about an upper motor neuron injury as the reason for paralysis. A stroke may destroy the cell body of the upper motor neuron within the brain. As a result, its axon that was previously connected to the lower motor neuron is lost. Similarly, injury to the spinal cord will transect that descending axon from that upper motor neuron. While the cell body may be intact, it can no longer communicate with the lower motor neuron. In both cases, this lower motor neuron is left without a message from above to tell the muscle when and how to move.

In this case the muscle remains connected to the spinal cord and can contract. Reflexes remain present and spasms are common. This is because the lower motor neuron works hard to compensate for the missing information from above. This neuron will become sensitive to any input that it can receive so that if there are any signals from above at all, it would do its best to produce an appropriate movement.

When this lower motor neuron becomes this sensitive, it now will overreact to the “noise” it hears from the sensory system. Whether the limb is bumped, there is a source of pain, or just a repositioning of the limb, the sensitized lower motor neuron will often respond to this input by eliciting a spasm. This can be a dramatic contracting, jerking or simply increased tone. In fact, in many cases, increased tone may be a constant experience in this condition.



Combination Injuries ---

In some injuries of the central nervous system, the descending axons of the upper motor neuron as well as the cell bodies of the lower motor neuron are affected by the same trauma. In spinal cord injury, for example, the axons descending from the brain are disrupted affecting the entire lower body with an upper motor neuron injury. The legs become hypertonic and respond to any touch with jerking. At the same time the lower motor neurons, which are at the same location as those descending axons, are destroyed.

In this case the hands and forearms may be flaccid and develop atrophy with time. A spinal cord injury "cure" would not fix these hands as they are no longer connected to the central nervous system.



Treating these injuries

It is important to distinguish these injuries because they are managed very differently. Lower motor neuron injuries must be addressed within months after they occur. That is because of the degeneration of the muscles. Once those muscles are lost, they cannot be recovered. Research is ongoing to lengthen this window and to find out if there are ways to recover muscles in the chronic period, but this is not yet available. Today, nerve grafting and nerve transfers are the primary treatment if we have the opportunity to treat these within the allotted time window. When this time window expires, we can still consider tendon transfers and muscle transplants as an option in many cases.

In an upper motor neuron injury, the same time window does not exist. The lower motor neuron is alive and well and maintains that muscle so that if it ever receives communication again from above, it can once again function. Because of this, we prefer to wait before undertaking surgery. Therapy should be pursued aggressively. Plasticity can result in quite a bit of recovery. Plasticity refers to the ability of the central nervous system to rewire itself so as to better communicate with the lower motor neuron in a useful way. Plasticity is driven by demand – that is, if you are not actively trying to perform better, then plasticity is probably not being effectively promoted. Practice, practice, practice – that leads to more plasticity and better recovery.

That being said, there is often a plateau. After a year or two of hard work you may find that you simply are not making more gains. This is when it is time to consider functional interventions. This may begin with Botox injections to temporarily remove the hindrance of uncooperative spastic muscle. Some people will make a lot of progress with this and no longer need these treatments. Others return every 3 months for another treatment and the effects become less robust with time. These patients should consider selective peripheral neurotomies. This is a procedure where the nerves

are trimmed to eliminate the problematic spasticity but in a way that is very specific, long-lasting, and maintains the function of the muscle.

Some muscles may never recover their ability to activate effectively. These muscles can often be recovered with a nerve transfer or a tendon transfer. In the upper motor neuron conditions, there is typically no time limit on when nerve transfers can be done. We have had success with these even 15 years after a spinal cord injury.

Some patients with very high spinal cord injuries or extensive stroke may have fewer options for nerve or tendon transfers. In some of these patients, spinal cord stimulation and Neuroprosthetics are showing a lot of promise. We have an active research group working on these options and spinal cord stimulation is quickly becoming a clinical practice at Spaulding. Stem cell research is also underway to try to regrow those upper motor neuron connections within the spinal cord and wake up those healthy lower motor neurons that are patiently waiting to receive a useful connection.





WHO SUFFERS FROM PARALYSIS?

In 2013, the Christopher & Dana Reeve Foundation unveiled some alarming statistics based on research into the prevalence of paralysis across the U.S.

According to the study, nearly 1 in 50 people are living with paralysis – approximately 5.4 million people in the US. **That's the same number of people as the combined populations of Los Angeles, Philadelphia, and Washington D.C - nearly 40 percent higher than previous estimates showed.**



Researchers designed and conducted a comprehensive survey of more than 70,000 households across the country. More than 30 experts in paralysis and statistics, including those from the Centers for Disease Control and Prevention (CDC) and 14 leading universities and medical centers helped to develop and set the parameters for the study.

This research revealed some important findings:

Paralysis is dramatically more widespread than previously thought. Approximately 1.7 percent of the U.S. population, or 5,357,970 people reported they were living with some form of paralysis, defined by the study as a central nervous system disorder resulting in difficulty or inability to move the upper or lower extremities.

The leading cause of paralysis was stroke (33.7 percent), followed by spinal cord injury (27.3 percent) and multiple sclerosis (18.6 percent).

* Data sourced from www.christopherreeve.org



ABOUT THE PARALYSIS CENTER

Founded in 2017 at Massachusetts General Hospital in conjunction with Spaulding Rehabilitation Hospital, the Paralysis Center is a world-class patient treatment and medical research center for all conditions resulting in weakness and paralysis.

Using a team approach, the Paralysis Center unites a multi-disciplinary team “under one roof” who are leaders in their respective fields: Neurosurgery, Neurology, Physical Medicine and Rehabilitation, Physical and Occupational therapy, Orthopedics and Plastic Surgery. We employ the best imaging and neurophysiology techniques available to give us the best information to inform our treatment plan.

At the same time, our research endeavors inform our current practice, as we collect detailed diagnostic, intervention and outcomes data for each patient. This same rigorous attention to detail helps pave the way for new interventions that we hope to implement in coming years. Finally, our basic science research lays the foundation for the future of the field as we explore new and exciting methods for solving problems for which we currently have no clinical solutions. These endeavors will all further enhance the lives of our patients.

Such comprehensive care gives patients access to the most cutting-edge technology and proven paralysis-reversal treatments — providing a best-in-class treatment facility for every aspect of patient recovery.

For more information, please visit www.ParalysisCenter.com





ABOUT DR. JUSTIN BROWN

FOUNDER, DIRECTOR – THE PARALYSIS CENTER

Justin M. Brown, MD is a board-certified neurosurgeon and global pioneer in Reconstructive Neurosurgery – an emerging specialty focusing upon surgical interventions to reverse the effects of paralyzing conditions.

Dr. Brown believes that patients suffering from conditions of paralysis have had limited access to the treatments that would improve their condition because most centers across the world focus on only a single type of paralyzing condition. Specialists in brachial plexus injury did not see patients with spinal cord injury. Specialists in spinal cord injury hand reanimation often did not have expertise in spasticity. Developing expertise across all of these disorders both provided benefit for each of these individual conditions, and opened up options for conditions not previously focused on in a surgical program. Applying SCI expertise to hands paralyzed from a brachial plexus injury has resulted in more sophisticated hand function in these patients. Applying spasticity procedures along with hand reconstruction in SCI has also led to much better outcomes for these patients. Bringing all of the treatments for each of these conditions together into a single center has now allowed for all comers to receive the best in paralysis reversal care without the obstacles that would otherwise limit care to those who do not fit the most commonly treated diagnoses. Dr. Brown has received widespread international recognition for this work. He is an avid educator and a regular featured speaker at medical symposiums around the world.

Dr. Brown's own training has been multidisciplinary in nature. He earned his medical degree from the Eastern Virginia Medical School in Norfolk,

Virginia and completed an internship in General Surgery and residency in Neurosurgery at Baylor College of Medicine in Houston, Texas. Following, based on his desire to understand these problems from the perspective of another surgical specialty, Dr. Brown completed a peripheral nerve surgery fellowship in the Division of Plastic and Reconstructive Surgery at Washington University School of Medicine in St. Louis, Missouri. Then, in collaboration with a notable pioneer in Restorative Neurology, Milan R. Dimitrijevic, MD, PhD, he helped establish the International Society for Restorative Neurology. Dr. Brown is also a member of the American Society for Peripheral Nerve, The American Association for Hand Surgery, the AANS/CNS Section on Disorders of the Spine and Peripheral Nerve, the Congress of Neurological Surgeons, the American Association of Neurological Surgeons, the Pan-African Association of Christian Surgeons, and Associate Professor for the Brachial Plexus International School.

Dr. Justin Brown currently serves as Director of Reconstructive Neurosurgery at Massachusetts General Hospital, is Associate Professor of Neurosurgery at Harvard Medical School, and is the founder and Director of the Paralysis Center.





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Harvard Neurosurgeon Helps Paralyzed Teen Surfer Ride The Waves Again

For Immediate Release
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Boston, MA. On December 28, 2016, high school senior and competitive surfer Josh Davis met up with some friends, as he often did, and headed to the slopes on Bear Mountain, CA. They were going snowboarding, like they had so many times before. Snowboarding was a big part of Josh's life - he preferred the adrenaline rush of extreme sports to the more traditional ones - but competitive surfing was his passion. Already Josh's high school team was doing well and poised for CIF. Josh was a strong contributor for both short board and long board. He was looking forward to surfing in the CIF championship representing his high school. But all this was about to change.

Diana Davis, Josh's mother explains what happened. "Josh was very familiar with the run he was on, and he was very familiar with the jump that he went off of. He wasn't doing anything crazy or outside of his ability or comfort zone. ..but that day he hit the jump wrong and wasn't able to land it... he essentially fell out of the sky and came down on the right side of his body. He crushed his clavicle and his shoulder in seven places,

compressing the brachial plexus and subclavian artery, and puncturing his lung."

On landing, Josh felt his entire right arm go numb, from his shoulder to his finger tips. Ski patrol immediately took him down the mountain and transported him via ambulance to the local mountain hospital who determined he had no blood flow to his right arm. "The hospital then airlifted him to a trauma center where his Dad and I were waiting for him," said Mrs. Davis. "As a parent that's a call that you never ever want to get."

The trauma center stabilized Josh and did surgery on his clavicle to relieve the compression on his artery and nerves. "The thing I kept asking all the doctors about was 'what about his arm'? It was still hanging limply by his side and he still had no feeling in it whatsoever. There was clearly an issue with the brachial plexus - the bundle of nerves at the top of his shoulder, but they kept saying there was nothing that could be done about the nerve damage at that immediate time..

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They said to me at the trauma unit, 'Ma'am your son is lucky to be alive – if he'd landed on his left side he would have punctured his heart and bled out',” said Diana Davis.

Now that her son had been stabilized, Diana Davis focused her attention on getting function in Josh's right arm and hand back. “I had been reading everything I could (nd on brachial plexus injuries and from the other medical specialists I had spoken to, it seemed like I needed to (nd a neurosurgeon who specialized in this kind of repair ..that's when I found Dr. Justin Brown. We managed to get an appointment to see him three weeks after Josh's injury.”

“Brachial plexus injuries can result from a number of causes, but are usually the result of some kind of trauma - most commonly motorcycle, ATV or snowmobile accidents where the rider is (ung and lands with a shoulder striking the ground. The shoulder is pulled forcefully away from the neck causing a tearing or rupture of the nerves”, says Dr. Justin Brown, Director of the Paralysis Center at Massachusetts General Hospital. “Because young men more commonly engage in these high-impact, high-risk activities, the majority of brachial plexus patients we treat are young men aged 16-30,”

“When Diana took her son Josh to meet with Dr. Brown, it was difficult to ascertain the extent of the damage to the brachial plexus. “When I examined the MRIs and CT scans that Mrs. Davis brought from other clinics – they didn't demonstrate any avulsions, but Josh clearly had sustained a complete injury to the brachial plexus,” said Dr. Brown. “The reason we could not determine the source of the injury on the MRI was that the metal plate holding the

clavicle together obscured the image dramatically. We therefore decided to explore the plexus to determine the type of injury he had suffered. When we did, we discovered that the nerves were severely compressed beneath scar tissue, but were able to be freed from their compression. After doing so, they appeared recoverable for the most part. The region that did not appear recoverable was then directly repaired with a nerve graft from his left leg.”

Fortunately for Josh, his surgery was a success. Over the coming months he started to regain feeling and movement in his shoulder (rst, and then it began to progress distally at the rate that nerves regenerate. Eventually (and to our surprise) he began to recover function even in his hand. “Early surgery can have a tremendous impact. We typically tell patients with such an injury that if we get even basic hand closing that we have made an excellent recovery. Josh went from shoulder to biceps and triceps, then on to his wrist, to his hand and then, to our surprise, began to recover even the small (ne motor control muscles within his hand. The surgery was a success, but his hard work and determination should not be understated,” said Dr. Brown.

“His recovery was slow, but Josh just kept at it. He did physical therapy two times a week and followed Dr. Brown's recovery protocol to the letter,” says Diana.” Josh sat on the beach and went to every practice for his surf team and every competition .. it was really hard for him, but he always kept a positive attitude and believed deep down that he would regain full function of his arm and hand.”

Today, nearly three years after his accident, things are a lot better for Josh - “Josh is living his dream life,” says his mother Diana Davis. “He got accepted

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at the University of Hawaii, he's doing a double major and he gets to surf several times a week. He has regained most of the mobility of his hand and about 90 percent mobility in his fingers and thumb." Diana Davis adds, "If Dr. Brown hadn't performed that surgery, there's no way that Josh would have had his arm back... the trauma center told me that it would take time and to see a neurosurgeon. Most facilities would not see my son for at least three months as they wanted to wait and see if the nerves began to recover on their own; but if we'd have done that, it would have been too late." Early intervention was the key to my son's recovery!

If you or a loved one has suffered a brachial plexus injury, please don't wait – see a paralysis specialist immediately to increase your chances of having function restored.

About Dr. Justin M. Brown, Director of the Paralysis Center

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Dr. Brown currently serves as Director of Reconstructive Neurosurgery at Massachusetts General Hospital, is Associate Professor of Neurosurgery at Harvard Medical School, and is the founder and Director of the Paralysis Center.

The Paralysis Center At Massachusetts General Hospital

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Using a team approach, the Paralysis Center unites a multi-disciplinary team "under one roof" who are leaders in their respective fields: Neurosurgery, Neurology, Physical Medicine and Rehabilitation, Physical and Occupational therapy, Orthopedics and Plastic Surgery.

Such comprehensive care gives patients access to the most cutting-edge technology and proven paralysis-reversal treatments – providing a best-in-class treatment facility for every aspect of patient recovery.

No matter what form of paralysis you or a loved-one suffers from, or what medical advice you may have received before – there is hope. We can help you get movement back.

For more information, please visit www.ParalysisCenter.com.



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