Developmental Apraxia Complicates BPI Recovery

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It has been well documented that babies with a brachial plexus injury at birth (BPI) do not recover function as well as adults with a similar peripheral nerve injury. Yet the babies, when tested later in life, are often found to have more than adequate regenerated nerve to have normal function. The question is why don’t they use the available nerve? The answer lies in the “Use It or Lose It” law that controls both brain and body growth.

The statement “Neurons that fire together, wire together”, attributed to D.O. Hebb, is how we form Habits. Whatever we do, we learn to do better. Brains are not judgmental and they will wire both Good (Adaptive) and Bad (Maladaptive) circuits into the growing brain. The reverse process is also true. “Neurons that do not fire together, do not wire together”. The “Use It or Lose It” law, so often used by athletes training their muscles, also applies to brains.

In the months after a Brachial Plexus Injury, the baby has limited movement of the affected arm. The unaffected arm moves normally and with that movement, the baby wires awareness of the arm and hand into the brain. By three months, most children are bringing their hands together and able to look at and play with their fingers. Their first attempts at useful function are a midline grasp with both hands, but very soon after, they are able to bat at objects, then capture them, and finally bring them to their mouth. The child with brachial plexus injury has only one arm and hand that work, so all of these normal developmental steps are impaired. By the time their peripheral nerve injury has recovered enough to allow function of the affected arm, they do not know how to use it. This is what we have named a Developmental Apraxia. Deprived of normal movement, they do not wire into their brains a motor plan for the affected arm and hand.

In the paper cited below, we were not overly optimistic of the ability of the baby’s brain to rewire and restore normal function. In part, that attitude was due to the reality that the paper was published in 2000, a time when neuroplasticity was not as accepted as it is today. However, the editors of the journal, Neurology, were smarter than us! They published a companion paper in the same issue and an editorial by Michael Noetzel and Jonathan Wolpaw that discussed how the two papers related to each other. The other research paper, by Rollnik et al, demonstrated restoration of normal arm function in older children after a treatment protocol that combined botulinum toxin to inhibit abnormal muscle co-contraction with active focused exercise of the normal muscle groups. Their combined therapy inhibited the habitual muscle co-contraction pattern and the focused therapy taught the child a new motor plan that improved function. After a year of injections, the child’s new motor plan was in place and the co-contraction habit did not recur.

Since then, other pioneers in neuroplastic interventions such as Constraint Induced Movement Therapy (CIMT) have demonstrated that our human brains are much more capable of rewiring than we had ever expected. To date, most of this work has been done in adults with stroke and children with hemiplegia, but there are a few early studies demonstrating the same improvements in children with brachial plexus injury.

Developmental Apraxia is a new concept that should dramatically change the outcome for many children. In the bad old days, parents and therapists and even doctors quite reasonably did not do repeated neurophysiological testing to document nerve recovery. The techniques used employed sticking needles into the muscles and maximally stimulating nerves. Both these techniques hurt and babies do not tolerate it well. Without actually measuring the nerve/muscle interaction, we all assumed the persistent impairment meant incomplete nerve regeneration. This belief lead to a time limited approach to therapy…if the nerve has not completely recovered, the best we can do is teach compensatory strategies. Cure was not part of the equation. This thinking is now seen to be wrong-headed by a growing number of therapists. Reliable, inexpensive, surface EMG units are now available to demonstrate whether or not the nerve is there and trainable.

I will write more about how this technology can be used in coming posts. For now, I just want to emphasize that most babies with BPI do regenerate their damaged nerves. Monitoring this recovery improves our ability to refer appropriately for a surgical evaluation if the signal is absent, if it stays weak or if it slows down. Any deviation from the expected course of recovery, such as abnormal co-contractions, can be quickly referred for a full diagnostic neurophysiologic examination by a neurologist or physiatrist and treated with Botulinum injections if needed. If the signal grows stronger, moving down the arm with regeneration, then both the parents and the therapists know what they have to work with. I am quite convinced that the “Missing Piece” of the BPI puzzle is knowing how much nerve is present. If the therapist knows the nerve is regenerating, then they have many “tools in their toolbox” to help increase the baby’s awareness of the limb and this will lead to better function. The rehabilitation of these babies and young children needs to be more proactive. Developmental Apraxia is a common complication of BPI. Now it is time to actively try to prevent and/or improve it.

A fair number of therapists and physicians are now using EMG Biofeedback and I would appreciate it if you would tell us about your experiences. You can read more about surface EMG Biofeedback at [www.advancedmusclestimulators.com](http://www.advancedmusclestimulators.com).

**Further Reading**


