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NeuroRehabilitation: Evolving Practice

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Duration of Recovery and Measurement

Following brain injury or brain disease there are potential widespread biochemical and functional brain changes that result in what might be considered a possibly very different brain. This adapted brain may react to environmental stimuli in a significantly altered manner. While an acutely injured brain may be neurochemically unstable and place the person at risk for seizures, irritability, and other dysfunctional reactions, in this early stage of recovery, the brain is endowed with the heightened potential for injury-induced plasticity. Though the human body essentially sets the stage for a powerful rewiring of the brain systems, it is not entirely clear how to maximize this potential. Some animal research suggests that during the first 30 days after brain injury, treatment can produce significant morphological changes in the brain [1].

Therefore, the challenge for neurorehabilitation becomes to maximize the potential for recovery of function within this circumscribed window. Yet, the early recovery is likely not the only opportunity for intervention: different processes may guide later rehabilitation gains. Thus, in addition to the early neurochemical facilitation to brain recovery, the same fundamental neural and behavioral signals driving plasticity during learning in the intact brain are engaged during relearning in the damaged or diseased brain. Accordingly, neuroplasticity research suggests that people may continue to recover functions for many years. Although researchers have also pointed out that the rate and extent of recovery occurs on acontinuum: recovery is easier and faster earlier and becomes increasingly more difficult as time progresses. Some studies have shown that the majority of people continue to make significant physical, cognitive, and behavioral recovery gains as many as five years or more post Traumatic Brain Injury (TBI). The challenge for the field of neurorehabilitation is to capitalize on neuroplasticity mechanisms to develop neurobiologically informed therapies focused on key behavioral and neural signals driving neural plasticity.

There is a great need for both researchers and clinicians to collect data on their treatment strategies and outcomes and to contribute to the growth of the field via publication of their findings. The resulting studies, while limited in scope, have the potential to engender new effective therapies or provide empirical support for the existing ones. After all, each evidence-based treatment must start somewhere, and it takes many years before a treatment technique or protocol can achieve the "evidenced-based"categorization. Some research [2] has referred to the time lag from bench to bedside as the 17 year odyssey, which highlights the long delay required to create an evidence base and weed out ineffective treatments. The Institute of Medicine (IOM) and other organizations make it clear that though there is an evidentiary basis for many brain injury and cognitive rehabilitation treatments, the empirical support for many others is still lacking [3].

While the limited support may be reflective of some the interventions themselves, a multitude offactors, particularly in cognitive rehabilitation, make it very difficult to collect publishable clinical data and nearly impossible to collect cause-effect data. In clinical settings, patient treatment goals and clinician interventions are individualized. Moreover, even when treatment is appropriate, the duration and intensity (due to funding or other limitations) may not be sufficient to produce the intended results. The cognitive prognosis of each patient is determined and influenced by a variety of patient variables, which makes generalization of findings extremely limited. For example, measuring early treatment effects is confounded by individual differences in spontaneous or natural recovery. With regard to later recovery, many individuals do not receive treatment long post-acute despite lingering impairments, which can create a selection bias, thus confounding data collected later in the process of recovery. Additionally, for many treatments, clinicians are likely to utilize some variation on a task or theme in response to their patients' unique constellations of individual symptoms and specific impairments.

Thus, there are thousands of very successfully treated brain injury survivors, but, as various reviews have suggested, many of the rehabilitation techniques utilized to accomplish these successes have limited empirical evidence. This limited empirical support is especially apparent in some types of cognitive rehabilitation.

Neurorehabilitation: Cognitive Rehabilitation

Case in point, as it relates to the previously mentioned challenges with accruing an evidence base for a neurorehabilitation technique, is Cognitive Rehabilitation Therapy (CRT). CRT, a form of treatment for TBI, is a patient-centered approach aimed at increasing the patients' ability to process and interpret information, and improve cognitive skills and functioning. Its primary goal is to help an individual with a brain injury to enhance his/her daily life coping by recuperating or compensating for impaired cognitive functions. CRT encompasses a wide range of treatments and frequently requires caregiver involvement [3]. Several organizations such as the Society for Cognitive Rehabilitation offer recommendations regarding best practices, but there remains many questions about the evidence for some treatments.

The Department of Defense requested the IOM to conduct a study that would determine the effectiveness of CRT for treatment of TBI. The IOM was asked to consider whether existing research on CRT provides a conclusive evidence to support utilization of specific CRT interventions and to establish guidelines for the use of CRT for members of the military and veterans [3]. The report generated by the Committee on Cognitive Rehabilitation Therapy for Traumatic Brain Injury recommended an additional investment in research to further define, standardize, and assess the outcomes of CRT interventions [3]. The conclusion of the committee seemed to intimate that while CRT interventions appear promising, the therapy requires further development and research support [3]. Specifically, the IOM committee

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highlighted the need for studies with larger sample sizes, which would facilitate the investigation of a much broader set of variables (e.g. types of injuries, patient characteristics, and specific outcomes). Though large controlled studies may be the gold standard, there is great potential for smaller studies utilizing either single subject designs or small group comparisons. What is most important is specificity in describing the sample and procedures.

In spite of mixed or lacking evidence for many neurorehabilitation strategies, some treatments, such as the Constraint-Induced Movement Therapy (CIMT) and several other physical treatments have managed togarner a substantial research support [4-7]. Based on the theory of "learned non-use," the concept behind CIMT is quite logical: constrain the stronger extremity, thus "forcing" the individual to use the affected extremity to provide stimulation to the affected system and facilitate recovery of functioning [4]. CIMT also provides an example of how therapy can change brain functioning in tangible ways [8]. Pizzamiglio et al. (1998) found that, following a two-month rehabilitation, patients with left neglect after right hemisphere brain injury showed greater activation of right hemisphere areas associated with attention on PET scans. In addition, they also evidenced improvement on tests of neglect and spatial skills [8].

Similar references to functional gains in living skills are essential to effectively guide the therapeutic choices of clinicians. Research can assist the therapists to select interventions that will address the client's goals. Yet, intervention choices are also impacted by a variety of larger issues, including cultural, social, historical, and theoretical influences [9]. In addition, a pivotal factor driving therapeutic decisions appears to be the professional training therapists receive in school or conferences as well as the resources available at their worksite [10]. Thus, depending on the tools chosen or the therapeutic approach taken, each patient experience with neurorehabilitation therapies can be quite unique.

In summary, in order to advance the field of neurorehabilitation, a concentrated focus on and funding support for research investigations of the efficacy and clinical utility of the various therapies currently available is necessary. The field's status quo presents a curious mix of talented clinicians and promising techniques, but limited empirical findings to support them. Given the great advances in neuroscience and the promise of brain mapping from the Human Connectome project (the NIH brain mapping project), there is enormous potential for neurorehabilitation advances in the near future. Any areas of best practices will likely be clarified. It is our hope that this journal remains a platform for clinicians and researchers to present their work as a contribution to this evolving field of care.

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