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The Issue Is…Neurorehabilitation – Are we doing all that we can?

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As occupational therapists, we are inclined to provide the best for our clients. It is our professional and ethical responsibility to ensure that we optimize outcomes and use the tools and strategies that will enable individuals to return to functional, meaningful lives. However, the selection of specific tools and techniques to facilitate client participation varies widely between practitioners. This variability creates a dichotomous picture of occupational therapy (OT): The art of OT can be seen in the creative and distinctly different approaches used by practitioners to treat similar diagnoses; the science of OT begs for evidence and proof that the radically diverse methods are effective.

Depending on the tools chosen or the therapeutic approach taken, each patient experience with OT is unique. Therapists learn to select interventions that will address the client's goals, but intervention choices are also impacted by a variety of larger issues, including cultural, social, historical, and theoretical factors (Reed, 1986). Interestingly, some of the primary reasons therapists select the interventions that they do is based on the professional training they receive in school or conferences, or on the resources available at their worksite (Korner-Bitensky, Menon-Nair, Thomas, Boutin, & Arafah, 2007). What is most concerning is that there appears to be an underlying, yet pervasive resistance by OTs to adopt evidence-based practice methods or to implement new technologies that have demonstrated effectiveness. A study of OT practice in Australia revealed that, for upper extremity rehabilitation following stroke, many therapists frequently use techniques *not* based in empirical evidence (Gustafsson & Yates, 2008). In 1999, Dubouloz et al. reported that OTs identified evidence-based practice as a "potential threat" (Dubouloz, Egan, Vallerand, & von Zweck, 1999). More recently, a questionnaire regarding preferred practice methods was given to 107 experienced OTs and indicated that 85% were using interventions for stroke that are not scientifically supported (Natarajan et al., 2008). Perhaps the novelty of an unfamiliar electromechanical device, the apparent theoretical complexity of a new intervention strategy, or the time needed to be educated in the use of these treatment options are excuses we use for our non-acceptance. We cannot continue to reject methods that are grounded in empirical evidence. We can no longer view advances in therapeutic intervention and evidence-based knowledge as a threat; it will be critical for OTs to accept and embrace these changes for the profession to survive.

Large, multi-center clinical trials and outcome-based studies focused on effective strategies for stroke intervention have generated literature that therapists can use for selecting creative and effective interventions. Rehabilitation technology such as neuromuscular electrical stimulation, neuroprosthetics, and robotics are changing rehabilitation practice daily. This column will explore the emerging research and new technologies that are changing the

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practice of occupational therapy. Strategies to help the profession accept and embrace the changes will also be discussed.

Research Evidence and New Technologies

Constraint-induced Movement Therapy

Constraint-induced movement therapy (CIMT) is an intervention for stroke and head injury that is not often used in clinics but has proven effectiveness and the evidence to support it. The concept behind CIMT is quite simplistic: constrain the stronger extremity, “force” the individual to use the weaker extremity, and potentially strengthen and facilitate normal sensorimotor responses that can lead to improved function. The EXCITE (extremity constraint-induced therapy evaluation) trials, a series of National Institutes of Health-funded, randomized, multisite clinical trials, have repeatedly demonstrated improved upper extremity strength and motor function in the hemiplegic arm using these techniques. For example, following a 2-week regimen of CIMT with patients who were 3-9 months post-stroke, significant gains were seen in movement ability and overall arm use (Wolf et al., 2006). This same group of participants was studied 2 years later and functional gains had been maintained and individual ratings of quality of life were high (Wolf et al., 2008). Recently, evidence is showing that CIMT can be effective for chronic stroke, as similar beneficial results have been found in persons who are 15-21 months post infarct (Wolf et al., 2010). The drawback to CIMT is that the effectiveness of this therapy is dependent on the patient’s having a moderate amount of residual movement early in the recovery process (approximately 10° of finger extension and 20° wrist extension) to participate; unfortunately, approximately 80% of stroke survivors do not meet this criterion (Mark & Taub, 2004). However, for those patients who do, CIMT is an evidence-based, function-based intervention that works. Additionally, several hours per day are needed for major gains to occur, but research is indicating that fewer hours, or what is known as modified CIMT, may be similarly effective (Leung, Ng, & Fong, 2009; Page, Levine, Leonard, Szaflarski, & Kissela, 2008).

Rhythmic Auditory Stimulation

Evidence is also providing support for the use of rhythmic auditory stimulation (RAS) to improve motor performance. Most applications pair an auditory stimulus with a required motor action, thereby activating the cortical skills of timing, sequencing, and rhythm to facilitate and organize movement. An early pilot study using RAS and a bilateral arm training device showed lasting improvements in strength, range of motion, and function of the affected upper extremity when this strategy was employed with chronic stroke patients over a period of 6 weeks (Whitall, Waller, Silver, & Macko, 2000). Subsequent investigations involving persons with stroke have demonstrated improved kinematics of upper extremity movement with RAS, revealing that compensatory trunk motion during reaching can potentially be reduced using this method (Malcolm, Massie, & Thaut, 2009). Industry has embraced these findings, and equipment designed to enable practitioners to use this intervention method has been developed and marketed. Interactive Metronome (IM, Sunrise, FL) has created a combined training program and auditory device with promise for improving educational efforts in children with learning disabilities (Taub, McGrew, & Keith, 2007). The cost of $6,500 may be a primary deterrent to widespread use of the system in clinics or educational settings, but the evidence is interesting and provides us with one more intervention option should we want to try a novel approach to motor relearning following stroke.

Visual Feedback

Interactive performance-based computer games using visual feedback are also showing evidence of maximizing patient motor, cognitive, and sensory abilities. Motor learning literature emphasizes that practice and feedback, implemented with specific guidelines, can be valuable learning tools. Expect to see more devices in our practice settings that provide immediate real-time visual feedback for clients. Learning a task using visual feedback can foster the skills of error correction and self-monitoring, while promoting functional autonomy. Neuromuscular electrical stimulation units are now available that have a visual feedback component. Electromyographical (EMG) signals are clearly displayed on a screen integrated within these units. Clients can know when muscle activity occurs, and, based on the amplitude of the signal, they also receive feedback as to the power of the muscle activity. Zynex Medical, Inc. (Lone Tree, CO) is one of several manufacturers of the EMG-triggered stimulation unit (NeuroMove NM900). This tool has contributed to improvements in hand use (Barth, Herrman, Levine, Dunning, & Page, 2008) and balance and gait (von Lewinski et al., 2009) in persons with chronic stroke. The REOGo by Motorika (Trussville, AL) and the Hand Mentor by Columbia Scientific (Tucson, AZ) are examples of other robotic-type devices that use repetitive movements of the upper extremity combined with engaging visual feedback for upper extremity rehabilitation and relearning.

Neuromuscular Electrical Stimulation

For some time, OTs true to the profession have viewed the use of neuromuscular electrical stimulation (NMES) as an intervention that is not “occupation-based” and is not congruent with the historical foundations of OT. Perhaps this controversy has resulted in a decreased enthusiasm for NMES. In any case, this modality is not an intervention therapists are willing to use readily, and the evidence shows this (Cornish-Painter, Peterson, & Lindstrom-Hazel, 1997; Taylor & Humphry, 1991). One of the reasons OTs do not use electrical stimulation as often as other modalities is that many curricula teach NMES at an introductory level, recommending that further professional education be obtained post-graduation to acquire full proficiency (McPhee, Bracciano, Rose, & American Occupational Therapy Association Commission on Practice, 2008). Both the Cornish-Painter and Taylor studies reported that most therapists who were using electrical stimulation with their clients learned to do so primarily from on-the-job training. Despite its infrequent use, several studies have reported favorable outcomes using NMES as a treatment option for upper extremity motor recovery following stroke.

A recent study demonstrated that the addition of both low doses of NMES (30 minutes daily) as well as high doses (60 minutes daily) to a standard rehabilitation therapy regimen resulted in better functional outcomes in the upper extremity when compared to a regimen without NMES (Hsu et al., 2010). A systematic review of stroke intervention literature also indicated that NMES is a viable option for post-stroke hemiparesis and is feasible for home use by patients (Urton, Kohia, Davis, & Neill, 2007). Empi, Inc., has developed a user-friendly portable stimulator that can be used effectively in neurological applications as well as orthopedic cases, but the training and education required for therapists to become skilled in NMES use may be an impediment for most practitioners. As a result, many states are moving to credentialing or certification in the use of physical agent modalities (Bracciano, 2008). The Physical Agent Modality Practitioner Credentialing Agency (PAMPCA) offers an intensive credentialing course several times yearly in physical agent modalities for OT practitioners (pampca.org). Clinicians who attend these seminars may be more inclined to use NMES as an option when selecting interventions for neurorehabilitation.

Bioness

Bioness, Inc. (Valencia, CA) has spent years developing a neuroprosthetic device for the upper extremity that facilitates hand movement using electrical stimulation. The device is known as the H200, a streamlined thermoplastic shell with embedded stimulator electrodes that trigger a normal motor sequence in paralyzed muscle to produce the forearm, wrist and digit activation needed for grasp and release. In selected trials of use of the neuroprosthetic with stroke patients, researchers noted increases in grip strength and active finger motion, along with decreases in perceived pain and improved Fugl-Meyer scores for the upper extremity (Hill-Hermann et al., 2008; Page et al., 2008). Other researchers saw improvements in functional tasks such as lifting a pot and holding a bag when the prosthetic was used for training (Alon, Levitt, & McCarthy, 2008; Alon, McBride, & Ring, 2002). The evidence is that the H200 can assist patients in reducing impairment and maximizing *function*. The obstacle to usage in this instance is not so much the training involved, but the price of approximately $6,000 per unit. Despite the success of the H200 and other similar neuroprosthetic and robotic devices, these still remain largely cost-prohibitive for the consumer. Luckily, many clinics are able to purchase various sizes of the H200 to use with several patients as training devices or therapeutic interventions for their rehabilitation caseload.

Saebo

The SaeboFlex is a mechanical, spring-loaded upper extremity thermoplastic orthotic that keeps neurologically flexed digits in an extended position so that persons with stroke can perform an active grasp with a spring-loaded assisted release. The device, in combination with a massed repetitive practice regimen, can facilitate motor and sensory relearning while reducing learned non-use. The enticing aspect of Saebo training is that, unlike CIMT, a large majority of persons with stroke meet the motor eligibility criteria for this system. Clients who demonstrate at least 15° of both shoulder and elbow flexion and one-quarter range finger flexion are eligible. Saebo additionally offers a static positioning device for the forearm, the SaeboStretch, which provides a prolonged static stretch to hypertonic wrist extensors; this device allows persons in the SaeboFlex training program to receive dual rehabilitative benefits of dynamic grasp-release training and static tissue remodeling. The SaeboFlex is extremely popular in clinics but there is a paucity of research available regarding its clinical effectiveness; however, a pilot study demonstrated the device and training can yield improved wrist extension and reduction in muscle tone (Farrell, Hoffman, Snyder, Giuliani, & Bohannon, 2007). A recent project also demonstrated that SaeboFlex training may improve balance in persons with stroke (Saebo, Inc. 2010).

Virtual Reality

Virtual reality has become the ultimate patient experience for sensory modulation. Although empirical evidence is limited, devices such as the Nintendo Wii are common in rehabilitation clinics. A few recent studies have suggested that Wii games, used as adjunctive interventions to conventional stroke rehabilitation, can result in improved upper extremity function after stroke (Joo et al., 2010; Saposnik et al., 2010) and improved balance (Clark, & Kraemer, 2009; Nitz, Kuys, Isles, & Fu, 2010). In addition, client motivation and interest in the Wii tasks, games, and sports are reported to be extremely high (Anderson, Annett, & Bischof, 2010; Joo et al., 2010).

Many of the Wii activities are competitive in nature, whether the participant competes against another individual or attempts to improve on his/her prior performances. This aspect of “Wii-habilitation” (the term often used) provides the participant with a goal, a new challenge, or a directed purpose. Historical evidence from the OT literature has shown that when tasks have added purpose or meaning, that is, when activities are multidimensional and goal-oriented, motor learning improves and movement kinematics are normalized (Ferguson & Trombly, 1997; Lin, Wu, & Trombly, 1998). Automatic motor responses and typical sensory feedback patterns emerge when clients engage in meaningful and enjoyable activities. Although rigorous investigations and specific outcomes obtained with the Wii are in the early stages, preliminary evidence indicates that the Wii may be a usable, motivating tool to add to our therapeutic repertoire.

Strategies for Change

If we continue to use ineffective strategies and outdated methods with our clients, we will soon see the consequences of failing to act. Healthcare spending is already being scrutinized and those professions who do not demonstrate successful outcomes will not receive healthcare dollars. Services not reimbursed will not survive. Most importantly, the disservice we do our clients by not providing them the most innovative, effective, and meaningful intervention during the limited time we have with them is unthinkable, not to mention, unethical.

There are options whereby we can redirect this dangerous trend:

1. **Educate.** Insuring that an OT department is fully versed in current practice is the responsibility of the manager of the department or the education specialist. Support for attendance at state and national conferences and continuing education offerings will provide the impetus for this learning. Therapists who are trained or who become familiar with novel devices or new intervention strategies will be more inclined to use these methods in daily practice. Occupational therapy programs can involve students in evidence-based practice behaviors and expose them to rehabilitation technologies that show proven effectiveness in the clinic.
2. **Collaborate.** Clinicians can reach out to academics and researchers within the profession and the academics can do likewise. These individuals are often the ones on the forefront of research evidence; they can assist practitioners in translating the literature into meaningful, effective interventions and creating evidence-based practice models within facilities.
3. **Defy Convention.** Accept that some of the methods we use to enable occupation in our clients will not be occupation-based. Strategies such as these may be grounded in the medical model, but we should not reject them merely because impairment or remediation is the focus. The medical model has served us well, securing and validating our worth; accepting that it is a *piece* of who we are as occupational therapy is paramount. Additionally, these interventions are the *means* to an occupational end, the *tools* that practitioners can use to facilitate and promote healing, which can lead to successful occupational performance in clients.

Summary

As research emerges, technology evolves, and markets grow, our intervention choices will continue to expand. If we acknowledge that many of our clients have physical limitations and impairments that, when reduced or remedied, can lead to function for occupational performance, then why would we choose not to use evidence-based tools and strategies with proven effectiveness in speeding functional outcomes?

If therapists are willing to try these devices and techniques and assess their worth and effectiveness, these treatment options would potentially become more available to patients. Only with our use and eventual purchase of the devices might we see these technologies as a widespread therapeutic option; only by implementing evidence-based strategies will payers recognize them as standard and effective treatments that are reimbursable. Many of these tools lend themselves easily to the *measurement* process, which validates our services. With measurable outcomes, we can demonstrate the cost-benefit of services; this evidence can in turn influence policy and funding, eventually providing more access to the interventions (G. Stone, November 18, 2009, lecture at the University of Texas Medical Branch, Galveston, TX). Devices such as these could then be accessible to more clinics and patient homes.

Healthcare has evolved and we *must* support the use of effective interventions. Our treatment choices *must* produce meaningful and measurable outcomes. Our results *must* be expedient. If tools and techniques at our disposal can begin to address impairments in such a way that our clients can improve their occupational performance, we have a professional and moral responsibility to explore them. As occupational therapists, we can then affirm the uniqueness and creativity of our therapeutic interventions, validate our practice by using evidence-based tools that produce effective outcomes, and simultaneously ensure that we are doing everything we can to enable human occupation.

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