Forced Use – A Handling Strategy

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The purpose of this article is to provide the reader with an historical perspective, and an overview of the methodology and findings in the area of Forced Use, Constraint Induced Movement therapy research; and to present implications for clinical practice.

Above: In this activity the client is forced to maintain the body mass by actively pushing with the involved upper extremity while at the same time utilizing coordinated motor control in the hip, knee, and ankle complex distally. The client is forced to recruit skeletal muscle force on the involved side. The involved upper extremity and lower extremity segments are organized in an alignment that requires force to be produced against gravity to control the center of mass within the limits of the base of support. The less involved lower extremity (flexed and on a higher surface) is placed at a disadvantage for the selection of compensatory strategies.

The forced use paradigm is defined as the employing of management strategies designed to engage the client in activities that disallow over compensation with the non/less involved body segments while forcing the utilization of the more involved segments. As a theoretical construct the forced use paradigm has been operationalized into therapeutic interventions to force the central nervous system (CNS) to optimize the potential for reorganization/neural plasticity and overcome learned non-use through situations of massed and controlled practice.

Forced Use as a concept has been applied to management strategies historically in Behavioral Science and also in the Bobath Approach. As early as 1917 Geoffrey Ogden and Shepard Franz published the results of research in an animal study demonstrating the potential for recovery of motor control through forced use.[1] Research in Forced Use as a viable method for reinstating motor control has continued to be explored by many scientists particularly in the last decade. The continuing research is being done by: S. Wolf[2], E. Taub[3], H. Hummelsheim[4], B. Kopp[5], A. Kunkel[6], W. Miltner[7], R. Nudo[8], Merznich[9], Leipert[10].

Above: In the upright posture the client is forced to support more of the body weight on the involved lower extremity. The less involved lower extremity is placed at a disadvantage for supporting body weight.

Berta Bobath also utilized the concept of forced use as a management strategy.. In her handling strategies for Adult Hemiplegia, Mrs. Bobath created conditions, which forced the client to use the more involved body segments in functional movement. Some examples of these strategies included transfers toward the involved side, a starting alignment with the involved foot behind the less involved foot for the transitional movement of sitting to standing, as well as utilizing higher surfaces with the involved foot on the floor and the less involved lower extremity supported on a surface so the client had no option for utilizing this side for support. In general the Bobath approach included management strategies disallowing overcompensation thus preventing the phenomenon commonly described by researchers as 'learned non-use.'

The current research in neuroscience lends support

Simultaneously the upper extremities are involved in the role of balance as the client steps from the floor to a footstool with the less involved lower extremity.

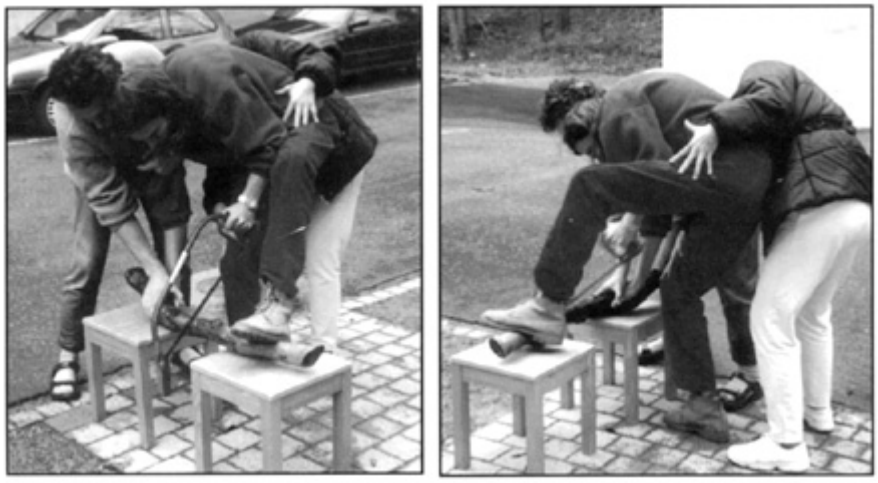
to the idea of forcing the CNS to recruit spared neural mechanisms requiring more intense levels of stimulation. The research also suggests that in the presence of compensation these neural mechanisms cannot be accessed. In other words the potential for recovery of motor control is dependent upon creating conditions requiring processing resulting in the recruitment of the spared neural mechanisms. An example of the possible neurophysiological basis underlying forcing the system to engage in processing resulting in recovery is demonstrated in the research regarding newly discovered motor areas of the cerebral cortex. Much of the research is related to the knowledge concerning of additional motor areas on the medial wall of the cerebral cortex projecting to lower motor neurons innervating skeletal muscle.[11, 12, 13] The research findings also include brain imaging on recovered clients with Hemiplegia indicating that these neural networks have been recruited for the re-instated motor control.[14, 15]

It is important at this point that a clear distinction be made between the two ways that Forced Use can be employed as a management strategy. Currently the research has employed Constraint Induced methodology to overcome the effects of learned non-use and ensure the experience of massed practice for activating spared neural mechanisms. In these conditions of practice the non-involved hand and wrist is restrained by a mitt or in other circumstances of practice the entire upper extremity is restrained including the elbow and shoulder. Stringent criteria have been constructed for inclusion in this program.

In the EXCITE(Extremity Constraint Induced Therapy Evaluation)[16] research that is being conducted in the United States, the clients are divided into two populations. In first category (lst Quartile) the clients must be capable of raising the involved upper extremity to 90 degrees, extend the wrist 20 degrees, and move all finger joints ten degrees. For inclusion in the second category (2nd quartile) the client must be capable of moving the shoulder into 90 degrees of elevation, ten degrees of wrist extension and ten degrees of abduction of the thumb and at least ten degrees of extension of at least two additional fingers. The clients in the first quartile group participate in Constraint Induced movement therapy for two weeks, for 90% of their waking hours. The clients in the second quartile participate for a three-week period.

Based on this criterion the majority of clients with Hemiplegia are excluded from participation in

these studies. To meet the needs of these clients and exploit the potential for recovery of function it becomes clear that clinical forced use management strategies would be necessary in order to access neural mechanisms leading to the recovery of motor control. These kinds of management strategies could potentially be used immediately after onset of a lesion to access the mechanisms involved in reinstating activation of skeletal muscle. If begun early development of compensatory strategies and the resulting "learned non-use" may be unnecessary. It becomes clear that while the goal of these two strategies for forced use is identical the types of intervention are very different. Training of the client would involve handling by skilled professionals to create situations of motor activity preparing the client to make more appropriate movement selections in function. This would involve intervention in which all of the body segments are considered and controlled simultaneously. Both of these conditions of practice require a great deal of motivation on the part of the client, and in both cases the experience of continued and repeated success is a factor in the intensity of motivation. Presently in the Constraint Method the client solves the movement problem alone with the more affected body segment, in this case the involved upper extremity. The selected movement strategy may not be energy efficient or visually pleasing initially but over time with continued practice the movements are characterized by more typical motor parameters.



Pictures number three and four: In this example a forced use paradigm is incorporated into the functional activity of sawing wood. The client is biased to the involved side through increased loading of the body weight over the involved lower extremity. The involved upper extremity is utilized in weight bearing to stabilize the wood. Sawing against resistance with the less involved arm promotes both increased stability in the involved shoulder girdle and a push into extension distally with the involved upper extremity. This activity generally creates conditions that enhance inter-limb dynamics between the two sides and promotes more active automatic movement in the involved limbs.

Forced Use Progressions and Handling Strategies

The following management strategies have been developed for the utilization of forced use progressions in the treatment of adult Hemiplegia. These strategies include creating practice conditions involving closed chain (weight bearing) activities for improved synergistic organization, strength, and endurance in the more involved upper and lower extremity segments. Under these conditions somato-sensory feedback is enhanced for graded force parameters in skeletal muscle by establishing the potential for accessing spared neural networks, which may be recruited in more intense conditions of stimulation. The less involved side is placed at a disadvantage for use as the primary base of support in relation to of the body mass. In addition there is an emphasis on open chain (non - weight bearing) movements of the less involved extremities. Under these conditions the client is forced to utilize skeletal muscle control in the more involved extremities.

The following activities are examples of strategies, which have evolved from what we have learned from the Bobaths, and from the evidence supporting motor recovery in Forced Use Research. The following pictures illustrate two examples in which forced use is incorporated into management as a preparation for meeting the demands of a functional goal. The last two pictures illustrate how forced use can be utilized in the practice of the functional goal itself.

In conclusion there are a number of theoretical as well ethical issues to be considered. This is a critical time in health care and it seems essential that integrating forced use progressions into therapeutic intervention has the potential to be beneficial to a broad spectrum of clients including those with little or no functional ability in the involved body segments. Inclusion of clients in the acute stages of recovery could result in faster more complete reinstatement of motor control, while at the same time eliminating the degree of overcompensation and resultant learned non-use.

Historically in early intervention the emphasis on the part of the health care professional and the client has been in the utilization of strategies emphasizing compensatory behaviors. It is possible that the choice of forced use in clinical management could eliminate the lack of recovery. Another way of viewing the integration of forced use interventions is the possibility of bringing the clients within the functional levels required in the upper extremity for Constraint Induced movement therapy research. Acceptance into the research protocol affords the client the experience of the massed practice conditions leading to further recovery in the arm. The focus of both of these approaches is directed toward affording clients the possibility of practice in the context of functional activities as opposed to exercises remote from function. The focus is entirely on the acquisition of function through multiple varieties of massed practice. The role of Forced Use as a management strategy in research has historically had a profound impact on reorganization in the central nervous system leading to the recovery of motor control. What has been presented here is an overview of a methodology that provides the trained specialist with information that can be useful in constructing therapeutic interventions leading to more complete recovery. What has been achieved in animal research needs to be recognized as having efficacy in recovery in humans.

Resources

1 Ogden, R and Franz, S. On Cerebral Motor Control: The Recovery From Experimentally Produced Hemiplegia. Psychobiology. 1917; 1(1): 33-49.

2 Wolf, SL and Blanton, S. An Application of Upper Extremity Constraint-Induced Movement Therapy in Patients With Subacute Stroke. Physical Therapy. 1999 Sep; 79(9): 847-853.

3 Taub, E; Uswatte, G; and Pidikiti, R. Constraint-Induced Movement Therapy: A New Family of Techniques With Broad Application To Physical Rehabilitation-A Clinical Review. Journal of Rehabilitation Research Development. 1999 Jul; 36(3): 237-251.

4 Hummelsheim, H. Rationales for Improving Motor Function. Curr Opin Neurol. 1999 Dec; 12(6): 697-701.

5 Kopp, B; et al. Plasticity in the Motor System Related To Therapy Induced Improvement of Movement After Stroke. Neuroreport. 1999 Mar 17; 10(4): 807-810.

6 Kunkel, A; et al. Constraint-Induced Movement Therapy For Motor Recovery in Chronic Stroke. Arch Phys Med Rehabil. 1999 Jan; 80(6): 624-628.

7 Miltner, WH; et al. Effects of Constraint-Induced Movement Therapy on Patients With Chronic Motor Deficits After Stroke: A Replication. Stroke. 1999 Mar; 30(3): 586-92.

8 Nudo, RJ; et al. Neural Substrates For the Effects of Rehabilitative Training on Motor Recovery After Ischemic Infarct. Science. 1996 Jun; 21(272): 1791-1792.
9 Merznich, MM. (Eds: Rakic P and Singer W.) Cortical Representational Plasticity in Neurobiology of Neocortex. Wiley; New York: 41-67.
10 Liepert, J; et al. Motor Cortex Plasticity During Constraint-Induced Movement Therapy in Stroke Patients. Neurosci Lett. 1998 Jun 26; 250(1): 5-8.
11 Nudo, R. Recovery After Damage To Motor Cortical Areas. Curr Opin in Neurobiol. 1999; 9: 740-747.
12 Hutchins, AM; et al. Corticospinal Projections From the Medial Wall of the Hemisphere. Exp Brain Res. 1988; 71: 667-672.
13 Dum, RP and Srick, PL. Medial Wall Motor Areas and Skeletomotor Control, Curr Opin in Neurobiol. 1992; 2: 836-839.
14 Chollet, F; et al. The Functional Anatomy of Motor Recovery After Stroke in Humans: A Study With Positron Emission Tomography. Ann Neurol. 1991; 29: 63-71.
15 Kandel ER, Schwartz JH and Jessell TM. Principles of Neural Science: Fourth Edition. McGraw Hill: 757-767.
16 Excite Grant; PHS 398 (Revised April 1998). Funded multi-site project being conducted at University of Alabama at Birmingham, University of Southern California, University of North Carolina at Chapel Hill, Wake Forest University, University of Florida, Ohio State University and Emory University.