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Educating Clients, Families, and Health Care Professionals About Constraint-Induced Movement Therapy (CIMT)

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EDUCATING CLIENTS, FAMILIES, AND HEALTH CARE PROFESSIONALS ABOUT CONSTRAINT-INDUCED MOVEMENT THERAPY (CIMT)

Master's Scholarly Project

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CHAPTER I

INTRODUCTION

The risk of stroke is increasingly prevalent after the age of 55. With a significant percentage of the United States population (i.e., the Baby Boomers) growing older, the impact of these strokes becomes an increasing concern for the American public. Strokes, also known as cerebrovascular accidents (CVA), are the leading cause of long-term disability and the number three killer within the United States (American Stroke Association, n.d.). It has been estimated that approximately 730,000 individuals fall victim to a stroke annually (Bonifer & Anderson, 2003), and 168,000 of those die (Stroke News, 2003). It is reported that as a result of stroke, 4 million people are currently living with a physical and/or mental disability (Bonifer & Anderson). It is estimated that Americans will pay approximately 51 million dollars for stroke related medical costs and lost productivity in the year 2003 (Stroke News).

Stroke clients are the largest of the physical disabilities populations served in a rehabilitation setting. Of the stroke clients, approximately 88% of them have suffered from an ischemic stroke (Stroke News, 2003). Researchers have determined that approximately 56% percent of these victims report continued impaired motor function, most often hemiparesis, after five years post-stroke (Taub, Uswatte, & Pidikiti, 1999).

These clients typically receive conventional outpatient rehabilitation therapy, consisting of 1-3 days per week for ½-1 hour sessions, for a period of several weeks to a few months (Blanton & Wolf, 1999). Rehabilitation therapies are comprised of physical, occupational, and speech therapy. Sessions focus on reducing impairment

and minimizing disability by using adaptations, compensation, and strengthening of the unaffected side (Page, Sisto, Johnston, Levine, & Hughes, 2001). The main objective in stroke rehabilitation is to enable the individual to become as independent and productive as possible (American Stroke Association, n.d.).

Within occupational therapy treatment, the clients, as well as their family members, are involved in the treatment process. The focus of the occupational therapy process is to maximize the client's function, which will enable them to increase their independence and safety across all environments. Every client and family member search for the best treatments that will give the client his/her greatest possible outcome. One occupational therapy intervention technique that has been researched in recent years, and has shown greater results than traditional therapy, for mild to moderate hemiparesis/weakness, is constraint-induced movement therapy (CIMT) (Page et al., 2001).

CIMT is an intervention that has research support for improving motor ability of the affected upper extremity (of those with mild to moderate hemiparesis) following a stroke or brain injury (Bonifer & Anderson, 2003; Sterr, Elbert, Berthold, Kolbel, Rockstroh, & Taub, 2002). CIMT is defined by Miltner, Bauder, Sommer, Dettmers, and Taub, 1999, as an intervention for clients more than one-year post-stroke that involves restraining the unaffected upper extremity over a two week period with intense rehabilitation training of the affected upper extremity, 6 hours per day, for 10 days. Research has demonstrated that CIMT produces great improvement of motor function within the 2-week period and the treatment effects remain stable for

many months after the termination of therapy. These improvements have also shown to transfer into the client's everyday lives (Miltner et. al., 1999).

An area that supports the effectiveness of CIMT has been the recent discovery in relation to cortical reorganization of the brain following this type of intervention. After a lesion or deprivation, cortical representation has been described to decrease in size. Dromerick, Edwards, and Hahn, (2000), state that discoveries have been made, with the use of neuronal imaging, in preventing further deterioration and promoting cortical reorganization when motor activation of the affected side is used to initiate tasks. These discoveries show that CIMT could possibly be a better intervention technique to use rather than the traditional therapies using compensatory techniques, in that CIMT has the abilities to promote cortical reorganization after a stroke.

The earliest CIMT techniques date back to the 1970s in animal research (Page et al., 2001), in which it was discovered that an affected limb is capable of active "movement by conditioning its use" (p.583), now referred to as CIMT. Ostendorf and Wolf (1981) expanded this technique by trying it on a human who had suffered from a stroke, which resulted in mild upper-extremity hemiparesis. The results of their case study demonstrated that the techniques used were effective, but were not conclusive. This study did provide a basis for further research with human subjects.

Wolf, Lecraw, Barton, and Jann (1989) and Blanton and Wolf (1999) later used similar techniques of restraining the unaffected upper-extremity of 25 individuals who had suffered from a stroke or traumatic brain injury during waking hours for 2 weeks duration. The participants needed to meet the following "traditional protocol" inclusion criteria: 1) ability to actively extend at least 20

degrees at the wrist and 10 degrees at the fingers of the affected extremity, 2) more than 1 year post-ischemic stroke, 3) sufficient stability to safely walk when the unaffected upper extremity is immobilized, 4) no communication barriers, and 5) no visual-perceptual impairments (Blanton & Wolf, 1999). The reason for set criteria was to ensure that the participants had the abilities to engage in such an intense intervention. Conditioning of the affected upper extremity was also accomplished throughout this study, as was done in Ostendorf and Wolf's (1981) study. The results showed improvements in 19 of the 21 functional task measures done with the affected upper extremity, which persisted at the 1-year follow-up study. This study demonstrated that "forced use" of the affected extremity reversed the "learned nonuse" phenomenon.

According to Dromerick et al. (2000) "learned nonuse" is a term used to describe the compensation that an animal or human may learn after one side is affected from a central nervous system injury or illness. Typically, the unaffected side is therefore used to compensate for difficulty experienced when trying to use the affected side to complete tasks. "Because the patient or animal continues to use compensatory strategies, the intrinsic recovery that occurs remains 'masked'" (Dromerick et al., p.2984). When the animals or humans are forced to use their affected side, it reinforces the abilities that the affected side once had.

A further study developed by Taub, Miller, and Novack in 1993, reported by Blanton and Wolf (1999), expanded upon studies done by Ostendorf and Wolf (1981) and Wolf et al, (1989). In this study, 6 hours of supervised training sessions were added to 10 of the 14 days of restraint. The training consisted of "shaping", as

described in Bonifer and Anderson's (2003) study: 1) choosing tasks that address the individual's motor impairments, 2) assisting the client for a portion of the task as if they were incapable of completing the task on their own at first, and 3) providing verbal feedback to acknowledge small improvements towards task completion. The results from this study showed even greater motor improvements when compared to the previous studies. Therefore a combination of the intervention approaches was demonstrated to be the most effective method (Blanton & Wolf). This combined method will be referred to as the "traditional protocol" for CIMT throughout this paper.

Past research has been limited to the "traditional protocol" CIMT, for stroke and traumatic brain injury diagnoses, which includes specific inclusion criteria, "shaping" training method, and extensive clinical rehabilitation intervention. Recent research, however, has been expanded to include multiple diagnoses and modified protocols. In the past, CIMT had not been viewed to be beneficial for individuals in acute, inpatient, or conventional outpatient settings. Within the past five years, CIMT studies have been conducted using modified approaches to show how effective and universal this therapy intervention can be.

One modification of the "traditional" CIMT protocol, with a variety of populations (i.e., cerebral palsy, childhood hemiparesis, inpatient clients, hemorrhagic stroke clients versus clients with ischemic strokes, and with clients up to 15 years post-stroke). Another modification that has been tested is alteration of the traditional protocol introducing less therapy time in the clinic and more motivation and self-discipline for a home-based program. These modifications, which will be discussed

further in Chapter II, may create greater opportunities for occupational and physical therapy clients in the future.

There are several monetary limitations that come along with the CIMT intervention technique. One is that CIMT works best on certain populations that have specific motor criteria on their affected side (i.e., at least 20 degrees of wrist extension). This limits those who would be considered as a "CIMT candidate". Another is that this intervention requires that the client is motivated to stay with the specific instructions regarding when and where to wear the restraint. This portion of the protocol not only needs the client's cooperation, but the family's as well. The client and their family must also understand the procedures and their purposes in relation to increasing the clients motor ability to function more effectively. This is why as occupational therapy professionals, it is of extreme importance to educate and inform the client and family members about this type of intervention technique.

The purpose of this project is to inform and educate occupational therapy clients suffering from mild to moderate upper extremity hemiparesis, their family, as well as other healthcare professionals about an alternative occupational therapy intervention technique, CIMT. By educating these individuals, they will better understand the importance of following the specific CIMT protocol, the achievable results and provide them with answers to questions they may have. Through edcuation, clients and family members will be better able to choose CIMT as an alternate treatment intervention. The following chapter will contain a review of CIMT research literature that will assist in the creation of the final products (Refer to Chapter IV), an educational brochure for clients and their families (See Appendix A);

and a brochure to containing in-depth educational information for healthcare professionals (See Appendix B).

CHAPTER II

LITERATURE REVIEW

Constraint-induced movement therapy (CIMT) was first researched by Carole Ostendorf and Steven Wolf in the late 1970s/early 1980s. Their study (1981) focused on the effects of "forced use" of the upper extremity of a patient with hemiplegia, secondary to stroke. This study was the first attempt to measure the benefits of restraining the unaffected extremity of a hemiplegic individual and to extensively incorporate the affected extremity in tasks and rehabilitative interventions. The study did report that the individual's functional use of the affected extremity increased during purposeful tasks (Ostendorf & Wolf, 1981). This improvement sparked further interest to research "forced use" interventions and the corresponding improvements in function.

The focus of this literature review is to report the efficacy of CIMT as a therapeutic intervention that in the long run has the potential to reduce consumer, third-party payer, and health care facility costs, includingan increased amount of staff utilization. The literature review will provide an extensive background regarding the benefits of incorporating CIMT into occupational therapy treatment interventions for clients post-stroke within a variety of rehabilitation settings.

Research has shown supporting evidence that CIMT has been effective for motor recovery of the upper extremity with clients post-stroke and recently, research has studied the effectiveness of using modified CIMT protocols, to reduce overall healthcare costs. Additional research has been conducted with a variety of diagnoses (e.g.,traumatic brain injuries, cerebral palsy, and aphasia) using CIMT interventions.

In the following pages, the supportive evidence for CIMT will be presented, including the more recent modifications and additions for more diverse client populations.

Animal CIMT Research

A series of experiments of "forced use" or CIMT interventions following the Ostendorf and Wolf (1980) study were conducted with monkeys and rats. Edward Taub and associates studied the effects of surgically induced strokes on primates. The primates immediately discontinued use of the deafferented extremity post-surgery. The primates continued to disregard the extremity during the next few weeks. However, if the unaffected arm was restrained, the monkeys began to use the affected extremity. Rehabilitation, or a "shaping" method, was incorporated by researchers to force the monkey to utilize the affected arm. The monkeys demonstrated extensive use of the extremity after treatment, thus demonstrating a reversal of "learned nonuse" patterns (Wolfgang, Miltner, Bauder, Sommer, Dettmers, & Taub, 1999).

The animal learned nonuse pattern and its reversal was again seen in the research study by Debow, Davies, Clarke, and Colbourne (2003). These researchers studied the effects of CIMT combined with a rehabilitation program on rats having suffered an intracerbral brain hemorrhage (i.e., stroke). Rats were randomly assigned to groups of no therapy, traditional exercise therapy, basic CIMT therapy, or CIMT with a rehabilitation program combined. The rats' unaffected forelimbs were restrained 7 days/week from 8:00 a.m. through 4:00 p.m., with the use of sleeveless jacket bracelet restraints. The rehabilitation exercises consisted of 1 hour/day, for 7

days, including a tray task for 30 minutes, 10 minutes for the cylinder, ladder crossing a minimum of three times, and wheel running for 10 minutes tasks.

The study reported that the group of rats with combined CIMT and rehabilitation intervention showed substantial motor recovery of the affected extremity during tasks and testing. The therapy alone and no therapy group did not demonstrate any benefits for the affected extremity. The CIMT group improved as well; however, not as significantly as the combination treatment group. In addition, the combination group showed a statistically significant, greater volume of brain tissue accessed after treatment. The increased brain tissue accessed demonstrates the increased ability for the brain to repair, or reorganize itself, resulting in increased function.

Noteworthy research using both traditional CIMT interventions and modified CIMT techniques has been done with human subjects. These research studies will be discussed in the following paragraphs.

Traditional CIMT Studies With Human Subjects

Traditional CIMT protocols, for persons greater than one year post-stroke, have consisted of an intensive 2 week program that requires restraining the unaffected arm 90% of waking hours, through the use of either a resting hand splint or a sling. Six hours a day, for 10 of the 14 days, are spent with skilled professionals (i.e., occupational or physical therapist) working on a variety of tasks resulting in "forced use". "Shaping" techniques (as previously described in Chapter 1) are consistently used throughout the traditional CIMT studies. Common assessments used to measure the effectiveness of this specific intervention are as follows:

1. Fugl-Meyer Assessment (Fugl-Meyer) is a 66 point upper extremity activity measurement scale.
2. The Total Action Research Arm (ARA) test is a 19 item assessment, divided into four subscales: grasp, grip, pinch and gross movement of the affected extremity.
3. The Motor Activity Log (MAL) is a structured interview which assesses how well (i.e., quality) and how much (i.e., quantity) the individual perceives he/she uses the affected upper extremity on 30 daily life activities. A score of 0 means it is not used; a score of 5 means that the extremity is used a normal amount or with normal function (i.e., same as before the stroke).
4. The Wolf-Motor Function Test (WMFT) is used to assess voluntary movements, joint-by-joint, during 14 timed functional tasks and 2 strength tests (Page, Sisto, Johnston, Levine, & Hughes, 2001; Page, Sisto, & Levine, 2002; and Dromerick, Edwards, & Hahn, 2000).

In a 1999 true experimental designed study by Wolfgang et.al., a traditional CIMT study was attempted using 15 chronic clients post-stroke. The study's participants experienced an average of 1.2 strokes in their lifetime. The range of time since stroke was 0.5 to 17 years. Recruitment methods were through advertisements, or physician/neurologist referral. All participants were required to meet the following inclusion criteria:

1. At least 20˚ extension of the affected wrist.
2. 10˚ of extension for each finger.
3. No balance problems sufficient enough to compromise safety.
4. No serious uncontrolled medical problems.
5. Limited spasticity and/or pain.
6. No serious cognitive deficits.
7. A maximum score of 3.0 on the Motor Activity Log (MAL).

During the study period, participants were restricted from movement of the unaffected extremity. This was done by the participant using a resting hand splint for 90% of waking hours for 12 days. The participants wore the splint during all hours with the exception of bathing, toileting, or other activities where restraint was unsafe. During CIMT intervention at the clinic, participants also wore a sling in addition to

the resting hand splint. Prior to intervention, participants were asked to sign a contract stating that they would comply with restraint rules and CIMT intervention standards throughout the study.

During the twelve day period, the "shaping" technique was performed on the affected upper extremity for 7 hours a day for 8 of the 12 days. Participants performed a variety of upper extremity exercises and tasks exclusively using the affected extremity to perform them.

Test measurements were taken both pre- and post-research intervention. Electromyography (EMG), electroencephalography (EEG), magnetic resonance imaging (MRI), and transcranial stimulation were conducted by specialists. These were done to assess the extent of each participant's brain tissue damage prior to intervention in comparison to after intervention. Functional laboratory task measurements were assessed using the WMFT. Real-world functional outcomes were assessed using the MAL. This assessment also incorporated the participant's perceptions of function, making the study outcomes both quantitative and qualitative.

From pre-treatment to post-treatment, each outcome measurement resulted in significant improvement. Two of the subjects who had suffered a CVA 6 months prior to intervention did about as well as some of the chronic individuals. These results indicated that CIMT may be a beneficial tool for improving the movement of the affected extremity after acute stroke in additionto chronic stroke.

A German research group, Miltner, Bauder, Sommer, Dettmers, and Taub, 1999, replicated this study to determine if CIMT efficacy could be generalized to their setting. This study involved 15 individuals, similar to the previous experimental

study, and also used the same inclusion criteria of the previous study. The participants were recruited via advertisement and physician referral. The MAL and WMFT were the standardized tests in this study.

The MAL was completed two weeks prior to initial contact to establish a baseline. The MAL and WMFT were both given 15 days prior to intervention, one day prior to intervention, 4 weeks after intervention, and at 6 months post-intervention. The intervention itself consisted of placing the unaffected extremity in a restraint for 90% of the waking hours for 12 days; and receiving intervention via the "shaping" method on 8 weekdays for 7 hours per day. Tasks and methods were similar to the American study by Liepert, et al., 1998.

The German facility's research study results were similar to that of the American research study. Improvements and function were similar after intervention; therefore the efficacy of CIMT and can be generalized to a broader cultural application (Miltner, et.al., 1999).

Bonifer and Anderson (2003) conducted a case study using a traditional CIMT protocol with a 53 year-old woman who had suffered a stroke 15 years prior to CIMT intervention. The WMFT, MAL, upper extremity portions of the Fugl-Meyer, the Brief Neuropsychological Cognitive Evaluation, and the Mini-Mental State Examination (MMSE) were used as the pre-intervention measurement assessments in this study. Post-intervention assessments were administered one day after intervention ended. The follow-up testing (1 and 6 months post-intervention) involved the motor assessment, graded WMFT, MAL, Fugl-Meyer, MMSE, and participant comments.

This study used a three-week intervention program that required the participant to restrain her uninvolved arm with a mitt for 90% of her waking hours, and to attend 6 hours of therapy on all weekdays. During the therapy the participant's treatment consisted of: massed practice, shaping, one-on-one training, occassional feedback, home treatment agreement, and keeping a daily diary of activity (i.e., both the participant and the caregiver).

The results of the intervention showed that the scores on the MAL, graded WMFT, and Fugl-Meyer scores had increased, although not significantly, from pre-test to post-test. At the 6-month follow-up, the only score that progressively improved was the graded WMFT. The Fugl-Meyer scores had not increased, but did remain higher than pretest scores at follow-up.

Modified CIMT Techniques

Because of difficulty with insurance reimbursement for CIMT, modifications in CIMT intervention protocol have been developed and studied over recent years. Reimbursement concerns regarding CIMT stem from the perceived increased treatment hours, increased staff usage, and the previous lack of definitive research supporting CIMT beneficence. Modifications in CIMT protocols were designed to address these concerns, decreasing the amount of intervention and staffing time, and moving more into a home-based intervention setting. Modifications have also been made not only to address reimbursement concerns, but to include clients acutely post-stroke in CIMT studies.

One of the first modified studies was done by Blanton and Wolf, 1999. Modifications were made regarding CIMT inclusion criteria to include acute or recent

persons post-stroke. Previous CIMT studies incorporated only more chronic CVA individuals, this study was developed to determine if CIMT was also efficacious in more recent stroke victims (i.e., prior to six months post-stroke).

The study's participant was a 61 year-old female who suffered a right cerebrovascular accident (CVA) from an ischemic lacunar infarct of the posterior limb of the left internal capsule. The participant's inclusion criteria were as follows:

1. ability to extend the MCP and IP joints of the thumb and at least 2 additional digits 10º.
2. passive range of motion of at least:
    a. 90º in shoulder abduction and flexion.
    b. 45º in shoulder external rotation.
    c. No more than -30º of flexion contracture at the MCP and IP joints.
3. 3-7 months since stroke occurred.
4. at least 24/30 on the Folstein Mini-Mental examination
5. ability to independently and safely transfer to and from the toilet, sit to stand, and maintain standing balance for 2 minutes
6. 18 years of age or older
7. no drug participation or rehabilitation

Initially after her stroke, the participant spent 19 days in inpatient rehabilitation. During the 14-day intervention time, the participant spent 10 days of 6-hour supervised treatments performing functional tasks using the affected extremity. She wore a mitt on her uninvolved hand during all waking hours except when performing activities with water such as showering, washing hands, and toileting.

Measurements were taken using the WMFT and the MAL at pre-, post-treatment, and at 3 month follow-up. After intervention, the WMFT assessment indicated increased ability speeds. These improvements continued to occur after intervention, even at 3-month follow up.

The MAL scores were based on participant observation. Both the participant and her caregiver reported increased quality and quantity of affected extremity use

after CIMT intervention. Scores continued to increase from post-intervention to follow-up.

Dromerick et al. (2000) performed a research study on 20 participants having suffered an acute stroke (i.e., within 2 weeks). This study was designed to research the implementation of CIMT immediately after stroke, and also the effects of using a modified CIMT protocol.

This research design was a prospective, randomized, controlled, clinical trial with ten participants in each group. Informed consents were received and baseline measurements were taken. Each participant was randomly assigned to either the control or experimental group. Each group would receive an equal amount of therapy sessions. Participants were only included after completion of 14 days of inpatient study. A blinded observer measured results at the end of the study.

Subjects for the study were selected from an acute stroke and brain injury rehabilitation hospital. Patients with hemorrhagic acute were excluded from the study to allow a focus on ischemic stroke results. Inclusion criteria included:

1. admission within inpatient rehabilitation facility within 14 days of ischemic stroke
2. persistent hemiparesis leading to impaired upper extremity function [score of 1 or 2 on Motor Arm Item of National Institute of Health Stroke Scale (NIHSS)]
3. evidence of preserved cognitive function (0-1 on consciousness, communication, and neglect items of NIHSS)
4. presence of a protective response [≥3 on Upper Arm item of Motor Assessment Scale(MAS)]
5. no upper extremity injury or conditions that limited the use before the stroke.

The NIHSS measure was used as the primary screening instrument and measure of the stroke severity. The upper arm function item of the MAS was used as

the screening tool for inclusion within the study. This test determined the amount/quality of protective reaction of potential participants.

Total Action Research Arm Test (ARA) was scored after 14 days of participant treatment. To measure each participant's basic ADL functions, the Barthel Index (BI) was used at patient discharge. The Functional Independence Measure (FIM) was used and includes five items that assess function of the upper extremity (i.e., eating, grooming, bathing, UE dressing, and LE dressing). Points are determined on a 7-point ordinal scale. The BI scores and FIM scores were taken at discharge.

Both groups received an equal amount of both time and intensity of treatment. All received treatment for 2 hours a day, 5 days a week, for 2 weeks. The control group received standard occupational therapy treatment which included compensatory training, strengthening, range-of-motion activities, ADL activities, positioning, and circuit training techniques. The CIMT group had treatment focused on directing subject attention and effort to the hemiparetic upper extremity. Intervention minimized the use of the functional or uninvolved arm during functional training activities. To prohibit the use of the functional UE, each CIMT participant wore a padded mitten for at least 6 hours per day during the 14 days of intervention. During this time, participants focused on using the affected arm during ADLs and other functional tasks.

Twenty individuals completed the 14 day study requirements. Measurements prior to intervention showed that there were no significant differences between the two groups for lesion location, Mini-Mental Exam Scores, or NIHSS scores.

After 14 days of treatment, however, the mean total ARA score was significantly higher in the CIMT group than in the traditionally treated group. These results support the study's hypothesis. All mean post-treatment ARA subtest scores were improved for the CIMT group, but only the pinch subtest showed statistically significant results. The FIM mean scores also increased for the CIMT group, with improvements in eating, grooming, bathing, upper extremity dressing, and lower extremity dressing. However, the BI demonstrated no significant differences between groups (Dromerick et al., 2000).

Sabari, Kane, Flanagan, and Steinberg (2001) reported an unplanned case study of CIMT intervention immediately post-stroke which occurred as a result of natural events, additionally supporting the beneficence of CIMT intervention immediately post-stroke. The participant was a 79-year old female who was right-handed. She had received an infarct to her right ventromedial pons area of the brain, and in doing so, fell and fractured her right humerus. Because her stroke occurred in her right hemisphere, her stroke affected the ability of her left extremity.

The humeral fracture required orthopedic intervention to immobilize her right arm in a sling. Data were obtained one year post-stroke and CIMT intervention. Data were collected from a review of her medical record, 3-hour session interview, and assessments (i.e., FIM, Arm Motor Activity Assessment (AMAT), and the MAL).

The AMAT evaluates a person's ability to use his/her affected arm in 28 task skills of 13 functional activities. Tasks are graded on a 6-point scale based on amount, speed, and quality of participation with scores ranging from 1-140.

Immediately after the participant's stroke, her upper limb muscle strength was recorded as 3/5 in shoulder elevation and 0/5 in remaining motions. Her FIM scores totaled 14, with an average score of 1.1 on each task. This indicated a total need for assistance to complete each task. The AMAT was not administered upon admission, however, chart reviews lead study facilitators to believe she would have received a total score of 0.

While within inpatient hospitalization, the patient was dependent upon the use of her affected extremity for independence. The occupational therapist was, therefore, obligated to use CIMT intervention techniques, forcing the patient to use her affected arm during graded activities and challenges.

The patient was discharged after 35 days of hospitalization. At this point in time she was able to move her affected (i.e., left) upper extremity through full range of motion. She required only minimal assistance in dressing and undressing tasks. She was independent with eating using her left upper extremity. With adaptive equipment, she was also independent with toileting, grooming, mobility, and other motor tasks.

Scores upon admission were: FIM-14, AMAT-0, MAL amount of use-0, MAL quality of use-0. At discharge scores were FIM-70 (i.e., an increase of 56). The AMAT-was not assessed, MAL quantity of use-15, and MAL quality of use-13. At one year case report study assessment the scores were: FIM-86, AMAT-136, MAL quantity of use-25, and MAL quality of use-24. AMAT, MAL amount of use and MAL how well of use all increased significantly from admission scoring to one-year post-discharge. Those who received rehabilitation within the same hospital had an

average increase of 18.86 on the FIM from admission to discharge, while this case study participant had an increase of 56 points. This statistically significant difference in post-inpatient intervention again supports the effectiveness of constraint-induced movement therapy as an effective technique any length of time post-stroke.

Sterr et al., 2002, performed a modified constraint-induced movement therapy study in which they compared the efficacy of longer versus shorter daily CIMT for persons with chronic stroke. This study's modification of CIMT intervention was to decrease therapy time by 50% (i.e., only 3 hours per day compared to the traditional 6-7 hour per day CIMT intervention.

The study was a two group design, with randomly assigned participants. Measurements, using the MAL and the WMFT, were taken both pre- and post-intervention, with a MAL assessment used again at follow-up. Fifteen participants were selected by convenience sampling for the research study. Thirteen of the participants were post-stroke, and 2 of the participants had suffered a traumatic brain injury. Prior to study participation, all participants were examined by a neurologist to determine if they were healthy enough to participate in the interventions required. Participant inclusion criteria were as follows:

1. ability to extend wrist 20˚ and extend fingers 10˚
2. few balance difficulties,
3. minor spasticity,
4. no aphasia,
5. a score of 20+ on the Mini-Mental State Examination
6. post-stroke more than 12 months.

Eight participants were randomly assigned to the 3-hour CIMT intervention per day group; and 7 to the traditional CIMT 6-hour intervention group. Both groups received traditional CIMT intervention, however, the one group received a reduced

amount of hours of the "shaping" intervention. Treatment was provided for each weekday for 2 weeks, and the participants wore their restraints on weekends although no therapy was given.

The results of this study indicated that there were significant gains for both groups, which increased the participants' quality of life and function in everyday activies. The gains were, however, greater in the 6-hour per day group.

This study demonstrated that a more cost-effective and less intensive training protocol is effective within a clinical setting. However, clients may gain greater functional independence with their affected upper extremity with the CIMT traditional protocol versus the modified protocol. As previously mentioned, the traditional CIMT contains more therapy session time when compared to modified versions, therefore it results in higher costs.

Page et al. (2002) also studied the effects of intervention time in a modified version of a CIMT protocol. The participant suffered a stroke 2 years and 4 months prior to the study. Inclusion criteria were the same as the traditional CIMT protocol, as stated in Chapter I. The Fugl-Meyer and ARA assessments were given on two separate dates prior to the intervention, and the MAL was given once.

The modification of the CIMT intervention included reduction of therapy time to one half hour session of physical therapy and one half hour of occupational therapy, 3 times per week, for 10 weeks. During therapy, the participant did not wear a restraint and worked on functional tasks, strengthening, compenstatory techniques, and stretching. The restraint was worn for 5 hours each weekday during the busiest time of the day.

The Fugl-Meyer, ARA, and MAL were administered 1 week after CIMT therapy and again 3 months after intervention. Results showed that both the Fugl-Meyer and ARA scores improved from pre-intervention to post-intervention, and continued to improve at the three-month follow-up. MAL scores also increased in both patient and caregiver report for both quantity and quality of use. The patient also reported an increased ability to perform activities of daily living at home since intervention. All improvements were maintained at 3-month follow-up and beyond.

Page et al., 2001, conducted another modified constraint-induced therapy protocol. The purpose of the study was to determine whether a modified CIMT protocol was feasible for outpatients who had a learned nonuse phenomenon of their affected arm. The CIMT group was compared to a traditional physical and occupational therapy group and also to a no treatment group.

The study design was a randomized pre- and post-test design. The 6 participants were recruited from 4 different hospitals upon discharge from outpatient therapy. The subjects had to meet the following inclusion criteria:

1. at least 20˚ wrist extension and 10˚ finger joint extension
2. Stroke 1-6 months prior to study intervention
3. a score of 70+ on the Modified Mini Mental Status Examination
4. no hemorrhagic or bilateral lesions or lesions in the primary sensory or motor cortical areas
5. be between the ages of 18 and 95 years of age
6. have no extreme spasticity
7. no pain in affected extremity
8. must be discharged from all therapies
9. and cannot be participating in any other studies, including drug or rehabilitation studies.

The outcomes of the study were measured with the Fugl-Meyer

Assessment, ARA, WMFT, and the MAL assessments. All participants were randomly assigned to one of three groups. The CIMT and traditional therapy groups had outpatient therapy 3 times a week for 10 weeks, with 1 half-hour of physical therapy, and 1 half-hour of occupational therapy each day. The traditional groups' intervention consisted of 80% neuromuscular facilitation and 20% compensatory technique education. The CIMT subjects were required to restrain their unaffected extremity with the use of a sling for 5 hours every weekday. The control group received no intervention.

The results of this study showed that the patients who had received the modified version of CIMT had significant improvements after intervention, as assessed by the ARA, Fugl-Meyer, WMFT, and the MAL. The other two study groups demonstrated no significant improvements after 10 weeks of intervention. These results reveal that modified CIMT administered on an outpatient basis can result in greater improvements than those receiving traditional or no therapeutic intervention.

In 2002, Page et al. reported the results of another modified CIMT intervention study with a subacute stroke participant. This was a case study in which measurements were taken both pre- and post-intervention. The subject was a 68 year old woman with a left ischemic stroke, 5 months prior to the study. It was determined through MAL interview that she was demonstrating a learned nonuse pattern with her affected right upper extremity. At time of intervention, she had already been discharged from outpatient therapy.

Study inclusion criteria included:

1. at least 10˚ of active wrist extension of the affected extremity
2. active extension of all thumb joints
3. 10˚ or more of extension in at least 2 or more of the fingers
4. 4 weeks to 6 months post-stroke
5. 70 or higher on the Modified Mini-Mental Status Examination
6. no hemorrhagic or bilateral lesions
7. between the ages of 18 to 95 years of age
8. no excessive spasticity
9. no extreme pain in the affected extremity
10. discharged from all physical rehabilitation
11. not participating in any other rehabilitation or drug studies

The Fugl-Meyer, ARA, WMFT, and the MAL were used to assess the functional performance of the participant. Twice prior to intervention, the ARA and Fugl-Meyer were administered. Only once prior to intervention were the MAL and WMFT administered. The subject's unaffected upper extremity was restricted with a sling for 5 hours per day for the 5 weekdays, over a 10-week period, totalling 250 hours. The subject kept a log to document times of restraint and the activities performed during the times of restraint.

In addition, the subject received therapy 3 times a week for 10 weeks, 30 minutes with occupational therapy and 30 minutes with physical therapy. Eighty percent of treatment time consisted of PNF techniques, with occupational therapy focusing on upper extremity functional tasks and physical therapy focusing on stretching of the upper extremity, gait, balance, and dynamic standing. The other 20% of treatment time was used to teach compensatory techniques for the unaffected extremity. The shaping technique was used throughout. All of the assessments were given one week after intervention was completed.

All assessment results demonstrated substantial improvements from pre-test to post-test, although they were not statistically significant. The Fugl-Meyer

Assessment showed a 20-point improvement and the ARA showed a 6-point improvement in scores. The WMFT demonstrated an enhancement in task performance and a decrease in the amount of time taken to complete the tasks. MAL scores revealed an increase in the amount of reported use of the affected extremity. The participant reported five more activities in which she used her affected extremity after intervention.

Page, Elovic, Levine, and Sisto (2003) studied the combined effects of constraint-induced movement therapy and botulinum toxin "A" injections. This was a case study of a 44 year old man who suffered a right middle cerebral infarct. Fourteen months after his stroke, he began a modified constraint-induced therapy program.

This study had many of the same protocols that previous studies used. The study lasted for 10 weeks while requiring a restrained unaffected extremity for 5 hours on each weekday, both during therapy sessions and at home. After the CIMT therapy, the participant reported an increased ability to perform activities of daily living such as answering/dialing the phone, pouring/drinking a beverage, and playing cards. He received a Modified Ashworth Scale tone score of 2 of 5 in the flexor muscles of his affected arm. He showed fair strength in finger flexion and wrist supination, with poor strength in finger extension. This was due to his continued spasticity and resultant impaired ability for fine motor movements and tasks.

Two weeks after modified CIMT ended, Botox injections were administered to the affected upper extremity in designated muscles that were reported by the participant to have stiffness and noted spasticity. Measurements were taken, using

the Fugl-Meyer and the ARA, two times before the CIMT intervention, one time after the CIMT intervention, and again one time after the Botox intervention. Scores on the Fugl-Meyer improved 13 points from the initial screening to the first post-test and increased another 4 points at the post-test after Botox injections. The ARA scores improved 7 points from the intitial administration to the first post-test and increased by 9 more points from the first post-test to the second post test after the Botox injections.

These results indicate the potential efficacy of the combination of constraint-induced therapy and the intervention of Botox injections to increase improvements when spasticity is inhibiting further rehabilitation.

Different Diagnoses and Ages in CIMT Studies

Traditional and modified constraint-induced movement therapy study participants have been limited to adults post-stroke. More recent studies, however, have researched CIMT and its effectiveness with other diagnostic populations.

One such study was done by Sterr, Freivogel, and Schmalohr in 2002. Their study's purpose was to evaluate the learned nonuse phenomenon of CIMT in adolescents with traumatic brain injury with the use of behavioral assessments. The study used two groups, one experimental, and one control group to compare the results. Pre- and post-tests were used, with outcomes measured using statistical analysis.

The experimental group consisted of twenty-one participants who had suffered from traumatic brain injuries, which resulted in hemiparesis. These participants were between the ages of 5 and 26. These subjects had been in a

rehabilitation clinic in Germany for at least one month before they were tested and were at least 3 months post-TBI. The control group consisted of 21 healthy individuals, who were recruited through school systems with the use of posters. A neurologist tested the experimental participants for the following inclusion criteria:

1. A TBI, resulting in upper extremity hemiparesis
2. at least 30˚ arm elevation of the affected upper extremity
3. 20˚ or greater wrist extension against gravity
4. at least 10˚ finger joint extension of at least one finger against gravity
5. able to open hand in order to grasp small ball
6. no moderate to severe spasticity
7. cognitively capable of following directions
8. and a minimum score of 20 on the Mini-Mental State Examination

The two tests used in this study were the Actual Amount of Use Test (AAUT) and the MAL. The AAUT is a test in which a professional observes spontaneous motor use of the affected limb during 14 different tasks. For this study, the AAUT was altered and divided into two sections. In one of the sections, the participants were asked to complete different tasks and were not allowed to ask questions during the assessment. The other section consisted of asking the participants to perform the tasks again, this time with their affected extremity. There was also a one minute time limit on each of the tasks. The MAL was also divided into two sections. The first section asked the participants to subjectively rate the amount of use and the quality of the movement of their affected limb in 20 daily activities. The second section asked that they perform the 20 tasks with their affected upper extremity and self-rate their actual performance.

The results of the study determined that those in the experimental group had low spontaneous AAUT scores and significantly higher forced AAUT scores, which showed that they had the capability of using their affected upper extremity when

forced to use it. The control group participants used their dominant hand for most of the spontaneous tasks and they all could use their non-dominant hand for all of the tasks when asked. MAL scores were lower overall in the experimental group compared to the control group. The spontaneous quality of movement and actual quality of movement scores differed significantly in the experimental group when compared to the control group. The experimental group, once again, underestimated their motor abilities of their affected upper extremity.

This study suggested that the learned nonuse phenomenon is possibly a behavioral act. The patients may underestimate their abilities, therefore do not use their affected limb for spontaneous activities. When forced to use the affected limb, however, they discover their innate ability to effectively use it. This shows that CIMT intervention training could be useful for individuals with a learned nonuse phenomenon after an accident or disease that causes an upper extremity to be affected.

A study by Candia, Elbert, Altenmuller, Rau, Schafer, and Taub (1999) researched the effects of constraint-induced movement therapy and focal hand dystonia in musicians. Focal hand dystonia is a disorder in which manual incoordination occurs, most commonly in individuals such as musicians, or those who engage in "extensive and forceful use of the hand's digits (fingers)", Candia et al. (p.42).

This study followed five professional musicians suffering from long-standing symptoms of focal hand dystonia. Three of the professionals were pianists and two were guitarists. All five participants were immobilized by splints placed on one or

more of the fingers, other than the affected digit. The affected digit was therefore required to carry out repetitive exercises in coordination with one or more of the other digits for 1.5-2.5 hours per day over a period of 8 consecutive days (under therapist supervision). There was also continued wearing of the splint for 1 hour per day at home in combination with gradually increasing periods of practice without the splint.

Measurements were taken with a dexterity/displacement device which continuously recorded digital displacement during a metronome paced movement of two fingers. A dystonia evaluation scale was also used to rate how well the participant performed without the splint.

The results of this study found improvement in ability to use the affected finger without the splint at the end of the treatment intervention. Only one participant was found noncompliant after 9 months of therapy intervention. Results also showed that progress continued even up to the 12 months post-follow-up, demonstrating the potential effectiveness of CIMT intervention with this diagnosis.

CIMT studies have recently been researched with younger populations. In an article by Willis, Morello, Davie, Rice, and Bennett (2002), conducted such a study on the effects of forced use with childhood hemiparesis.

This study used an experimental design, with both a control group and an experimental group. Twenty-five children between the ages of 1 and 8 were recruited to participate. All children suffered from chronic hemiparesis as a result of a static brain lesion. Participants were randomly assigned to each group, with measurements taken both before and after intervention, using the Peabody Developmental Motor

Scale (PDMS). This is a commonly used assessment within the pediatric domain. The measurements of these children were compared to normative data results.

The PDMS was given to all 25 children prior to participation. The experimental group was then casted prior to intervention. This entailed placing a plaster cast on their unaffected upper extremity, below the elbow, distally to the fingertips, to be worn for 1 month. At this time, both groups continued with their traditional occupational and physical therapy sessions, neither group receiving any additional intervention.

At 1 month after cast removal, the PDMS was again administered and again 6 months later. At the six-month follow up, only 7 treatment and 10 control participants were re-tested. At this time, the control group individuals were placed in upper extremity casts identical to those in the experimental groups. After 1 month of wear, the casts were removed and the participants were reassessed, and again 1 month and 7 months later.

The scores of the initial experimental group increased by 12.6 points after 1month of casting, whereas the control group scores only increased by 2.5 points after 1 month. Six months later, 7 control participants having been casted had mean scores on the PDMS that showed an increase of 15.9 points from pre-treatment assessment to post-treatment.

The initial control group participants, that were casted six months later than the other 7 control group participants, showed improvements in their scores by 12.5 points after only 1 month of casting. All parents reported improvement in motor function in the affected upper extremity of their children after casting. This study

supports the use of a modified pediatric constraint-induced movement therapy as an effective therapeutic intervention.

In 2002, Pierce, Daly, Gallagher, Gershkoff, and Schaumburg reported the beneficence of CIMT intervention with the pediatric population as well. This study researched the effects of CIMT on a child with hemiplegic cerebral palsy.

The study was a case study involving a 12-year-old male with cerebral palsy, whose right upper extremity was affected as a result. Upon study admission, the boy received one-hour sessions of occupational and physical therapy, two times per week, for a duration of 3 weeks. Occupational therapy's focus was on the neuromuscular re-education of the left upper extremity with the use of functional activities in therapy. The physical therapy focus was on exercise, fine motor and play activities.

The patient wore a mitt on his left (unaffected) upper extremity during treatment and an average of 1 hour each day at home. A home exercise program was implemented which included functional and play activities for him to perform while wearing the mitt restraint.

Measurements were taken using the WMFT, dynamometer for grip strength, and the Assessment of Motor Skills (AMPS). Assessments were taken at baseline, post-intervention, and at 8-month follow-up. The results were improvements in the time for 13 of 15 activities on the WMFT from pre- to post-intervention. Grip strength also improved by 4.9 pounds per square inch of force at this time. The AMPS indicated improvements in 8 of the 16 motor skills and 5 of the 20 process skills from baseline to post-intervention testing. Scores at the 8-month follow-up

found that WMFT scores had continued to improve. The participant also reported that he used his left arm more than he had prior to intervention.

CIMT and Speech-Language Pathology

Constraint-induced therapy studies have not only been performed with different modifications and diagnoses, but have also recently been researched using this intervention within different professional discipline sessions. Traditionally, CIMT interventions have been implemented by occupational and physical therapists. Speech pathologists have now begun researching CIMT and its efficacy with clients' post-stroke suffering from chronic aphasia, a condition in which language processing or word formation is impaired as a result of the brain lesion.

In a study by Pulvermuller, Neininger, Elbert, Mohr, Rockstroh, Koebbel, and Taub in 2001, study participants were randomly assigned to a treatment group or a control group. The treatment group received a modified version of constraint-induced therapy and the control group received conventional speech intervention. Both groups received the same amount of treatment hours (30-35) throughout their designated days of study. The treatment group (i.e., ten participants) received massed practice language exercises during a minimum of 3 hours per day for 10 days. The conventional group (i.e., seven participants) would receive treatment over a longer period (about 4 weeks).

Study members were required to sign an informed consent prior to intervention. All participants were pre-evaluated by neurologists and speech therapists for confirmation of aphasia, using a battery of tests. The study's exclusion criteria included: any severe perceptual or cognitive deficits, left-handed participants,

or those with neurological deficits or depression. All participants presented with a language deficit secondary to a stroke affecting the left middle cerebral artery.

The CIMT group sessions were comprised of 2 to 3 participants playing a variety of therapeutic games using cards with a therapist. During treatment sessions, all communication had to be performed by speaking with words or complete sentences. No gesturing, pointing, or other body movements were allowed.

Constraint was applied by slowly increasing the amount of difficulty of communication material, shaping the rules of the game, and by using reinforcement contingencies. In addition, participants were required to use proper names of other participants, such as: "Mrs. Smith", and to specify how many of an item, or what color of the item in questions. The control group received conventional methods most commonly used in outpatient rehabilitation settings for individuals with similar diagnoses.

Testing was done for both groups immediately before and 1 day after treatment intervention. Testing was done using four subtests of the Aachen Aphasia Battery: the token test, repetition, comprehension, and naming. The Communicative Activity Log was also used to determine the amount of communication and the quality of communication.

These testing results found that the CIMT group showed substantial improvement after the 10 days of intervention. This group increased overall in 3 of the 4 subtests (token, naming, and comprehension). The control group was not able to show any significant overall improvement. The control group only improved in one of the subtests post-intervention. The cumulative change for the CIMT group

was 17%; whereas the conventional group improved by only 2% after the same amount of intervention time.

The CIMT participants' performance in everyday communication was also noted to improve. There was a significant improvement of 30% reported in the amount of communication. The control group did not demonstrate any improvement in these measures.

This study showed that constraint-induced aphasia therapy does demonstrate quicker, greater results than conventional speech therapy. It supports the belief that constraint-induced movement therapy can be applied not only with different diagnoses, but also within different treatment disciplines.

Summary

The majority of the CIMT research studies conducted have been with participant's post-ischemic stroke that have met inclusion criteria and fulfilled a treatment and intervention time. These studies have shown supportive evidence regarding the efficacy of traditional CIMT intervention with this population.

Over the last several years, CIMT has become more well-known to the general public. Several high profile television networks have reported about the emerging studies and their results. Because of this recent development, this literature review was conducted to determine what exactly CIMT entails, who it is appropriate for, and the benefits and supporting research studies of CIMT intervention. This information has been compiled into a brochure for families and caregivers of clients post-stroke, with the objective to educate the individuals about CIMT, its demands, and its appropriateness. This brochure will also educate the consumer about the role

of occupational therapy providing CIMT for individuals post-stroke (See Appendix A or Chapter IV).

Occupational therapy's focus within physical disability settings is based primarily on assisting the client to regain upper extremity motor ability in order to functionally perform life tasks. Life tasks include feeding, dressing, personal hygiene, basic home management tasks, among others. CIMT has been shown to be one of the most effective upper extremity motor recovery interventions used for clients post-stroke. Study results have demonstrated that motor recovery for the upper extremity is not only possible with this intervention, but has also shown more significant improvement than with traditional occupational and physical therapy intervention. Not only have the studies reported objective benefits of the CIMT intervention, but study participants have also reported substantial improvements in overall function within their personal contexts.

By educating the consumer, family, and caregivers about the benefits of CIMT and the necessary demands, it is believed that the client will become more motivated and compliant with CIMT home interventions. This has the potential to help individuals more easily perform dressing, feeding, grooming, and other basic care needs. This increased ability will help to lower the costs associated with long-term disability. CIMT has been shown to be beneficial within both inpatient and outpatient rehabilitation settings. Due to the effectiveness of this technique, it is suggested that CIMT be considered for occupational therapy intervention to increase clients' functional abilities.

CHAPTER III

METHODOLOGY

The effectiveness of constraint-induced movement therapy (CIMT) has been demonstrated through extensive research presented in Chapter II. Researchers have typically studied CIMT with adult clients more than one-year post-ischemic stroke. Research results with these specific clientele have shown statistically significant motor (i.e., measured with the Fugl-Meyer, Action Research Arm, and Wolf-Motor Function Test assessments) and self-reported improvements (i.e., measured with the Motor Activity Log). Therefore, researchers have expanded the CIMT intervention to be used with different diagnoses and disciplines, as well as modifying the "traditional protocol" by altering the inclusion criteria and reducing the amount of necessary professional time.

The "traditional protocol" includes specific inclusion criteria (e.g., being able to actively extend the affected wrist 20 degrees and fingers 10 degrees), wearing a mitt or sling on the un-affected arm for a certain time period (i.e., 90% of waking hours for 2 weeks duration), using a specific method of training (i.e., "shaping", a behavioral technique), and intense hours of professional training (i.e., 6 hours per day for 10 days). Although modifications to the traditional protocol have demonstrated motor improvements and reported self-satisfaction, the improvements are not as great as when the traditional protocol has been implemented. Since CIMT studies have shown that this type of occupational therapy intervention results in greater improvements than conventional therapy (Page et al., 2001), CIMT should be considered as an alternative treatment method.

Even though there has been extensive research conducted and reported efficacy studies with the use of CIMT, many individuals, such as clients, their support systems (i.e., family), and healthcare professionals may not fully understand the concepts behind it. For example, these people may feel it is cruel to restrain the stronger arm and make a person use one's weaker arm to initiate their self-care tasks. Since most individuals are not aware or educated enough about this alternative intervention, it is not as accepted as the conventional occupational therapy interventions, such as strengthening and compensatory strategies. Therefore, the focus of this scholarly project is to overcome this issue by creating end products that will educate and inform individuals.

The literature review, in Chapter II, was conducted to reveal the extent of research done regarding the efficacy of CIMT, which may demonstrate its value to society as a whole by reporting clients' significant improvements. The literature, focusing on CIMT studies and clients post-stroke, was gathered from medical journals via resources such as CINAHL, PubMed, ODIN, and OT Search. Also included within this scholarly project are the writers' clinical experiences, educational knowledge, and information obtained from other practicing occupational therapists' clinical experiences regarding CIMT
(M. Waind, personal communication, November 20, 2003).

Occupational therapy's role with stroke clients is congruent with CIMT's objectives, as both strive to increase upper extremity motor recovery, as well as the client's satisfaction, in order for clients to perform their everyday tasks safely and

independently across all environments. This scholarly project was chosen by the writers in order to reveal CIMT's value, its compatibility with occupational therapy, and to educate clients, their families, as well as healthcare professionals about this alternative intervention method.

With the intent to inform clients and their families about CIMT, the writers created two brochures, which are presented in Appendix A. The first brochure contains "Top Ten Questions" and answers asked by clients and their families regarding the occupational therapy intervention, CIMT. The grandma of one of the authors assisted with the question format (L. Younggren, personal communication, November 20, 2003). The second brochure information is to educate healthcare professionals and includes a thorough description of CIMT, stroke facts, what the intervention process entails, the populations that benefit from this intervention, and the motor and personal benefits based on supportive research, presented in Appendix B. The final products are intended to increase the overall acceptance of this emerging, alternative occupational therapy intervention.

CHAPTER IV

PRODUCTS

The purpose of this scholarly project was to compile information into two brochures in order to inform and educate clients, families, and healthcare professionals about constraint-induced movement therapy (CIMT) intervention. First, the brochure for clients and family members contains the following "Top 10 Questions" and answers format regarding CIMT (See brochure presented in Appendix A). Secondly, the brochure for healthcare professionals contains a thorough description of CIMT, stroke facts, what the intervention process entails, for which populations it is appropriate, and the motor and personal benefits based on supportive research (See brochure presented in Appendix B). The content of the two brochures will be presented in the following paragraphs.

Client, Family, and Caregiver Brochure: "Top 10 Questions" and Answers

Q1. What is CIMT?

A: CIMT is an alternative occupational therapy (OT) intervention in which the client wears a mitt on their uninjured hand and performs selected activities with their weaker arm. This intervention requires that a client wear the mitt for 90 percent of their day, enabling the client use of their injured arm to do tasks. Approximately 2 to 6 hours are spent in therapy within the OT clinic each day over a period of 2 weeks. This intervention helps to "reprogram" the brain to remember how to use the injured arm when performing tasks a person previously did before the stroke.

Q2. How is it different from other interventions?

A: Instead of compensating for muscle weakness by using the uninjured arm, treatment is focused on allowing the weak arm to do tasks to make it stronger and more functional.

Q3. Who is CIMT for?

A: Research has found that this intervention is most useful for clients who have suffered from an ischemic stroke, also known as a stroke caused by a blood clot or other blockage in the vessels of the brain. It has also been recently studied with other populations having arm weakness, such as clients with traumatic brain injuries or cerebral palsy. CIMT clients must be motivated and willing to spend a large amount of time working with their weaker arm on a daily basis for a time commitment of 2 weeks. They must also be willing to make some changes to their daily routine as recommended by their occupational therapist. For example, wearing slip-on shoes rather than shoes with laces is commonly recommended.

Q4. How will I/my family member complete daily tasks when wearing a mitt?

A: The therapist and the client will work together to decide which tasks can be done without the mitt and which tasks must be done with the mitt on, before CIMT intervention begins. Tasks such as bathing and toileting are traditionally done without the mitt. Small adaptations can be made during this intervention time, such as, wearing sweat pants with elastic waists which allow the client to more easily take them on and off.

Q5. Who provides this service?

A: This service is provided by a trained registered occupational therapist.

Q6. How much improvement will I/we see?

A: Improvement varies from client to client; however, most results have shown to be more effective than the traditional therapy interventions. Typically, most clients notice changes in arm strength and function within 10 to 12 days into the intervention.

Q7. How long do the results last?

A: Studies have shown that results last up to six months to one year after CIMT treatment. Researchers and occupation therapists believe that with continued use of the injured arm, improvements remain and can continue to be seen thereafter.

Q8. Is it safe for me/my family member?

A: Your occupational therapist will determine if this intervention technique is best for you or your family member. This determination is made by the occupational therapist's thorough evaluation of your strength and other skills related to safety.

Q9. Does my insurance company cover CIMT?

A: Occupational therapy will use CIMT as an intervention technique within the clinic and through the use of a home program. Individual providers may vary, so the occupational therapist will receive therapy

authorization prior to starting the 2-week intervention. This approach allows your therapy to be reimbursed.

Q10. Who can refer me/my family member for this intervention?

A: Physicians are responsible for referrals to occupational therapy rehabilitation. You, a family member, or a health care professional can suggest this occupational therapy intervention to your physician to obtain an OT referral for CIMT.

Healthcare Professionals Brochure

What is CIMT?

CIMT is a rehabilitation intervention for persons post-stroke that involves restraining the unaffected upper extremity, allowing the affected limb to move and perform tasks. A mitt or sling is worn by the client on the unaffected upper extremity over a 2-week period. Intense occupational therapy training of the affected upper extremity occurs for 6 hours per day, for 10 days (Miltner, Bauder, Sommer, Dettmers, & Taub, 1999). This intervention is provided by a trained registered occupational therapist.

Research supports CIMT for improving motor ability of the affected upper extremity following a stroke or brain injury with those individuals having mild to moderate hemiparesis (Bonifer and Anderson, 2003; Sterr, Elbert, Berthold, Kolbel, Rockstroh, & Taub, 2002). CIMT produces observable improvement of motor function within the 2 weeks of treatment. The treatment effects have been shown to remain stable for many months after termination of therapy. The effects also have been demonstrated to be useful in the everyday lives of the clients (Miltner et al.,

1999). Studies in recent years have revealed faster motor results from CIMT than traditional occupational or physical therapy interventions (Page, Sisto, Levine, Johnston, & Hughes, 2001).

Stroke Facts

It has been estimated that approximately 730,000 individuals fall victim to a stroke annually (Bonifer & Anderson, 2003). Strokes are the leading cause of long-term disability within the United States (American Stroke Association, n.d.). It is reported that as a result of stroke, 4 million people are currently living with a physical and/or mental disability (Bonifer & Anderson). According to the American Stroke Association (2003) Americans will pay approximately 51 billion dollars for stroke-related medical costs and lost productivity in the year 2003.

Stroke is among the most common of populations served in a physical rehabilitation setting, which includes occupational, physical, and speech therapies. Of the clients post-stroke, approximately 88% have suffered from an ischemic stroke (Stroke News, 2003). The majority of CIMT clientele have experienced an ischemic stroke. Researchers have determined that approximately 56% percent of stroke victims report continued impaired motor function, most often hemiparesis, five years post-stroke (Taub, Uswatte, & Pidikiti, 1999). CIMT studies validate the effectiveness of this intervention, showing an increase in one's functional abilities within everyday lives.

What does CIMT entail?

The time restraint of the unaffected upper-extremity is during 90% of waking hours over 2 weeks duration. Restraining of the upper-extremity is accomplished

with the use of a padded mitt or an arm sling. This encourages the individual to use their affected arm to initiate tasks, which in turn re-trains motor ability for motion and activities done prior to onset of the stroke.

In addition to the 2 weeks of restraint, the client participates in 6 hours of supervised, professional training sessions. Professional intervention involves an occupational therapist to carry out the training. The training method consists of a behavioral technique, "shaping", as first described by Taub and Uswatte (2000) in the study by Bonifer and Anderson (2003). Shaping includes: 1) choosing tasks that promote improvement of the individual's motor impairments, 2) assisting the patient for a portion of the task as if they are incapable of completing the task on their own, and 3) providing verbal feedback to acknowledge small improvements towards task completion. Specific tasks that may be included are activities of daily living (i.e., brushing teeth, dressing, eating), instrumental activities of daily living (i.e., telephone use, cooking, cleaning), and leisure activities (i.e., cards, drawing, computer games) (AOTA, 2002).

In order to measure CIMTs efficacy, there are standardized, reliable, and valid assessments that are administered to the clients before and after treatment. These specific assessments include the Fugl-Meyer Assessment (Fugl-Meyer), Action Research Arm (ARA) Test, Motor Activity Log (MAL), and the Wolf-Motor Function Test (WMFT) (Dromerick, Edwards, & Hahn, 2000; Page, Sisto, & Levine, 2002; and Page et al., 2001).

Who Can be Referred for CIMT?

Traditionally, CIMT was used with clients at a minimum of one-year post-stroke/injury with mild hemiparesis. The studies that were first conducted showed that CIMT was more effective in increasing the motor abilities of these specific clients, when compared to regular rehabilitation therapies.

CIMT research has recently been expanded to determine its efficacy when used with modifications to the traditional protocol, which will be further described under the "Benefits and Supportive Research" section. Recent modifications have included acute clients post-stroke (i.e., less than 6 months).

Specific clients that would benefit from CIMT intervention would be clients with mild to moderate hemiplegia, secondary to a stroke or traumatic brain injury. Others that would also benefit are those with cerebral palsy or weakness of the upper extremity. If you are unsure if a client would benefit from CIMT, an evaluation can be done by an occupational therapist to determine if the client meets the specific inclusion criteria. Further questions can be answered by contacting an occupational therapist directly.

Benefits and Supportive Research

CIMT intervention techniques date back to the 1970s with animal research (Page et al., 2001). It was discovered that an affected limb was capable of active "movement by conditioning its use" (Page et al., p. 583), or what is now known as CIMT. Ostendorf and Wolf (1981) expanded this technique to a human subject who had suffered from a stroke, which resulted in mild upper-extremity hemiparesis. The results of their case study demonstrated that the techniques used were effective and

showed significant improvements in the client's function. This study sparked the interest of other researchers and launched over twenty years of CIMT research studies.

Studies have focused primarily on using the traditional CIMT protocol. Traditional studies done by Wolfgang, Miltner, Bauder, Sommer, Dettmers, and Taub (1999), Miltner et al. (1999), and Bonifer and Anderson (2003) have found that traditional CIMT intervention has been shown to demonstrate significant improvements in the affected upper extremity. All studies' results have shown motor improvements as well as increased quality and quantity of use of the affected extremity reported by the participant and their caregivers. Increased functional ability has been shown to remain from CIMT discharge to follow-up, with some further improvements seen during this period of time as well.

Traditional CIMT studies have required extensive professional intervention and have had clear inclusion criteria for participants. Because of this, recent CIMT research studies have begun investigating the effects of using modifications of the traditional CIMT protocol. Examples of these modifications include: decreased professional intervention time, more home-based intervention programs, and inclusion of acute (less than 6 months) clients post-stroke.

Studies regarding clients less than three months post-stroke have been done by Blanton and Wolf (1999), Dromerick et al. (2000), and Sabari, Kane, Flanagan, and Steinberg (2001). These study results have all shown significant improvements in all outcome measures of the affected extremity post-CIMT intervention. These study

results are encouraging other researchers to continue investigating acute CIMT intervention.

In 2002, Sterr et al. performed a modified CIMT study in which they compared the efficacy of longer versus shorter daily CIMT treatment sessions for persons with chronic stroke. The study results reported improvements in measurements for both groups; however, more significant improvements were demonstrated in the group using the longer CIMT intervention time.

Page et al. (2001, 2002, 2003) performed three different research studies which researched the effects of a reduced amount of CIMT clinical intervention. Again, study participants were seen to have improvements in all outcome measures, including the quality of the movement of the affected extremity. The results of CIMT intervention in one study (Page et al., 2001) found significant motor improvement when compared to the results of a traditional therapy intervention. Study participants also reported maintenance of their function after study discharge, up to one-year post CIMT intervention.

Summary

The purpose of this chapter was to compile information into two brochures, to inform and educate individuals about CIMT. The first brochure was designed for clients, caregivers, and family members. The brochure will be written using non-professional terminology. The format contains the "Top 10 Questions" and answers, as described previously and includes 14 size font and Arial text in order to create a more easily read product for those who may have visual difficulties (presented in Appendix A).

The second brochure was written for health care professionals, such as physicians, nurses, home health aides, and other allied health professionals in order to educate and inform them about CIMT. This brochure provides a medically relevant description of CIMT, pertinent stroke facts, a description about the intervention process, the appropriate populations, and a brief overview of the motor and personal benefits achieved, based on supportive research (presented in Appendix B). References used in development of the brochures will be supplied for further research purposes and personal contact information will also be provided for further questions regarding CIMT.

CHAPTER V

SUMMARY

For years, CIMT interventions have been considered to be an experimental technique. However, over the last 25 years, research has moved from studying animals and CIMT to included CIMT with human research participants. Study participants traditionally include clients at least one year post-stroke. Recent CIMT studies have now included individuals with traumatic brain injuries, cerebral palsy, or acute strokes.

Modifications have also been made to the traditional demands of CIMT intervention that have resulted in a more cost-effective and consumer-friendly intervention. Both traditional and modified CIMT research results have demonstrated that this intervention has the potential to produce statistically significant improvements in study participants' motor function, as well as an increase self satisfaction in regards to the use of the affected upper extremity during daily tasks.

Benefits of CIMT interventions are becoming increasingly familiar among the medical community and also the general community. As information regarding CIMT becomes more available to the general public via media, it is imperative that the consumer, their family, and their caregivers become educated about what CIMT intervention entails.

The CIMT information gathered through an extensive literature review has been condensed into two educational brochures. One brochure addresses the "Top Ten Questions" and answers most frequently asked by the client, family, and caregivers. The brochure is composed of a question/answer format and addresses

issues such as: *Who is CIMT appropriate for?*, *Who implements CIMT intervention?*, *What does CIMT intervention entail?*, *What are potential benefits of CIMT intervention?*, and *What is required of the CIMT client?*.

The brochure for healthcare professionals will contain a thorough description of CIMT, stroke facts, what the intervention process entails, for which populations it is appropriate, and the motor and personal benefits based on supportive research. A reference guide will be supplied to give professionals a list of resources to utilize for research purposes, as well as personal contact information for further questions regarding CIMT.

The plan is for the brochures to be distributed to clients, family members, caregivers, physicians, nursing staff, home health personnel, and stroke support groups. Future action may include distributing the brochures to the American Occupational Therapy Association (AOTA), in which the brochures can be available to all members of the association for clinical or personal usage. The overall end goal is to inform and educate individuals regarding the occupational therapy intervention CIMT.

APPENDIX A

APPENDIX B

APPENDIX C

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Websites to check out:

- www.stroke-info.com/cimt.htm
- www.strokecenter.org
- www.uab.edu/CITHERAPY

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CONSTRAINT-INDUCED MOVEMENT THERAPY (CIMT)

"TOP 10 QUESTIONS" & ANSWERS

FOR THE CLIENT, FAMILY, AND CAREGIVER

Q1. What is CIMT?
A: CIMT is an alternative occupational therapy (OT) intervention. The client wears a mitt on their stronger hand and performs activities with their weaker arm. The client is required to wear the mitt for 90 percent of their day, enabling the client use of their weaker arm to do tasks. About 2 to 6 hours are spent in the OT clinic each day over a period of 2 weeks. This intervention helps to "reprogram" the brain to remember how to use the weaker arm as used before the stroke.

Q2. How is it different from other interventions?
A: Instead of compensating for muscle weakness by using the stronger arm, treatment is focused on allowing the weak arm to do tasks to make it stronger and more functional.

Q3. Who is CIMT for?
A: Research has found that this intervention is most useful for clients who have suffered from an ischemic stroke, also known as a stroke caused by a blood clot or other blockage in the vessels of the brain. It has also been recently studied with other populations, such as clients with traumatic brain injuries or cerebral palsy. CIMT clients must be motivated and willing to spend a large amount of time working with their weaker arm on a daily basis for a time commitment of 2 weeks. Some changes in their daily routine may be recommended by their occupational therapist during the 2 weeks, such as, wearing slip-on shoes rather than shoes with laces.

Q4. How will I/my family member complete daily tasks when wearing a mitt?
A: The therapist and client will work together to decide which tasks can be done without the mitt before CIMT intervention begins. Tasks such as bathing and toileting are traditionally done without the mitt for safety reasons. Adaptations can be made to make tasks easier, such as, wearing pants with an elastic waist that allows the client to more easily take them on and off.

Q5. Who provides this service?
A: This service is provided by a trained registered occupational therapist.

Q6. How much improvement will I/we see?
A: Improvement varies from client to client; however, most results have shown to be more effective than the traditional therapy interventions. Typically, most clients notice changes in arm strength and function within 10 to 12 days into the intervention.

Q7. How long do the results last?
A: Studies have shown that results last up to six months to one year after CIMT treatment. Researchers and occupational therapists believe that with continued use of the weaker arm, improvements remain and can get better thereafter.

Q8. Is it safe?
A: Your occupational therapist will determine if this intervention is safe by thoroughly evaluating one's strength and skills related to safety.

Q9. Does my insurance cover CIMT?
A: Individual providers may vary, so the occupational therapist will receive treatment authorization prior to starting the 2-week intervention. This approach allows your therapy to be reimbursed in most cases.

Q10. Who can refer me/my family member for this intervention?
A: Physicians are responsible for referrals to occupational therapy rehabilitation. You can suggest this occupational therapy intervention to your physician to obtain an OT referral for CIMT.

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CONSTRAINT-INDUCED MOVEMENT THERAPY (CIMT)

FOR HEALTHCARE PROFESSIONALS

What is CIMT?

◘ An Occupational Therapy (OT) rehabilitation intervention for persons post-stroke that involves restraining the unaffected upper extremity, allowing the affected limb to perform tasks during therapy.

Stroke Facts

◘ Approximately 730,000 individuals fall victim to a stroke annually
◘ 88% have suffered an ischemic stroke
◘ Leading cause of long-term disability within the United States
◘ Most common of populations served in a physical rehabilitation setting
◘ Approximately 56% percent of stroke victims report continued impaired motor function, most often hemiparesis, five years post-stroke
◘ Americans will pay approximately $51 billion for stroke-related medical costs and lost productivity in the year 2003 (American Stroke Association, n.d. & Stroke News, 2003)

What does CIMT entail?

◘ Restraint of the unaffected upper-extremity, with a padded mitt, during 90% of waking hours over 2 weeks duration

◘ The client participates in 2-6 hours of supervised, professional OT training sessions during the 2 weeks

◘ CIMTs efficacy outcomes are measured with standardized, reliable, and valid assessments administered before and after treatment. These specific assessments include the Fugl-Meyer Assessment (Fugl-Meyer), Action Research Arm (ARA) Test, Motor Activity Log (MAL), and the Wolf-Motor Function Test (WMFT)

Who can be Referred for CIMT?

◘ Traditionally, CIMT was used with clients at a minimum of one-year post-stroke/injury with mild hemiparesis

◘ CIMT research has been expanded to include studies using modifications. Examples of these modifications include: decreased professional intervention time, more home-based intervention programs, and inclusion of acute (less than 6 months) clients post-stroke, clients with traumatic brain injuries, focal hand dystonia, or cerebral palsy.

◘ If you are unsure if a client would benefit from CIMT, an evaluation can be done by an occupational therapist to determine if the client meets the specific inclusion criteria.

Benefits and Supportive Research

◘ Recent studies have shown that CIMT is more effective in increasing the motor abilities of these specific clients, when compared to regular rehabilitation therapies (Page, Sisto, Johnston, Levine, & Hughes, 2001).

◘ Research supports CIMT for improving motor ability of the affected upper extremity following a stroke or brain injury with those individuals having mild to moderate hemiparesis (Bonifer and Anderson, 2003; Sterr, Elbert, Berthold, Kolbel, Rockstroh, & Taub, 2002).

◘ CIMT produces observable improvement of motor function within the 2 weeks of treatment. The treatment effects have been shown to remain stable for many months after termination of therapy. The effects also have been demonstrated to be useful in the everyday lives of the clients (Miltner, Bauder, Sommer, Dettmers, & Taub, 1999).

Internet Resources

◘ **www.stroke-info.com/cimt.htm**
◘ **www.strokecenter.org**
◘ **www.uab.edu/CITHERAPY**
◘ **www.scrippshealth.org**
◘ **www.cnn.com/**
◘ **www.intelihealth.com**