

# Improving Activities of Daily Living Performance in an Adult With Ataxia

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This case report describes occupational therapy interventions focused on improving the activities of daily living (ADL) performance of a 31-year-old man with an ataxia syndrome (motor control deficits, visual dysfunction, gait disturbance) secondary to multiple sclerosis. The rehabilitation of clients with ataxia syndrome is a challenge for occupational therapists because of the severity of dysfunction in ADL as well as the limited number of treatment options described in the rehabilitation literature. Various authors have advocated the use of weighted and adaptive ADL equipment (Broadhurst & Stammers, 1990; Schneitzer, 1978; Wyckoff, 1993; Yuen, 1993), weighting of the distal limb (Morgan, 1975), and application of various sensorimotor techniques (i.e., proprioceptive neuromuscular facilitation) (Urbscheit & Oremland, 1995). In addition to these techniques, case reports have advocated the use of relaxation techniques and biofeedback (Guercio, Chittum, & McMorrow, 1997) and the use of weighting in conjunction with elastic bandages (Okajima, Chino, Noda, & Takahashi, 1990).

Although “traditional” models of motor control based on reflexive or hierarchical frameworks are not supported in the literature as having appreciable effects on functional performance (Horak, 1991), a contemporary task-oriented approach (Haugen & Mathiowetz, 1995; Horak, 1991; Mathiowetz & Haugen, 1994) was chosen as a theoretical base for this client to guide evaluation and treatment. The occupational therapy treatment techniques described in this case report are based on a current review of the literature focusing on the motor control deficits associated with ataxia that were assumed to be the limiting factor for ADL independence in this client.

The contemporary task-oriented approach is based on a systems model of motor control in which the person, task, and environment are considered components of a system that interact to produce movement. This approach to motor control remediation focuses on occupational or role performance, client collaboration to determine problematic tasks, and collection of information regarding the role of the environmental context on performance as well as the interaction of multiple systems and subsystems that contribute to functional deficits (Mathiowetz & Haugen, 1994). Treatment is focused on helping clients find optimal strategies to achieve functional goals, alteration of task requirements, alteration of the environmental context, and the remediation of subsystem deficits that impair performance (Mathiowetz & Haugen, 1994).

With this model of motor control, the challenge for the occupational therapist is to identify control parameters that are the most important for the client. Haugen and Mathiowetz (1995) identified control parameters as the following: personal characteristics or environmental factors that constrain movement into specific patterns, factors that

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can cause a shift from one pattern of behavior to another, and factors that promote use of optimal or dysfunctional patterns for task performance.

In this particular client, it was hypothesized that performance would be improved by increasing postural stability and decreasing the number of joints (decreasing the degrees of freedom) required to participate in chosen tasks. This hypothesis was tested and supported by outcomes of improved scores on ADL measures and the client's ability to engage in specific activities that were meaningful to him. Interventions during occupational therapy treatment sessions included adapted positioning, orthotic prescription, adapted movement patterns, use of the environment for increasing trunk and limb stability, and prescription of adaptive ADL devices.

### Motor Control Deficits Commonly Observed in Clients With Ataxia

Damage to the cerebellum or the pathways that provide cerebellar input or output results in various motor control deficits that are collectively termed *ataxia*. According to Ghez (1991), the function of the cerebellum is to "regulate movement and posture *indirectly* by adjusting the output of the major descending motor systems of the brain. Lesions of the cerebellum disrupt coordination of the limb and eye movements, impair balance, and decrease muscle tone" (p. 627). Commonly observed motor control deficits that are associated with cerebellar pathology have been described in the literature (Bastian, 1997; Bastian, Martin, Keating, & Thach, 1996; Bonnefoi-Kyriacou, Trouche, Legallet, & Viallet, 1995; Ghez, 1991; Trouillas et al., 1997; Urbaschait & Oremland, 1995). Observable motor control deficits include tremors that are increasingly marked at the end ranges of movement and as precision is required; dysmetria (overshooting or undershooting a target); dysidiadochokinesia (decreased ability to perform rapid alternating movements); hypotonia, movement decomposition (dyssynergia); and tremors of the head, neck, and trunk.

In addition, the timing of postural responses is inadequate. Persons with ataxia generate trunk and lower-extremity responses too early to effectively counteract the effects of arm movements, resulting in a loss of stability. Postural responses of the trunk and lower extremities typically occur before upper-extremity movements (Belenkii, Gurfinkle, & Paltsev, 1967; Bouisset & Zattara, 1981) to stabilize the proximal segments and to counteract the movement of the upper extremity. Clients with ataxia demonstrate the same *pattern* of response but the *timing* of the response is delayed. The proximal responses are generated too early to counteract the destabilizing effects of the upper extremity (Diener, Dichgans, & Guschlbauer, 1989). Trunk control and stability is considered a prerequisite to participation in more complex activities (Franchigoni, Tesio, Ricupero, & Martino, 1997; Gillen, 1998).

Another hallmark of ataxia is related to functional

deficits associated with multijoint movements. These deficits may be more profound than those associated with single-joint movements. Persons with ataxia have an inability to control increasing degrees of freedom of the trunk and limbs. As the number of joints involved in the task increases, neural and biomechanical control demands increase, resulting in increased severity of ataxia and deterioration of function. Associated with this phenomenon is the client's inability to control interactional torques that occur passively in joints that are anatomically connected to the moving segment (Bastian et al., 1996). Faster movements may increase torque and further break down function.

### Client History

Phil was a 31-year-old man who was diagnosed with multiple sclerosis 2 1/2 years before the inpatient rehabilitation admission outlined here. His initial symptoms appeared 5 years before this admission and were characterized by diplopia, gait dysfunction, and limb coordination problems. He was admitted to the hospital with severe ataxia and an inability to care for himself. He reported that his neighbors were shaving him and performing his oral care and that he was attempting to eat by bringing his head to his plate or bowl because he had a complete breakdown in upper-extremity function due to the ataxia. In addition, his bladder function was affected, and he required intermittent catheterizations every 4 to 6 hr.

Phil lived alone, and although his immediate family members did not live locally, they were involved in his care. Additionally, he had a large support system of friends. Phil was a shoe designer for an international company. His private insurance covered 5 weeks of inpatient rehabilitation and limited home therapy, but it did not cover a home health aide.

Phil was admitted to the inpatient rehabilitation unit after receiving 10 days of intravenous solumedrol on the acute care unit of the same medical unit, with the goal of improving ADL and mobility skills. He received occupational therapy for 90 min daily, physical therapy for 90 min daily, and therapeutic recreation. He was cared for by certified rehabilitation nurses throughout his 5-week stay. His rehabilitation was overseen by a physiatrist, and his medication regime of oxybutynin chloride, clonazepam, propranolol, and methotrexate was monitored by his neurologist. Daily communication between the treatment team and neurology service was emphasized to monitor the functional effects of tremor dampening medications; specifically, in this case, propranolol (Andersson & Goodkin, 1996; Manyam, 1986).

### Evaluation Findings

Phil's initial evaluation focused on basic ADL because Phil identified this as the most important area for intervention. The Functional Independence Measure (FIM; Keith,

**Table 1**  
**Activities of Daily Living Assessments and Outcomes**

Assessment	Score on Admittance	Score on Discharge
Functional Independence Measure (Keith, 1987)		
Self-care		
Feeding	2	6
Grooming	2	6
Bathing	2	6
Upper body dressing	6	6
Lower body dressing	6	6
Sphincter control		
Bladder management	1	6
Bowel management	4	7
Barthel Index (Mahoney & Barthel, 1965)	40	90

1987) and the Barthel Index (Mahoney & Barthel, 1965) were administered as standardized measures of ADL performance. Selected FIM scores and Barthel Index scores are outlined in Table 1. Performance component dysfunction was evaluated within the context of functional activities (i.e., direct observations of task performance). See Appendix A for a summary of performance component dysfunction on initial evaluation.

*Feeding.* Phil required maximal assistance to eat. Attempts at hand-to-mouth patterns with and without utensils resulted in a complete breakdown of motor control, characterized by utensil stabbing of lips, cheeks, and tongue; food being propelled off his utensils; and emotional distress readily verbalized by Phil. It was noted that as Phil's utensil approached his mouth, his upper-extremity tremors and head and neck titubations worsened; in other words, as he approached the endpoint of the movement, his motor control deteriorated.

*Grooming.* Oral care was again characterized by stabbing of the oral cavity, multiple unsuccessful attempts to place his toothbrush in his mouth, and inability to control brushing movements secondary to dysdiadochokinesia. His attempts at brushing patterns resulted in the brush being propelled out of his mouth secondary to the severe ataxia. Shaving was evaluated with an electric razor, and Phil required maximal physical assistance to maintain contact of the razor on his face and to control the required movement patterns. He frequently propelled both the razor and toothbrush out of his hands secondary to violent tremors. Head and neck tremors also became a limiting factor during grooming activities.

*Bathing.* Showering required maximal assistance. Limiting factors for showering included lack of endurance to complete the task and an inability to hold and effectively use the soap. A tub seat was used during the evaluation to compensate for balance dysfunction and to ensure safety.

*Bowel and bladder management.* Phil required intermittent catheterization secondary to the bladder dysfunction associated with the multiple sclerosis. He required maximal assistance to complete this task. Bowel management required supervision only secondary to minimal balance dysfunction during clothing management. Phil was able to

perform toilet hygiene independently while seated.

*Sexual activities.* Phil was upset over his inability to successfully masturbate. He was comfortable sharing that his difficulties were due to lack of coordination and an inability to stabilize his posture (his preferred position to perform this activity was tall kneeling).

*Communication.* Phil was unable to use the telephone because he could not place the phone to his ear. Attempts to perform this movement pattern resulted in his throwing the phone receiver and hitting it into his skull. Phil's speech was intact, with the exception of minimal dysarthria that was manifested during periods of fatigue. Writing was not evaluated because both Phil and the occupational therapist did not consider this activity to be a realistic goal at that time.

*Dressing.* At the time of his evaluation, Phil preferred loose-fitting clothing without fasteners (sweatsuits, etc.); he required supervision only for safety while dressing with this type of clothing. Phil did not view this task as an area for immediate intervention and was satisfied with his performance.

The treatment sessions after his initial evaluation were spent changing various control parameters in an effort to collect data about what parameters enhanced his performance (i.e., decreased ataxia) as well as which task parameters further impaired his performance (exacerbated his ataxic movements). Experimentation with various movement patterns and environmental manipulations were key to identifying these parameters. See Appendix B for a summary of findings.

## Control Parameters

On the basis of the preceding findings from the evaluations and clinical observations, the following control parameters were hypothesized to have the most impact on the severity of Phil's tremors and his overall ADL performance:

1. As the degrees of freedom (number of joints involved in the task) increased, tremors increased and functional control decreased. This was demonstrated by Phil's inability to reach into space and inability to manipulate objects when paired with reaching activities and that his tremors worsened when he was required to control his trunk and upper extremity at the same time. When the degrees of freedom were controlled (decreased) during treatment sessions, upper-extremity trajectories were smoother and resulted in an improved ability to interact with the environment and perform functional activities. We were able to decrease the degrees of freedom by various techniques including the following: Phil sliding his hand across a table to reach a target versus reaching in space toward a target; using gross hand grasps rather than finer manipulation of objects; stabilizing both upper

extremities against his trunk (i.e., shoulder adduction and elbow flexion) during activities requiring distal function; using orthotics to stabilize selected joints; and using objects in the environment to stabilize his upper extremities and upper trunk during manipulation tasks (i.e., stabilizing proximal segments by leaning against sinks, counters, tables, walls).

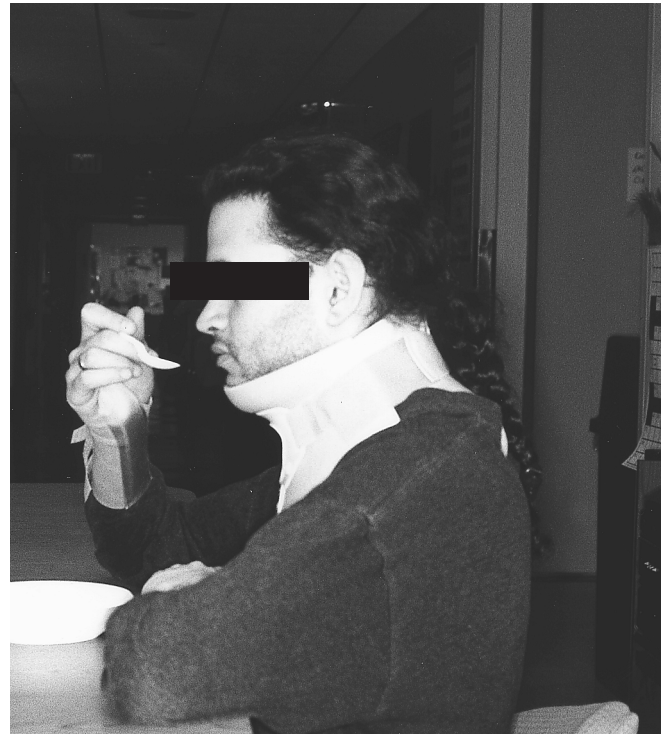
2. When Phil engaged in activities that challenged his postural stability, his tremors worsened. Observations to support this hypothesis included progressive worsening of tremors as Phil moved from supine to sitting to standing; improvement of tremors while seated in high-back chairs and semi-reclined postures where his trunk was supported (i.e., semisitting position with knees flexed and supported by pillows on the bed); and worsening of tremors when Phil became increasingly posturally insecure or when he was required to control his trunk against gravity (i.e., reaching beyond his arm span, weight-shifting during ADL).
3. A worsening of tremors was clearly evident during periods of emotional upset and fatigue. Before this admission, Phil practiced meditation techniques, which he reported had decreased the severity of the tremors.

### Treatment Interventions

Specific interventions introduced in occupational therapy were then based on the hypothesized environmental control parameters, as previously described. Treatments focused on task-specific training in basic ADL incorporating the occupational therapy modalities of orthotics, environmental adaptation, adaptive equipment prescription, and movement retraining. The basis for all interventions was decreasing the degrees of freedom required to participate in each task while simultaneously decreasing postural requirements. Specific task interventions are discussed in the following paragraphs.

*Feeding.* Orthotics were provided in an effort to decrease motor control requirements and to stabilize the cervical spine as well as the distal upper extremities. A semi-rigid Philadelphia collar was prescribed as well as off-the-shelf wrist supports. Phil's feeding position promoted postural security and was characterized by leaning into the table in a position of forearm weight bearing to stabilize his upper trunk. In addition, Phil's hand-to-mouth pattern of movement was modified from a continuous trajectory from plate to mouth to a three-step pattern as follows:

1. Slide hand and utensil across the table and manipulate food onto the utensil;
2. Bring the hand to a point approximately 2 in. from the mouth (to decrease the effects of intention and



**Figure 1.** The use of orthotics, positioning, and changing the endpoint target during feeding increases independence.

- smaller target size on worsening tremors); and
3. Relax and place food in the mouth.

Breaking the feeding pattern into three steps, decreasing the degrees of freedom with orthotics, and increasing postural stability via positioning resulted in increased control of the desired movement pattern (see Figure 1). Phil was able to eat independently with utensils, albeit with effort and increased time. Continued practice eventually decreased the time required to eat to a performance level acceptable to Phil.

Independence in finger-feeding was achieved by Phil bringing food to his mouth and stabilizing his hand under his chin; this posture, in conjunction with wrist orthotics, had stabilizing effects on both Phil's upper extremity and his head and neck. Food was then manipulated into the oral cavity, using his lips and tongue to bring the food into his mouth (see Figure 2).

*Oral care.* Wrist supports were also helpful for tooth brushing because they decreased upper-extremity control requirements. Movement patterns were adapted to use the environment for upper-extremity stabilization and to minimize reach into space (see Figure 3). Phil stabilized his hands on the edge of the sink during manipulation of the toothpaste and when putting the toothpaste on his brush. An electric toothbrush minimized the need to perform rapid alternating movements. Positioning during toothbrushing was adapted to one of standing in front of a wall in a position of forearm weight bearing while simultaneously co-contracting his trunk to promote postural stability. Using these stabilization techniques, Phil moved his



**Figure 2.** Independence is increased in finger-feeding by the use of orthotics, the stabilization technique of resting chin on hands, and the use of hand-over-hand patterns.

mouth around the toothbrush; that is, the toothbrush remained stable (see Figure 4).

*Shaving.* Wrist supports were again used during this task. Positioning was modified so that Phil was standing facing the corner of a wall. Phil used the facing wall to provide stabilization for the electric razor in a forearm weight-



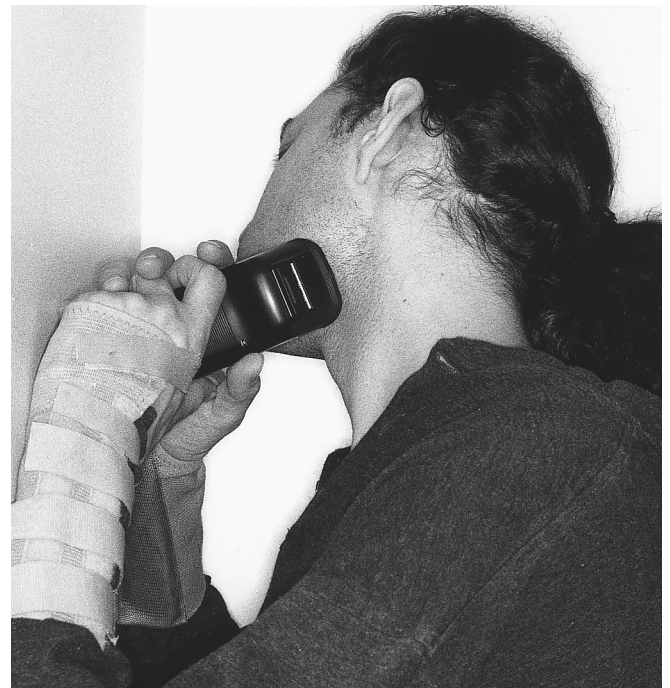
**Figure 3.** The use of orthotics and the environment to stabilize the upper extremities increases manipulation skills during grooming.



**Figure 4.** Independence in oral care is promoted through the use of orthotics and adaptive positioning, which increases upper-extremity stability.

bearing position while using the side wall to stabilize his head. While in this stabilizing position, he moved his face around the head of the razor (see Figure 5). Once stabilized, he was able to shave independently.

*Bathing.* Techniques were adapted for bathing by prescribing a tub seat to conserve energy and provide stability.



**Figure 5.** The client uses the environment, positioning, and orthotics to promote independence in shaving. The wall on his right stabilizes his head, and the front wall stabilizes his upper extremities.

Soap-on-a-rope was provided to decrease manipulation demands. Movements were adapted so that Phil did not reach into space toward specific body parts but instead slid his hand along his body to reach various body parts.

*Bladder management.* Intermittent self-catheterization became a paramount goal because Phil was not eligible for home assistance, and the medical team decided that an indwelling catheter would be a high risk in terms of infection and possible symptom exacerbation. Bladder management training was performed in conjunction with rehabilitation nursing. Techniques included adapted positioning in bed for the self-catheterization to promote a semisitting position that was maintained with pillows under his knees and upper trunk. This position provided full trunk support and stabilization. Wrist supports were used to promote wrist stability and thus increase potential finger dexterity. Two pillows were placed under Phil's upper extremity to stabilize it in the proper position. A 5-lb weight was draped over Phil's distal forearm to provide increased stability. Practice sessions were scheduled to gain control over a simulated catheterization movement pattern. Phil practiced the movement required for this task by holding a cylinder-shaped sewing bead in his lap and threading a catheter through the bead. This pattern was practiced until Phil felt confident threading the catheter through the bead. At this point, Phil began self-catheterization training with this setup. After 1 week of training and practice, Phil was able to insert the catheter into his urethra independently.

*Sexual activities.* Using the PLISSIT (Permission, Limited Intervention, Specific Suggestions, Intensive Therapy) model of intervention (Annon, 1976; Farman & Dicker-Friedman, 1998), specific suggestions were provided to increase Phil's ability to masturbate. Phil's specific complaints related to masturbation were his inability to maintain a kneeling posture and difficulty with rapid alternating movements. Phil favored a kneeling position; he reported that this was the only position in which he was able to ejaculate. A positioning device similar to a padded footstool was provided to support his pelvis in a three-quarter kneeling position. In addition to the pelvic support, he leaned against the wall to further stabilize his trunk. These positioning adaptations allowed Phil to be independent in his chosen position and sexual activity.

*Instrumental activities of daily living (IADL).* Phil identified several IADL issues that he wanted to address before discharge. These included simple meal preparation (cutting food items and carrying meal items to a dining area) and telephone use to maintain work and social contact. An adapted cutting board with a nail was provided to stabilize food items while Phil implemented previously learned upper-extremity control techniques (wrist supports, stabilizing forearm against work surfaces) to cut with a knife. Food items were transported via a basket that was lined with a nonskid surface, which he carried at his side with his

arm stabilized against his trunk. A speakerphone was prescribed to allow Phil to be independent in work and social communication.

## Discussion of Interventions

The focus of occupational therapy for this client was to teach environmental strategies and adaptive techniques to compensate for the effect of his movement disorder on his functional performance in ADL. Interventions were not aimed at changing underlying movement capabilities but, instead, were focused on devising strategies to integrate available movement and control in the most effective and efficient manner possible.

Throughout his stay, Phil received daily physical therapy that focused on increasing independence in indoor and outdoor ambulation with assistive devices, improving endurance, improving standing balance, stair climbing, and management of ramps and curbs. Specific techniques included gait and mobility training, standing balance perturbations, stationary bike training, closed chain strengthening, and flexibility exercises. In addition, propranolol (a beta adrenergic antagonist) was identified as an effective pharmacologic tremor-dampening agent, and Phil's dose was stabilized during his stay.

Of note is the fact that although the magnitude of Phil's tremors were dampened with the use of a pharmacological approach, they remained ever-present during attempts to function. To critically evaluate the variables that contributed to his ADL outcome, reevaluations before discharge included attempts to discontinue orthoses and equipment use and to return to more familiar and previously learned (i.e., before the aforementioned training) postures and movement patterns, all without success. Although Phil's response to the medication was favorable, the effect did not carry over into functional activities unless the described environmental, postural, and movement adaptations were also used. It may be inferred that the adaptations described in this study alone or, more likely, in combination with the effects of the propranolol, were responsible for the ADL outcomes because the results were not reproducible without the described interventions.

## Conclusions

In spite of continued symptoms associated with ataxia, Phil was able to independently engage in tasks that he chose and that were meaningful to him by using the occupational therapy interventions of adapted positioning, orthotic prescription, adapted movement patterns, and use of the environment for trunk and limb stability. In this case, treatment was deemed successful because Phil made substantial gains in scores on standardized ADL evaluations (see Table 1), reported satisfaction with improvements in his ADL abilities, was able to return to his previous living environment, and was able to resume part-time work as a consultant with his previous employer.

Treatment interventions were aimed at increasing postural stability and decreasing multijoint movements with the goal of improving ADL performance of specific tasks chosen by the client. Specific techniques of adapted positioning, orthotic prescription, adapted movement patterns, use of the environment for trunk and limb stability, and prescription of adaptive ADL devices were all instrumental in achieving Phil's desired goals.

In a study focusing on the rehabilitation of persons with ataxia, Jones, Lewis, Harrison, and Wiles (1996) concluded that therapy "used to improve dynamic posture and methods of performing functional tasks can result in improvements of functional ability...where spontaneous improvement would not otherwise be expected" (p. 280). This case study outlined specific occupational therapy interventions for tasks deemed important by this client and supports this finding. A contemporary task-oriented approach was used as a theoretical base, and interventions were based on the practical application of current motor control theories and clinical observations. A hypothesis focusing on which control parameters were having an impact on function was developed and supported by improved functional outcomes. ▲

## Appendix A

### Summary of Evaluation Findings

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#### *Performance Component Dysfunction*

- Proximal instability (scapula and trunk)
  - Resting and intention tremor
  - Proximal weakness
  - Decreased endurance
  - Severe ataxia
  - Head and neck titubations
  - Impaired seated and upright postural control
  - Visual dysfunction (decreased acuity and tracking, nystagmus, and oscillopsia)
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## Appendix B

### Parameters That Influenced Tremors in the Client

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#### *Decrease in Severity of Tremor and Increase in ADL Performance*

- Stabilization of the head and neck
- Approximation through the spine
- Limbs stabilized against trunk
- Automatic movements
- Stabilization of the trunk
- Forearm weight bearing
- Relaxed emotional state
- Distraction

#### *Increase in Severity of the Tremor and Decrease in ADL Performance*

- Emotional upset
  - Fatigue
  - Use of targets
  - Effort
  - Reach into space
  - Postural insecurity
  - Goal-directed movement
  - Intention
- 

## Resources

Canoe Creek Rehabilitation Products  
2508 Collins Road  
Pittsburgh, PA 15235  
800-753-1788  
Self-feeding products for clients with ataxia

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