CASE REPORT

Improving Mobility and Community Access in an Adult With Ataxia

Glen Gillen

KEY WORDS
• assistive technology
• multiple sclerosis
• wheelchair prescription

This case report describes occupational therapy interventions focused on improving mobility and community access for a 40-year-old man with multiple sclerosis. Primary impairments included ataxia, paraparesis, and decreased endurance. The focus of this case study was on improving the client’s ability to use powered mobility to access the community despite severe ataxia.

A task-oriented approach was used as a frame of reference to guide the evaluation and intervention process. The primary goals of intervention were to control the degrees of freedom required for task participation and simultaneously increase postural stability, resulting in independent control of a power wheelchair. A combination of occupational therapy interventions is illustrated, including assistive technology, positioning, orthotic prescription, and adaptation of movement patterns.


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used interventions that included prescription of appropriate assistive technology, positioning, orthotic prescription, and adaptation of movement patterns.

Similar techniques have been reported previously in the literature as successful in improving the functional status of clients with ataxia. Gillen (2000) described occupational therapy interventions aimed at increasing a client’s basic and instrumental activities of daily living (ADL) performance through environmental strategies and adaptive techniques to compensate for an ataxic movement disorder. Specific treatments were aimed at increasing postural stability and decreasing multijoint movements through adapted positioning, orthotics, and use of the environment for trunk and limb stability. In addition, 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. 277) in patients with ataxia resulting primarily from multiple sclerosis.

Motor Control Deficits

The motor control deficits of the client described in this case report were consistent with textbook descriptions of ataxia and cerebellar dysfunction (Bastian, 1997; Bastian, Martin, Keating, & Thach, 1996; Ghez & Thach, 2000; Trouillas et al., 1997). Specific deficits were ataxia, loss of postural control, head tremor, dysmetria, resting and intention tremor, an inability to perform multijoint movements, and dysdiadochokinesia.

Client History

Jim (pseudonym) is a 40-year-old man with multiple sclerosis. He received the diagnosis 10 years before the inpatient rehabilitation admission described in this article. Jim lived alone with support from a home health aide 8 hours each day, multiple friends in the neighborhood, and his mother. Upon initial diagnosis, his symptoms included fatigue, lower-extremity weakness, and upper-extremity tremor (left greater than right). During the course of the disease, he had received inpatient rehabilitation 8 years and 2 years before this admission. At the point of this case study, Jim was initially admitted to the acute neurology unit at the hospital with worsening upper-extremity tremor, progressive lower-extremity weakness, decreased visual acuity, and a neurogenic bladder. He reported an overall decrease in daily function.

Jim was admitted to the inpatient rehabilitation unit at the same medical center after receiving 10 days of intravenous solomedrol and methotrexate on the acute care unit; the rehabilitation goal was to improve ADL and mobility skills. He received occupational therapy 90 min daily, physical therapy 90 min daily, therapeutic recreation, and speech therapy, and he was cared for by certified rehabilitation nurses throughout his 5-week stay. Jim’s rehabilitation was overseen by a physiatrist, and his medication regime was monitored by a neurologist.

Occupational Therapy Evaluation

Jim’s initial evaluation in occupational therapy focused on an assessment of living skills and the factors that constrained or support- ed task performance. The Functional Independence Measure (FIM; Keith, 1987) was the standardized measure of functional performance used. Table 1 summarizes Jim’s impairments, activity limitations, and participation restrictions.

A client-centered focus (Law, Baptiste, & Mills, 1995) is integral to the task-oriented approach and was used to enable Jim to define his goals and prioritize the focus of his treatment through semi-structured interviews. Jim was most concerned with his mobility restrictions. Specific concerns included an inability to be mobile outdoors, to visit friends, and to “be part of the neighborhood.”

Mobility Status

Jim was admitted with his personal lightweight wheelchair. Existing adaptations to this wheelchair included a solid seat, pressure-relieving gel cushion, and oblique rim projections. Jim reported that he had owned the wheelchair for approximately 6 years and was spending an increased amount of time in it over the past 2 years. In terms of a standardized measure of wheelchair use, Jim scored a 4 on the FIM for indoor mobility, indicating that he required minimal assistance from a caregiver to propel and maneuver the wheelchair at least 150 ft on a level surface. Jim was unable to propel the wheelchair outdoors, resulting in an FIM score of 1 for outdoor mobility (i.e., he required total assist from a caregiver). Limiting factors to indoor and outdoor wheelchair use included inefficient propulsion secondary to Jim’s ataxia, resulting in excessive effort; hands slipping off rim projections and contacting spokes; trunk instability, resulting in balance loss.

Table 1. Summary of Evaluation Findings on Admission*

<table>
<thead>
<tr>
<th>Impairments</th>
<th>Activity Limitations</th>
<th>Participation Restrictions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trunk instability</td>
<td>Feeding</td>
<td>Inability to access community (social)</td>
</tr>
<tr>
<td>Resting and intention tremor</td>
<td>Shaving</td>
<td>Inability to access community resources (medical follow-up, support groups, etc.)</td>
</tr>
<tr>
<td>Impaired postural control</td>
<td>Bathing</td>
<td>Feeling “not part of the neighborhood”</td>
</tr>
<tr>
<td>Severe ataxia</td>
<td>Oral care</td>
<td></td>
</tr>
<tr>
<td>Paraparesis</td>
<td>Hair care</td>
<td></td>
</tr>
<tr>
<td>Lability</td>
<td>Bladder and bowel management</td>
<td></td>
</tr>
<tr>
<td>Head tremor</td>
<td>Wheelchair management</td>
<td></td>
</tr>
<tr>
<td>Decreased endurance</td>
<td>Ambulation</td>
<td></td>
</tr>
<tr>
<td>Visual dysfunction (decreased acuity, nystagmus)</td>
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</table>

*Forty-year-old man with multiple sclerosis.
during propulsion; decreased upper-extremity strength and endurance to support distance propulsion; and exacerbation of fatigue symptoms after manual wheelchair activities.

Attempts at ambulation were made in physical therapy with the use of lower-extremity orthotics (bilateral ankle-foot orthoses) and a platform walker. After several sessions, Jim and the rehabilitation team decided that a goal of ambulation was unrealistic because of the severity of lower-extremity weakness and the fatigue that followed attempts at gait.

At this point, occupational therapy intervention was shifted to evaluating Jim’s ability to use powered mobility. Treatment sessions were spent changing various aspects of the task, such as Jim’s position in the wheelchair, amount and type of arm support, head support, grasp patterns on the joystick, and so forth in an effort to collect data about which task parameters increased his performance (decreased his ataxia during wheelchair use) and which task parameters further impaired his performance (exacerbated his ataxic movements during wheelchair use) (see Table 2).

### Control Parameters

The following control parameters (variables that caused a shift in motor behavior) were thought to have the most significant impact on the severity of Jim’s tremors and his ability to use powered mobility:

- As the degrees of freedom (number of joints involved in the task) increased, there was a worsening of tremors and decreased control. The resulting decrease in function was demonstrated by an inability to propel his manual wheelchair with coordinated upper-extremity movements, an inability to control a standard joystick, and further worsening of tremors when he was required to control his trunk and upper extremity together (without trunk support). When the degrees of freedom were controlled (decreased) during treatment sessions, upper-extremity movement patterns were smoother and resulted in an improved ability to interact with the environment and perform functional activities. The degrees of freedom were decreased by various techniques, including providing full head and trunk support with adaptive seating, providing a volar wrist support to stabilize Jim’s wrist, adapting his armrest to provide full support from elbow to wrist, and changing his grasp on a modified joystick so that isolated joint movements were used to control the direction of the wheelchair.
- As Jim’s postural demands increased during task performance, his tremors worsened. This pattern was observed when Jim attempted to propel his manual wheelchair with an unsupported trunk or when he was required to control his trunk against gravity (reaching beyond his arm span, weight shifting during ADL, etc.). His tremors were dampened when he supported his trunk against the backrest of the wheelchair and were further decreased when he was provided full trunk support with contoured lateral supports and a tilt-in-space wheelchair frame.

### Treatment Interventions

Specific interventions then were planned based on these observations. Treatments focused on task-specific training of wheelchair mobility, incorporating the occupational therapy techniques of orthotics prescription, assistive technology, positioning, and movement retraining. The goal of all interventions was to decrease the degrees of freedom required to participate in the wheelchair mobility task while simultaneously decreasing postural requirements. Specific interventions used to provide maximal postural support, maximize control of Jim’s right upper extremity, and maximize his potential to participate in power wheelchair training included the following:

- **Wheelchair prescription:** To maximize Jim’s indoor and outdoor mobility, Jim and his therapist chose a tilt-in-space frame (Bain, 1998). During the evaluation process, it was discovered that placing Jim in a backward tilt of approximately 20° allowed him to decrease his efforts of controlling his trunk against gravity and provided increased postural stability. The tilt position provided increased trunk and pelvic support, resulting in decreased tremor and increased control of the upper extremities.
- **Positioning:** Jim was given a choice of cushions and finally was provided with a pressure-relieving gel cushion that fully supported his femurs. In addition, a solid back with bilateral lateral supports was added to the wheelchair. The supports were placed symmetrically on either side of his ribcage. A head support was added to the wheelchair to control for the degrees of freedom in the cervical spine and to provide increased support while in a tilt position. Finally, a trough was added to the right armrest to provide upper-extremity support. The trough allowed Jim to keep his upper extremity supported during joystick use and decreased the ataxic patterns observed when he was required to stabilize his arm in space.
- **Orthotic prescription:** After trying various orthotics, Jim and his therapist decided to use a volar wrist support to provide increased distal stability and provide proximal support to the digits involved in controlling the joystick.
- **Assistive technology:** In addition to the aforementioned choice of the wheelchair base, tremor-dampening electronics were added to decrease the sensitivity of the joystick and increase Jim’s accuracy while

### Table 2. Wheelchair Mobility Task Parameters That Influenced Tremors

<table>
<thead>
<tr>
<th>Decreased Severity of Tremors, Increased Mobility Performance</th>
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<tbody>
<tr>
<td>Support and stabilization of head and neck</td>
</tr>
<tr>
<td>Upper extremities supported on environmental surfaces</td>
</tr>
<tr>
<td>Use of isolated joint movements</td>
</tr>
<tr>
<td>Support and stabilization of the trunk and pelvis</td>
</tr>
<tr>
<td>Relaxed and rested emotional state</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Increased Severity of Tremors, Decreased Performance of Activities of Daily Living</th>
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</thead>
<tbody>
<tr>
<td>Emotional upset</td>
</tr>
<tr>
<td>Fatigue</td>
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<tr>
<td>Multipoint movements</td>
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<tr>
<td>Reach into space</td>
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<tr>
<td>Postural insecurity</td>
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<tr>
<td>Effort</td>
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driving the wheelchair. Specifically, MKIV electronics1 were used.

- **Adapted movement patterns**: Using the volar wrist support in conjunction with the tremor-dampening electronics, Jim and his therapist found that holding the joystick between his second and third digits while keeping his forearm fully supported in the trough provided the most stability. He then used minimal joint movement to control the joystick (i.e., finger abduction and adduction for right and left movements, shoulder flexion and extension with his forearm supported in the trough for forward and reverse movements).

After this mobility system was prescribed, power wheelchair training commenced in varied environments (hospital, community, Jim's apartment and neighborhood). Jim practiced specific skills in the various contexts, including start and stop, obstacle avoidance, doorway management, elevator management, use of the community bus, navigation of curbs and ramps, and emergency stopping. At the end of the power wheelchair training sessions (10 sessions of 1/2 hr each), Jim's score for indoor power wheelchair mobility on the FIM increased from 4 (minimal assistance) to 6 (modified independent), indicating that he was able to use and maneuver a power wheelchair independently with the described adaptations. In addition, his FIM score for outdoor mobility with the power wheelchair improved from 1 (total assist) to 5 (requires only supervision). At a 1-year follow-up, Jim's FIM score remained the same for indoor mobility and improved from 5 (supervision) to 6 (modified independent) for outdoor use.

**Discussion of Interventions**

The focus of occupational therapy for this client was to assist him in meeting his goal of improving his mobility skills and ability to access the community. Occupational therapy interventions such as orthotic prescription, positioning, use of assistive technology, and adapting movement patterns were used to compensate for the effect of his movement disorder on his ability to perform mobility tasks. 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. In addition, the described mobility system maximized the client's mobility function despite the chronic effects (fatigue and weakness) of his primary condition. Finally, the interventions had long-lasting results despite the chronic progressive nature of the disease.

Throughout his stay, the client received daily physical therapy that focused on attempting ambulation, improving endurance, improving sitting balance, stretching, and strengthening. In addition, Jim followed a medication regime that included tremor-dampening agents (Andersson, 1996; Manyam, 1986). His response to the medication was positive, but the effects of the medication did not carry over into functional activities until they were used in conjunction with the described occupational therapy interventions. The improved functional results were not reproducible without the described interventions. It is important to note that the client's ataxia persisted to the point that he required substantial assistance with basic ADL, such as feeding. Despite the wheelchair task being considered higher risk and perhaps more difficult than basic ADL, the task-specific treatment was successful.

**Conclusion**

Despite continued symptoms associated with ataxia, the client was able to engage in tasks that were meaningful to him. In this case, treatment was deemed successful as his scores improved on standardized measures, and the client met his chosen goals. The interventions were based on the practical application of current motor control theories and used a task-oriented approach as a guiding frame of reference. A hypothesis about which motor control issues were affecting function was developed; a treatment plan was formulated; and the treatment was supported by improved functional outcomes.

Treatment interventions were aimed at increasing postural stability and decreasing multijoint movements with the goal of improving mobility performance, a task chosen by the client. Specific occupational therapy techniques of adapted positioning, orthotic prescription, adapted movement patterns, and assistive technology were all used to achieve the client's desired goals. ▲

**References**


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1 Invacare Corporation, One Invacare Way, PO Box 4028, Elyria, Ohio 44036-2125; 800-333-6900.
behavior research: Implications for therapeutic approaches to central nervous system dysfunction. *American Journal of Occupational Therapy, 48*, 733–745.


