Self-Feeding System for an Adult With Head Injury and Severe Ataxia

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This report describes a customized self-feeding system designed to increase the independence of a person with a head injury who is unable to use his arm for self-feeding. The client has spastic hemiparesis in the right upper extremity and profound ataxia in the left upper extremity. Due to the severity of these disabilities, the client required total assistance at every meal since his injury 6.5 years ago. The self-feeding system described consists of an adapted spoon, a spoon holder, a scoop dish, and a dish stand. The client scoops food from the scoop dish with the adapted spoon held in his mouth and then transfers the spoon to a magnetic holder for positioning. This adaptation allows the client to position the spoon with his chin without demanding fine motor coordination. The self-feeding system is evaluated with a BAB single case research withdrawal design. Results indicate that this self-feeding system provides a viable alternative to assisting independence in self-feeding as measured by the cost-benefit ratio and nutrition intake. The client used the self-feeding system for 12 months at the rehabilitation center and has continued using the equipment at his nursing home.

Ataxic-hemiparetic motor syndrome results from damage to the cerebellum, brainstem and pyramidal tracts (Griffith & Mayer, 1990). Clinically, the person exhibits ataxia (intentional tremor) on one side and spastic hemiparesis on the other side. One of the most disabling manifestations of ataxic-hemiparetic motor syndrome is its interference with self-feeding, a basic activity of daily living. The ataxic limb has poor motor control in delivering a utensil to the mouth, and the hemiparetic limb has little volitional movement to complete the task.

At present, there are no pharmacological or surgical interventions that successfully reduce ataxia so that daily functional activities can be resumed. Therefore, rehabilitation focuses on the use of adapted aids to attenuate the intentional tremor, such as a weighted cuff, or to compensate for the tremor, such as feeding devices (Griffith & Mayer, 1990).

Hewer, Cooper, and Morgan (1972), who measured the decrease in intentional tremor after putting a lead weight around one wrist each of 50 subjects with ataxia, found that only 36% (18) demonstrated clinical improvement in the daily life situation. None of these subjects had severe tremor and only 22% (4) had severe tremor, 61% (11) had moderate tremor, and 17% (3) had mild tremor. They concluded that weights were most effective in controlling moderate intentional tremor, and less effective in cases of severe tremor. In this study, only two thirds of the successful subjects were willing to continue wearing the weights for 6 months, which reduced the success rate to 24% (12). A follow-up study by Morgan (1975) demonstrated that subjects with basal ganglia lesions responded poorly to weighted cuffs.

Because the effectiveness of added weight in controlling ataxia seems limited to a small sub-group of persons, rehabilitation efforts should focus on other intervention strategies, that is, adapted equipment like robot manipulators or electric feeders. However, these devices can cost more than $1,000. Feeding can be performed less expensively by family members, or a personal care attendant (Bach, Zeelenberg, & Winter, 1990; Einset, Deitz, Billingsley, & Harris, 1989).

A customized self-feeding system can be less expensive and easier to maintain or replace than a sophisticated robot manipulator or an electronic device. This report describes and evaluates a customized feeding system designed to enable a person with severe tremor as a result of head injury to feed himself independently.

Client History

The client was a 26-year-old single white man who sustained a severe closed head injury in a motor vehicle accident 6.5 years ago, followed by a coma of 2 months' duration. The injury included both cerebral and brainstem contusions. An initial computerized tomography
scan showed evidence of a focal hemorrhage in the right temporal lobe, left internal capsule region and basal ganglia. A scan performed 1 month later showed a Grade I hydrocephalus. The client was hospitalized for 2 months, had acute rehabilitation for another year, and after discharge received multidisciplinary home services for 6 months.

**Occupational Therapy Assessment: Motor Examination**

Left Upper Extremity: Range of motion (ROM) was within normal limits with tone appearing normal. Movement was isolated at all joints and within the good-to-normal strength, but profound ataxia, dyskinesia, and dysmetria were manifested. A low frequency high amplitude tremor of near ballistic movement was exhibited when the client performed any volitional activity. The tremor increased as he reached the end point of motion, which limited his abilities in fine motor tasks such as self-feeding, combing his hair, or blowing his nose without hurting himself. The client was unable to accomplish rapid rhythmic alternating movements. No resting tremor was observed. Sensation was intact for light touch and proprioception.

The right upper extremity showed significant spastic hemiparesis with marked hypertonicity, limited motor control and functional use. In response to total body movement the right limb moved into an extensor or flexor posture. Grip strength was poor. Gross sensation was intact.

ROM of the neck was within normal limits; active movement was present throughout his head and neck. Strength was essentially normal. There was a significant head titubation: A tremor was present at rest and increased with effort. The presence of a strong asymmetrical tonic neck reflex interfered with the client's ability to self feed with upper extremities. Sitting was impaired when he was challenged through postural shifting to either side. He walked with an ankle-foot orthosis on the right leg, demonstrating a markedly ataxic gait with wide-based and short stride on the left.

**Self-feeding Evaluation**

His medical history indicated that he had refused to eat as a form of self-abuse, stating that he wanted to die, and that he preferred private as opposed to group eating settings. The family reported that he was dependent in feeding and demonstrated low frustration tolerance when independence was encouraged. When demands were imposed on him, he would refuse to eat. When he tried to bring a spoon to his mouth, the ataxic limb would miss its mark, producing spillage. Hemiparesis of the right limb excluded its use in assisting the ataxic left limb. No facial, oral-motor or swallowing dysfunction was observed.

**Neuropsychological Evaluation**

Neuropsychological assessment revealed a pattern of cognitive and neurobehavioral deficits involving motor, attentional, learning, short-term memory, language and visuospatial functions. He had a low frustration tolerance, often refusing to continue a motor task if results were not immediately successful. He was unable to problem solve sufficiently to address the many difficulties that resulted from his injury. He also demonstrated lack of insight into the permanency of his cognitive and physical status, decreased awareness, and poor judgment regarding his safety. He frequently used profanities and demonstrated impulsivity and confabulation.

**Medications**

Baclofen was discontinued before occupational therapy intervention started. Inderal was tried for 2 months after Baclofen was discontinued, but was discontinued after 2 months, because there were no noticeable clinical effects.

**Intervention**

Two months after admission to a rehabilitation center, the client still relied on staff to feed him. While observing the client painting ceramics, I discovered that he was able to use his mouth to hold a paint brush and color a ceramic statue. On the basis of his willingness to hold a paint brush in his mouth for at least 15 continuous min to perform a coloring task in two therapy sessions, the oral-motor and self-feeding evaluations, and poor response to efforts to improve his upper extremity motor coordination, I concluded that the use of a mouth stick type feeding device might facilitate the client's independence in self-feeding.

A self-feeding device was fabricated based on the design developed by Hall and Hammock (1979). The client's initial attempts to use this device were unsuccessful and he refused to use it subsequently after three trial sessions. It was apparent that the system would have to be modified to address his low frustration and decreased head and neck motor control.

**Description of Self-feeding System**

The next self-feeding system developed consisted of an adapted spoon, a spoon holder, a scoop dish, and a dish stand. To decrease the motor control required in placing the spoon on the holder, metal was wrapped around the handle of an ordinary spoon to increase its width. A handle cut from a plastic measuring cup was attached to the end of the spoon to improve the client's ability to hold it in his mouth. The spoon holder consisted of two magnets screwed to a small wooden block (6.0 cm x 5.0 cm x 1.3 cm) mounted on top of a vertical dowel (2.5 cm in diame-
To increase the magnetic pull and the contact surface area, two magnets were installed side by side on top of the spoon holder. This feature allowed the client to adjust the position of the spoon with his chin. The dowel was attached to a wooden base (43.0 cm x 20.0 cm x 2.5 cm) with Epoxy glue and a screw. The height of the spoon holder was measured by subtracting 7 cm from the distance between the table top and the bottom of the client's chin while the client sat in upright posture. The scoop dish was mounted upside down on a cake stand to raise it to the level of the spoon holder. To use the self-feeding system, the client scooped food from the raised scoop dish with the adapted spoon held in his mouth, and then transferred the spoon to a magnetic holder for positioning (see Figures 1 through 4).

Considering the client's low frustration tolerance, the use of the self-feeding system was introduced gradually. Based on the client's long-standing neuromuscular and psychosocial status, I reasoned that he would not have been able to improve his motoric proficiency enough to use the first self-feeding device to complete a meal independently after setup. The client demonstrated increase in resistance and verbal aggression after two trials with the first self-feeding device. Insisting on training him to use the first device was judged to be fruitless and destructive to the established rapport. On the other hand, the second self-feeding system was modified to accommodate the client's intact motor control to complete the task with minimal difficulty. My role was to train the client to accept the self-feeding system and improve skills competency through provision of successful task completion.
experience. Initially, the system was used only at lunch. During this time, the client accepted assistance only from his physical therapist, a woman with whom he had some rapport. The therapist introduced the self-feeding system by scooping his food for him and then placing the adapted spoon on the spoon holder where he could reach it. Although initially he ate just a few bites, independence was gradually developed through a process of slowly increasing the number of steps that the client was expected to complete.

Two weeks later, when the client demonstrated increased proficiency in using the system, further intervention strategies were used to decrease his psychological dependence on the physical therapist. Gradually the number of meals supervised by the physical therapist decreased as other direct care staff provided supervision. During this time, the client's independence increased and he only required physical assistance at the end of meals due to frustration and fatigue. Approximately 4 weeks later, the client was using the adaptive self-feeding system at every meal. At this time, the client had mastered the use of the system, but continued to seek assistance from staff. To address this behavior, supervision was given from a greater distance (i.e., the staff member decreased eye contact with the client, consumed a meal at a different table, and gradually increased distance between his or her table and the client's). This strategy resulted in a further increase in his self-feeding independence.

**Evaluation of Self-feeding System**

To evaluate the effectiveness of this self-feeding system, data were collected over a period of 4 months. The client was observed during lunch and dinner so his performance with the system could be compared with his performance while being fed. A BAB single-subject research withdrawal design was used to evaluate the self-feeding system. Phase Bs were when the client used the self-feeding system; phase A was when he was fed. Phase A was conducted immediately after phase B1; phase B2 was conducted approximately 3 months after phase A. Data were collected for lunch or dinner or both because the content of the food was similar; the menu rotated between lunch and dinner on a monthly basis. The client consumed all meals in a common dining room where food was served.

For his first 8 weeks at the facility, the client was fed for three meals daily. Between week 8 and week 12, the first feeding device was tried and rejected; the second self-feeding system was fabricated, modified, and tried out. During week 12, the client began to use the self-feeding system only at lunch; data collection for phase B1 commenced. During week 14, the client started to use the self-feeding system for lunch and breakfast, but data were not collected for breakfast because the food was different from that served for lunch and dinner. At week 16, data collection for phase A began; during this phase the client used the self-feeding system at lunch, but data were only collected during dinner, when the client was fed. At week 18, phase A ended; the client began to use the self-feeding system for all three meals and continued to use it until he was discharged. Data collection was discontinued until approximately week 28, when phase B2 began and data were collected for lunch and dinner. The client also moved to a new common dining room at this time.

Five variables were measured: staff assistance time, number of times physical assistance was given, length of the meal, percentage of meal consumption, and weight change. **Staff assistance time** was defined as the length of time a staff member was required to actively engage one-on-one with feeding, which included cutting food into bite-sized pieces, seasoning food, setting up the equipment, and providing any other physical assistance. Staff assistance time was measured cumulatively with a stop watch. **Staff assistance time** was the same as the length of the meal when the client was fed, as one-on-one supervision was required throughout the meal. The **number of times physical assistance was given** was recorded after the self-feeding system was set up. The **length of the meal**
was defined as beginning when the client or the staff member first picked up the utensil and ending when the client either stated that he was finished, refused to continue, or left the dining area. The percentage of food consumption was determined by comparing the weight of the food at the beginning of the meal to that left after the meal. Weight change was noted from medical record because the client was weighed monthly.

Outcome

Staff assistance time decreased from an average of 20.5 min (range: 28.0 to 13.5 min) when the client was fed to an average of 4.0 min (range: 5.9 to 1.4 min) when the self-feeding system was used (see Figure 5). After 3 weeks of using the self-feeding system at every lunch and breakfast, the client no longer required physical assistance after the system was set up (see Figure 6). The average length of time spent on completing a meal was 20.5 min (phase A: M = 20.5 min) when the client was fed, and 32.3 minutes (phase B1: M = 32.5 min; phase B2: M = 32.0 min) when he used the self-feeding system (see Figure 7). The average percentage of meal consumption was 94.7% (phase A: M = 94.7%) when the client was fed, and 72.6% (phase B1: M = 75.5%; phase B2: M = 69.7%) when the client used the self-feeding system (see Figure 8). A higher percentage of meal consumption was attributed to more physical assistance being given to the client at the beginning of feeding system use. Weight at discharge was the same as weight at admission. Weight was reduced by 1 kg during the month the self-feeding system was introduced and was regained within the subsequent 2 months.

After the client had used the self-feeding system for 4 months, improvements in the areas other than motoric proficiency in use of the system were noted. The client was independent in self-feeding, requiring assistance only for set-up and clean-up. Dietary staff reported that his appetite had improved and that he was more patient in waiting for his food and equipment to be set up. During the first 2 months of using the self-feeding system, he had insisted on designating one particular staff member to set up his system, but at this point he was willing to accept help from whoever was on duty, and in fact was able to direct new staff to set up the system properly. At discharge, the client expressed the desire to take the self-feeding system to the discharge site (a nursing home).

Discussion

This self-feeding system has several important advantages, including a substantial decrease in time spent by staff members in assisting the client during meals. An average of 16.5 min per meal was saved. This decrease reflects the fact that when the client was fed, he required

![Figure 5. Staff assistance time required when the client used the feeding system (Phase B1) and when he was fed (Phase A).](http://ajot.aota.org)
Figure 6. Number of physical assists given when the client used the feeding system (Phase B1).

Figure 7. Length of time that the client spent on completing his meal when he used the feeding system (Phases B1 and B2) and when he was fed (Phase A).
Figure 8. Percentage of food consumption when the client used the feeding system (Phases B1 and B2), and when he was fed (Phase A).

one-on-one supervision throughout the meal, whereas when he using the self-feeding system, he required staff assistance only for set-up.

The client preferred to take a longer pause after each bite and to enjoy social interaction with other people around him during meal time. As the results indicated, the completion time for the main meal in general was within reasonable limits (i.e., less than 45 min).

The client seemed to prefer using the self-feeding system to being fed. He was willing to use the system not only in the rehabilitation center for 12 months but also during home visits and at his nursing home, suggesting that he wanted to be more independent. Ott, Readman, and Backman (1990) stressed the importance of self-feeding in fulfilling sociological and psychological needs. The ability to feed oneself in a presentable manner is one of the most basic skills that society expects (Jones, 1978).

The self-feeding system was easily cleaned and was made from parts easily obtained at local hardware stores and equipment suppliers. Compared with an electric feeder, the self-feeding system was less costly and more durable. As mentioned in Einset et al. (1989), even within as short a time as 2 weeks, subjects encountered electric feeder failure.

A merit of the study design was that the client did not actually lose the right to receive routine intervention, as the study did not require a complete withdrawal of intervention during phase A. During phase B1, the client used the self-feeding system at lunch time only. This procedure was arranged so that I could supervise and monitor the data collection, and because more staff members were available for collecting data during lunch time. During phase A, the client consumed his lunch using the self-feeding system, but was fed at dinner. The only difference between phase A and phase B1 dinners was that data were collected during phase A.

I decided that the client should start to practice the self-feeding system when sufficient staff and support were available. When he mastered the motoric skills (based on the physical assistance required) and accepted the self-feeding system psychologically, which was approximately 4 weeks after the data collection, I decided that the client could use the self-feeding system without supervision after set-up (i.e., at dinner time).

The two major concerns for using adapted self-feeding equipment are its cost-benefit ratio and its effect on the client's nutrition (Einset et al., 1989). The cost of the system made for this client was estimated as less than $50. At this price, the system is not only more cost-efficient than an electric feeder, but also a viable alternative to assistance given by family members or personal care attendants.
In terms of nutrition, Steefel (1981) suggested that the only objective indicator of the adequacy of a client’s nourishment was weight change. Even though the client on average consumed three quarters of the food provided when he used the self-feeding system, the client’s weight was stable since his admission, and no vitamin or nutritional supplement was required. It can be concluded that he obtained sufficient nutrition from his food intake through self-feeding. Finally, in terms of satisfaction, the client, members of his family, and the insurance carrier were pleased and satisfied with his independence in self-feeding.

Others who may benefit from the self-feeding system are persons with arthrogryposis, acquired or congenital bilateral amputations, spinal cord injury, or burns who are unable to feed themselves using their upper extremities. To be able to use the self-feeding system independently and proficiently, persons must possess the following minimal physical and cognitive skills: intact oral muscular motor function, functional visual spatial perception, adequate head and neck ROM and control, trunk support and control, sitting balance, and adequate attention span and concentration to perform multistep tasks.

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References


