Technology and Occupational Therapy in the Rehabilitation of the Bedridden Quadriplegic

(environment, equipment design, rehabilitation, quadriplegia)

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In recent years, home health care services have been expanded considerably. These services, combined with current technological advances, allow severely disabled, even bedbound, people to remain at home. This report demonstrates how one individual, although bedridden and quadriplegic, has successfully adapted his home environment. His functional independence has been markedly improved through computers, environmental control units, innovative carpentry, and adaptations by the occupational therapist. His need for attendant care has been reduced and his quality of life significantly enhanced through increased control of his surroundings. This paper suggests innovative and technological solutions to environmental problems at home. These ideas may aid the home health care occupational therapist in treating individuals who are bedbound.

Recent advances in medical care and technology have enabled severely disabled patients to live longer. Patients are returning home from the hospital sooner (1, 2), and sometimes have more complex needs. When faced with the alternative of nursing home placement, most individuals want to stay at home if possible. Fortunately, improved scientific technology, state-of-the-art adaptive devices, and expanded services in home health care allow some severely disabled people to remain at home successfully.

This report explains how an intelligent, strongly motivated, creative individual was able to adapt his home environment to suit his needs. By collaborating with rehabilitation engineers, occupational therapists, carpenters, and friends to control his immediate environment, this bedridden individual was able to improve his functional independence significantly.

Background and Clinical Picture
John (fictitious name) is a 39-year-old quadriplegic and is a resident of Danvers, Massachusetts. John sustained a spinal cord injury at the C5 level. His prior home was adequate for his needs, but it was time to adapt his environment to his new level of independence.

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old male who sustained a C7 spinal cord injury 23 years earlier in an athletic accident. Despite quadriplegia, he lived independently, received a PhD degree, and held a responsible position at a university.

Four years ago, John developed syringomyelia/syringobulbia and a right shoulder Charcot's arthropathy, both rare progressive neurological complications secondary to long-term quadriplegia. The syringobulbia or cyst, although draining through a myeloperitoneal shunt, still causes increased pressure to the spinal cord and lower brain centers. When in an upright position, John experiences difficulty breathing and swallowing or gets severe headaches, or both. Consequently, he must be in a fully supine position and thus has been mostly confined to bed for the past two years.

Although John has a full-reclining motorized wheelchair, his transfer from bed to wheelchair causes head and neck jarring, which results in further discomfort. Therefore, bed-to-wheelchair transfers have been kept to a minimum. He is presently investigating the use of a motorized stretcher in hopes that bed-to-stretcher transfers will reduce the amount of head and neck mobilization.

With the diagnosis of C7 quadriplegia, John has all functional upper extremity muscle power on his left side, up to and including his wrist. Because of neurogenic arthropathy, his right shoulder joint has virtually disintegrated and he must limit the use of his right upper extremity to retard further deterioration. Strength in internal and external rotators and elbow extensor muscles is limited. He has the ability to extend his left fingers, but essentially no other hand muscles are functional. As a result of the syringomyelia, dissociated sensory loss occurs throughout his extremities.

John lives in a private home with a friend and a boarder who provide several hours of home care tasks during the week. Additional care is provided by home health aides. Private insurance originally reimbursed all home health care services, including nursing, occupational therapy, physical therapy, and home health aides. Two and a half years after the onset of these complications, he became eligible for Medicare. Medicare is currently reimbursing Visiting Nurse Association services. When Medicare coverage ends, John will have to pay privately for essential services.

**Basic Activities of Daily Living Status**
The occupational therapist assisted John with his basic self-care needs. John's set-up for feeding includes a scoop dish secured on a nonskid Dycem mat placed on his chest. For eating, he uses angled utensils. For drinking, he uses a half-gallon plastic jug with a handle and a long straw. An extendable mirror attached to his bed frame helps him see his food. John shaves independently using an electric shaver adapted with an Orthoplast C-clip; he cares for his teeth by using two dental floss holders secured in opposite ends of a universal cuff (see Figure 1). He can use a push-button telephone handset independently, but he also has a speaker phone system. He requires moderate to maximal assistance with bowel care, washing, and dressing, and has a home health aide for three to five hours per day.

**Environmental Adaptations**
John finds it advantageous to be in
an electric hospital bed with a full-length Balkan frame mounted onto it. From this frame hang trapezes, which assist with bed mobility, a Plexiglas tray table, which holds papers, and mirrors and reachers. Shelves are mounted onto the headboard and frame; these hold his stereo equipment, dictating machine, lights, and environmental control box.

Because John is completely supine, the visual knowledge of his surroundings is limited. To compensate, wall-to-wall ceiling mirrors were installed. These mirrors allow John to see his entire room and also to locate his lower extremities for proper body positioning.

After several months of unsuccessfully shuffling around crowded tray tables, a carpenter built a bedside lazy Susan (see Figure 2)—a four-tier, four-foot diameter construction of round shelving mounted on a pole secured from floor to ceiling. This device gives John access to dozens of square feet of space and stores his television, CB radio, cassette recorder, audiotapes, telephone, papers, and personal items. All reading material is filed vertically for easier access. Mounted on the side of the television is a dispenser with small cups that hold premeasured medications; this allows John to take his own pills without having to open several vials.

John can easily operate electrical appliances using a Sears home remote control unit system (available through specialty catalogs, e.g., Popular Science, MED. Inc., and many electrical retail stores, e.g., Radio Shack, Service Merchandise). This remarkable yet relatively inexpensive device (under $200) enables him to control appliances remotely by sending electrical impulses from the control box to remote outlets. The several appliance modules presently hooked into the system permit him to operate lights, television, stereo, fan, air filter, and a motorized window quilt.

For privacy, John wanted to be able to open and close the door to his room independently. To avoid
the high cost of a motorized automatic door opener, the occupational therapist and John designed a mechanical pulley system. This device uses eyelets, pulleys, and ropes on the door and ceiling to allow John to open the door. The door closes automatically through the use of a spring-hinge automatic door closer.

Together, John and his occupational therapist have created some home computer adaptations that have improved John's productive time. The computer is mounted on a sturdy over-the-bed table, which is adjusted to a 45° angle and secured with rubberized bunji cords. The computer components are either stored in a plastic box tied to the table or attached to the computer with Velcro. John uses a mirror clamped to a gooseneck stand to view the keyboard and has learned to read backwards to avoid using a second mirror (see Figure 3).

Bilateral hand splints assist John in depressing the data entry keys (see Figure 4). Although computer output can be displayed on the television screen, a carpenter constructed a holder for a special computer monitor (see Figure 5, arrow). This monitor hangs from the Balkan frame overhead, more directly in line of sight than the television screen. John uses the computer for word processing, record keeping, budgeting, and playing games.

A custom-made reading stand, collectively designed by the therapist, John, and a manufacturer (Bob Kolwicz, Independent Specialty Company, PO Box 39, Middle Haddam, CT 06456) (see Figures 5 and 6), enables John to read effectively. The covers of the book are fastened to a 14-in. × 11-in. board with bankers clasps. The
Figure 5
Computer monitor holder suspended from Balkan frame (see arrow)

Figure 6
John using custom-made reading stand with universal joint

The supine position and the limitations of using his right upper extremity made it more difficult for John to use knobs and dials. Extended levers, made by the therapist from Orthoplast were attached to television knobs, computer dials, light switches, and the citizen's band radio knobs to make manipulation easier.

Summary
This case report illustrates how it is possible for a quadriplegic person to control many aspects of his or her environment even while confined to bed. With the combined efforts of technology (e.g., computer and environmental control unit), innovative carpentry, occupational therapy, and, most important, an individual's will and perseverance, many environmental barriers can be overcome. Home health care services have allowed John to successfully remain at home, and the adaptations described here have made it easier for him to be a vital productive human being.

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REFERENCES