
CHAPTER 2

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Mobility Device for Child With Myotubular Myopathy

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INTRODUCTION

The goal of this project is to build/modify/ accessorize a vehicle that a particular handicapped child could independently maneuver, while keeping the cost of building such a vehicle to a minimum. The objective is to provide mobility and to gain perceptual motor abilities by moving in a sense of spatial awareness, directionality, motor planning and body awareness.

SUMMARY OF IMPACT

The patient in this case is a five year old boy who suffers from Myotubular Myopathy. Progress since birth has been, both quantitatively and qualitatively, very poor. Numerous regressions in the patient's pulmonary status have interfered and prohibited development of motor status. With each setback, the patient's muscle and motor performance deteriorates, forcing him to be in the lying down position for long periods of time. At the present time he uses a mechanical wheel chair. This provides very little benefit, since the weakness in muscle make it very difficult if not impossible to operate it by himself. (Insurance will provide another wheelchair when the patient is an adult.)

Corresponding to the goals set forth in this project, this device provides the patient with independence (though supervised), mobility, and motivation to be in a sitting position for longer periods of time, making functional use of both upper and lower extremities, creating some therapy by fostering him with a sense of direction, motor planning, confidence and body awareness.

TECHNICAL DESCRIPTION

There are many institutions and rehabilitation centers that work with modifying and adding accessories to vehicles to make them suitable for specific handicaps. I could not find any institution that has come up with a steering mechanism that uses the available motor to propel the vehicle.

A simple but effective idea was conceived. It required a battery operated vehicle, available at almost any toy shop. The clinch was to find a vehicle that was equipped with two separate motors and modify it in such a manner as to operate one or both motors at will, with the use of switches.

The forces applied by the motors on the wheels drive the vehicle in either forward or reverse direction as shown in Fig. 1. When either motor

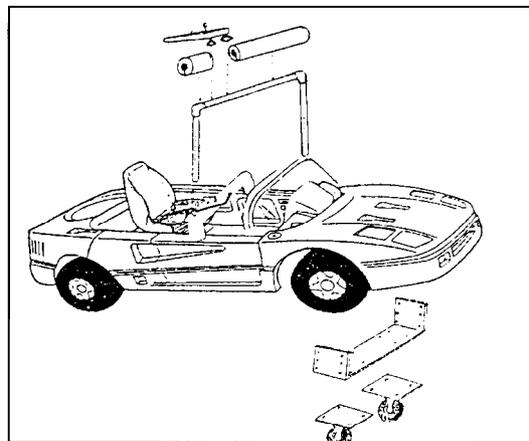


Fig. 1.

is shut off, the direction of motion is changed. By applying this theory of circular motion, it was conceivable to steer the vehicle by modifying the electrical circuit of the existing vehicle, which allowed both motors to be either on or off.

The Existing Design

In the existing circuit both the motors can be switched for forward or reverse motion or switched off. The switching systems consisted of a power switch on the left side of the dash, a forward foot operated switch/accelerator, a reverse foot operated switch/accelerator and a speed control (up to 3 MPH and up to 6 MPH) switch on the right side of the dash. As things stood, the patient was unable to operate any of the said switches. Hence a radial modification had to be done.

Modifications

Installation of Casters. Casters were installed to have free motion in the front. As shown in Fig. 1 (bottom), an aluminum plate was bolted to the supporting rods. The height of the plate is adjustable to adapt to road surfaces. Two free rolling casters were in turn bolted to the aluminum plate. Two casters were used to achieve a good balance. This construction allowed the car to run freely depending on the force applied.

Switches & Circuit Modification. After considering many types of switches, a four-way joy stick was selected. A three-way switch would have sufficed, but since a four-way was available, it was put into use. The position of the power switch was swapped with the speed control switch. The speed control switch was secured in the low speed position (up to 3 MPH) as a safety measure. A toggle switch on the joy stick plate connecting the modified main circuit was implemented.

Accessing the Joy stick. Two holes, large enough to allow a 0.75" PVC pipe through them, were drilled from top in the side of the car body. PVC piping, bent twice at right angles, was inserted into these holes. The joy stick plate, installed with two screw held clamps, was secured to the top of the PVC piping at a convenient angle. The rest of the piping was covered with pipe installation for safety reasons (Fig. 1, top).

Seating Requirements. A child car seat was initially considered. However, since a head support was required, it would have made it impossible to swing the safety bar over the child's head. Initial plans were to build one to specifications. It then came to our attention that a chair our patient was using was to be discarded. To keep the cost low, the seat was modified to suit the car. The foam molding was shaped by cutting the bottom at an angle. An aluminum plate was bolted down to the support rods on the underside. Velcro strips fastened molding to the plate and plastic seat with securing belts was placed on the molding. The head rest is to be installed top of the plastic seat.

Measurements used on this car correspond to pertinent measurements of the patient. The patient's therapist was referred to during modification, so as to suit the muscle strengths and weaknesses of the patient.

The car, which functioned perfectly as intended, is shown in Fig. 2. A videotape is available documenting its function. A three-stage testing protocol was established. First, tests were performed initially by operating the joy stick from outside with no driver or passenger in the car, then with another four year old child, then once appropriate the disabled child. The total cost incurred was \$500.

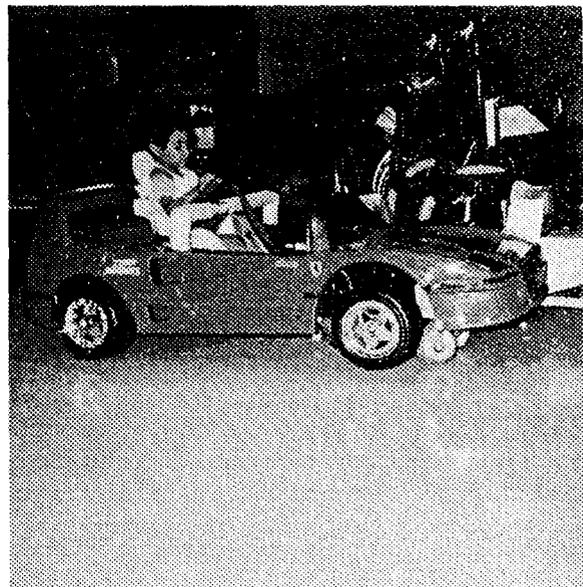


Fig. 2

Custom-Designed Variable-Mode Home Exercise System for a Partial Quadriplegic

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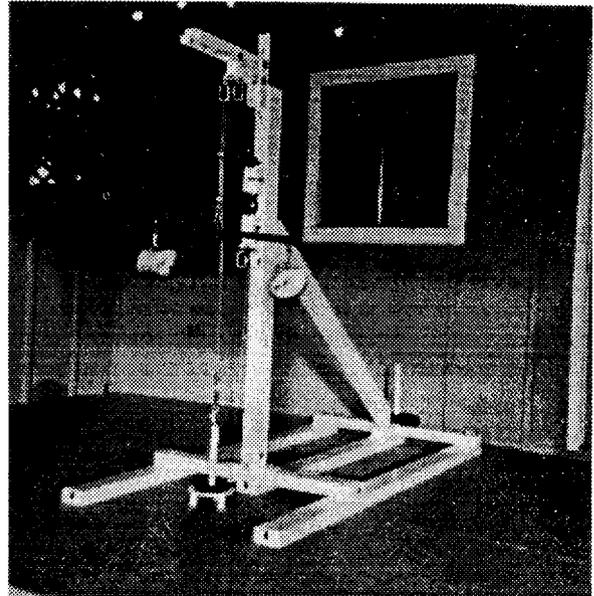
INTRODUCTION

Public awareness of the handicapped community has increased over recent years. The specialized needs of the handicapped have produced an increased need for adaptive equipment. Hopefully, such adaptations will improve the quality of life for the physically impaired.

The goal was to design a portable weight system for a C5-C6 quadriplegic man with the areas of concern listed: 1) stabilizing the subject, 2) keeping the exercise system within his limitations, 3) providing varying types of resistance (isotonic and spring loaded), 4) keeping the area in front of the base as small as possible for ease of wheelchair maneuverability/positioning when exercising, 5) designing a system with a safety factor of two, 6) modifying hand-grips for use by a quadriplegic, 7) providing an instruction manual for assembly and exercises to be performed with the system, and 8) making the system easy to assemble/disassemble and ship in a box 96 inches by 12 inches by 10 inches to the subject's new housing arrangements.

SUMMARY OF IMPACT

This project was to modify a weight unit for a 21-year-old male, C5-C6 quadriplegic. The subject was a very athletic young man prior to injury. He needed a weight system to increase his strength and endurance following discharge from the hospital. The system needed to be portable, meaning easy to disassemble and reassemble because he was unsure of his living arrangements when he left the hospital. The pulley system was intended to be used as a strengthening device, and a motivational tool. The unit needed to be such that he could make adjustments without great difficulty. A successful device was designed that is now being utilized.



TECHNICAL DESCRIPTION,

A wall mounted Life Line Pulley System from GNR Health Systems was modified to fit on to an aluminum frame with the dimensions calculated for safety and the patient's range of motion. The moment about the front of the system was calculated to determine the amount of weight required to counterbalance the unit. The subject was lifting 40 pound weights on a pulley system in the hospital. Assuming the subject's strength improved sufficiently to lift 100 pounds on the pulley system (with a safety factor of two), a 200 pound force was used to calculate the dimensions of the unit. Six 22 pound weights were required to counterbalance the force applied to the pulleys.

A hollow, lightweight, rectangular frame made of aluminum was used because of its ability to withstand bending moments. It also has the added feature of blending in with the existing system. The rectangular tubing used was reinforced at the joints with solid aluminum plugs to increase the surface area in contact with the screws and to keep it from bowing in with repeated tightening of the wing nuts. A cable was placed through the inside of the diagonal tubing to the counterbalance as an additional factor of safety. Wing nuts and washers were used for easy assembly and additional screws were added in pairs to strategic points.

Two types of resistance were used, spring loaded and isotonic. Varying thicknesses of surgical tubing created the different spring loads. Isotonic resistance was created by using iron weights attached to the pulley system. The weight cuffs were attached to a steel cable that ran through the pulleys. The cable can withstand 370 pounds of axial load, which is 170 pounds more than the safety factor of two requires.

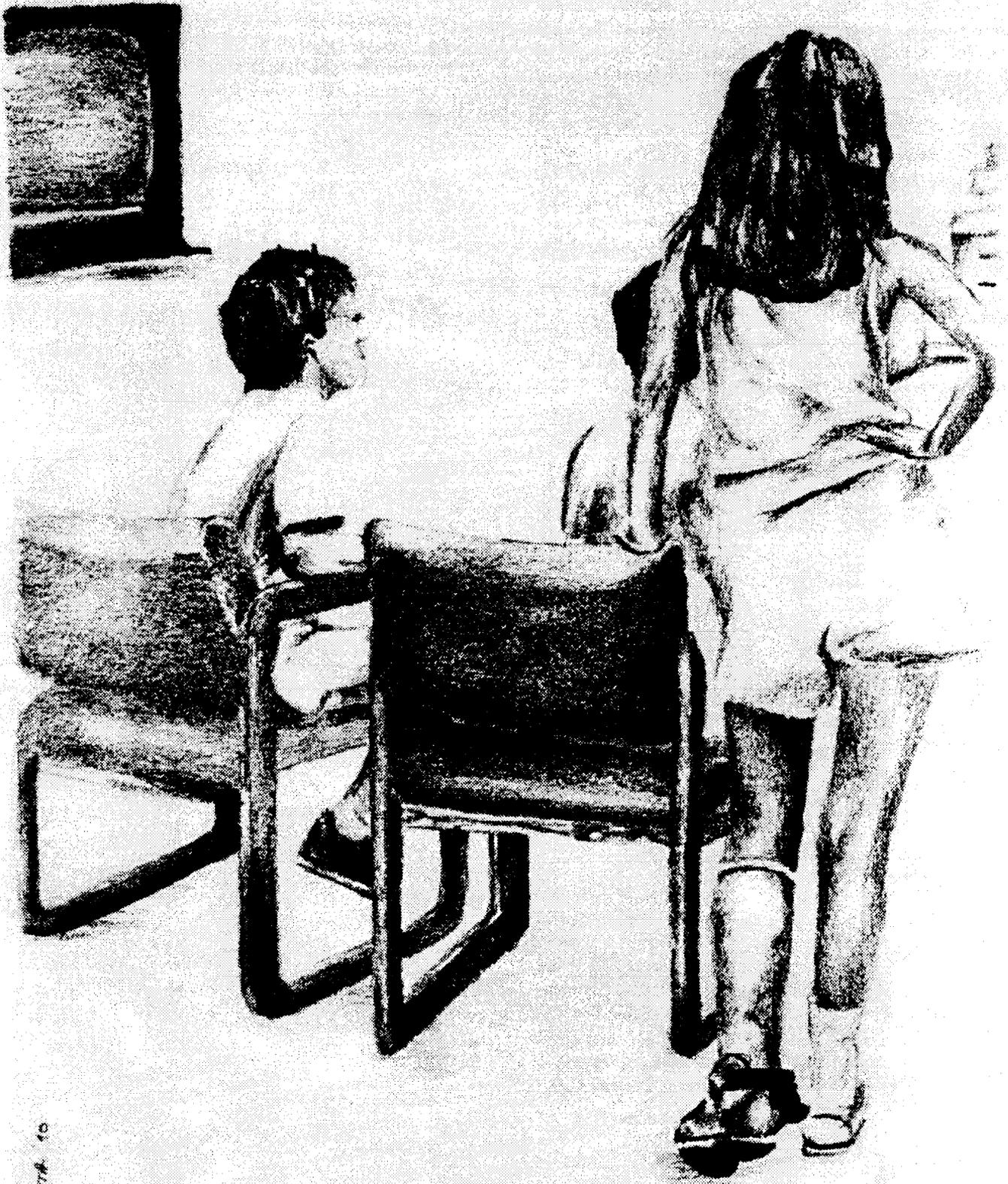
Extra cable also was provided for easy adjustment to allow for changes in range of motion.

Leather wrist cuffs lined with lamb's skin were used in place of hand grips. Detachable clips were used to allow for easy removal and attachment for the various exercises. Velcro closures made the cuffs easy to don independently. An additional wire was used to connect the cuff to the tubing for increased safety.

The subject stabilized himself in the wheelchair by using a strap that goes around the back of the chair

and across his torso. Wheel locks on the subject's wheelchair allow the chair to remain stable.

A booklet of written instructions and pictures was used to explain the five step setup, along with the exercises to be performed. The portable pulley system met the particular needs of the subject previously mentioned. The total cost of the completed unit was about \$500.



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