CHAPTER 15
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THE ROCKAWAY: THE WHEELCHAIR GLIDING SYSTEM

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Client Coordinator: Manda Mountain; St. Margaret's, New Orleans
Supervising Professors: Dr. David Rice, Dr. Annette Oertling
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INTRODUCTION

St. Margaret's Daughters Nursing Home plans to add to the intergenerational activities available to its residents. One traditional activity is a senior rocking a baby or small child in his or her lap. Since many of the residents use wheelchairs, this presents a problem. These residents are often unable to transfer between their wheelchair and a rocking chair independently, and since they are very reluctant to ask for assistance to do so, they would be left out of this activity.

Our design includes a wood frame that surrounds, on three sides, a wheelchair platform. The platform is supported at its corners by four steel bars. These bars terminate on simple bearings that allow the platform to move forward and backward while staying parallel to the ground. This provides the simple and comfortable motion of gliding chairs. A ramp permits the wheelchair user to mount the platform. A single lever raises the ramp upright so that the wheelchair is locked into position on the platform.

Motion is initiated when the wheelchair user pushes against the stationary footrest or by pulling on the handrails.

Fig.15.1. The Rockaway with client. Photo by Guillermo Cabrera-Rojo.

Fig. 15.2. Shown is the ramp with continuous hinge, return spring, cable, and cable housing.

SUMMARY OF IMPACT

"Boy, oh, boy, did they do a good job!" exclaimed the resident at the home who was the first to try out the new rocker. The first time she tried it, she was able, all by herself, to mount the platform, lock in her wheelchair, and begin rocking. She noted as well that it would be a nice place to read a book.

Some wheelchair rockers are commercially available, but these are difficult to access independently and present stability, comfort, or safety issues.

The Rockaway is attractive to the residents and staff because its surfaces are wood, a familiar material, and the sides is painted to resemble a New Orleans streetcar, an iconic mode of transport in New Orleans that has a distinctive rocking motion.

"There's nothing more beautiful than intergenerational interaction," said the St. Margaret's administrator.

TECHNICAL DESCRIPTION

The wheelchair gliding system consists of three basic components: 1) a wraparound frame topped with handrails that supports a footrest and a rocking platform; 2) a suspended rocking platform; and 3) an approach ramp with latching lever and cable system to secure the wheelchair during rocking.

The frame is made primarily of wood. This material was requested by the Home because of its friendliness and non-institutional look, and because the staff knows how to maintain it. The footprint is 45.5" wide by 60" long. The sides are 30" high, the back is open, and the front is "dropped" to keep the user from feeling confined and to give the staff better visibility.

The platform is made of three-quarter inch birch plywood, 40" wide and 32" long. Side and front rails form guides and stops for the wheelchair and stiffen the structure. Four steel bars, 1/8" x 1" x 28" with simple end bearings, support the platform from the frame. Each side of the platform is a four-bar mechanism (the bars are the two suspension rods, the platform itself, and the frame from which the rods swing) that keeps the platform parallel to the floor while it swings back and forth. The platform is suspended one-half inch off the ground and can swing five inches in either direction reaching a maximum height of 1.0 inches.

The ramp permits independent access to the platform. A 35" continuous hinge fastens the ramp to the rear of the platform (see Fig. 15.2). The ramp is tapered to minimize the bump on entry. Two spring mechanisms from snap rattraps hold the ramp to the floor. A strip of rubber mounted beneath minimizes skidding. A J-hook toggle clamp (DE-STA-CO model 371) operates the cable system. Aircraft cable routed through bicycle brake cable casing pulls the ramp to vertical. This action releases the friction and secures the wheelchair in the platform.

The action of the toggle clamp is straightforward, and its position is visible to the user and others. Rocking is initiated by pushing on the footrest or by pulling on the handrail. We considered motor driven rocking, but found that the system didn't need it.

Safety is paramount. Regular maintenance and inspection of wear points is specified. The platform is designed to work with a 400 lb. load, but overloading causes no harm to the user or the rocker. The platform will deflect to the floor, preventing any lateral motion, and the floor will support the excess weight. Overloading causes no damage to the system.

The cost to replicate the wheelchair rocker is approximately $400.

THE GYRO-RYDER: A HORSEBACK RIDING SIMULATOR

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Client Coordinators: Carrie Cassimere
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INTRODUCTION

A local school that serves autistic children ages 3-18 uses equestrian therapy. The educational goals, which are individualized for each student, include balance, following instructions, and learning cause and effect. To provide additional practice opportunities and better prepare students for horseback riding, the school requested a simulator that could be used for longer periods under the attention of fewer staff. Because the stimulator training was to prepare for horseback riding, the details of mounting the horse, sitting in the saddle, and holding and using the reins had to be similar.

The Gyro-Ryder is a horseback riding simulator with a regular saddle and interchangeable reins. It is mounted on a pivoting post and is guided by an internal gyroscope. Pulling on the reins tilts the gyroscope, and momentum transfer causes the body and the rider to turn in the direction of the pull. The reins provided are standard, color-coded, or padded.

SUMMARY OF IMPACT

The school reports, "The Gyro-Ryder horse simulator ... has been such a wonderful asset to our students in so many ways. It has become a motivator for one of our students, who has refused to even attempt to get on the horse for the past 3 or more years, to actually get on the live horse at the stables because he has found stability and consistency with the horse simulator. It has allowed some of our other students to practice and generalize motor planning steps required for getting on and off the horse. Other students have been able to practice the motor planning skills to use the reins, guiding the horse to the left or right. Some of our younger students are learning and practicing following directions for 'pull,' 'red,' 'blue,' 'left,' and 'right,'"

Fig.15.3. Team member demonstrating the simulator.

TECHNICAL SUMMARY

The Gyro-Ryder comprises three main parts: 1) The body assembly, 2) the base support and bearing system, and 3) the gyroscope assembly.

An 18" diameter HDPE drainage pipe forms the structure of the body assembly. It sits on vertical steel shafting 5.5" long that fits into the base support. The shafting is welded to a steel plate that is through-bolted to an internal steel plate. A brown blanket for a horse like appearance covers the body.

The plywood base support is 48" in diameter and is laminated to a thickness of 1.5". A 2.5" x 14" schedule 40 steel pipe is welded to a flange that fastens at the center of the base. This pipe contains thrust and roller bearings that accept the vertical shafting of the body and allow easy rotation.

Making the body and the base separable greatly simplifies transporting the simulator.

To avoid tipping, the base radius extends beyond the length of the body to insure that the overall center of gravity is always within its limits. The calculated strength of the body and base support and bearing system exceeds 600 lbs. applied anywhere. This strength, which was confirmed by proof testing, provides safety factor of three with respect to the maximum expected rider weight.

The gyroscope system uses the GYROWHEEL bike trainer (http://www.thegyrobike.com). It is a battery powered gyroscope that replaces a bicycle wheel. We mounted it to the front fork of a bicycle and welded the fork to the steel plate internal to the horse body. The GYROWHEEL contains it's own battery, charger, and control switches which we left intact. To reduce sound level, we lined the horse body with sound absorbing material.

The total cost of this device is approximately $900.

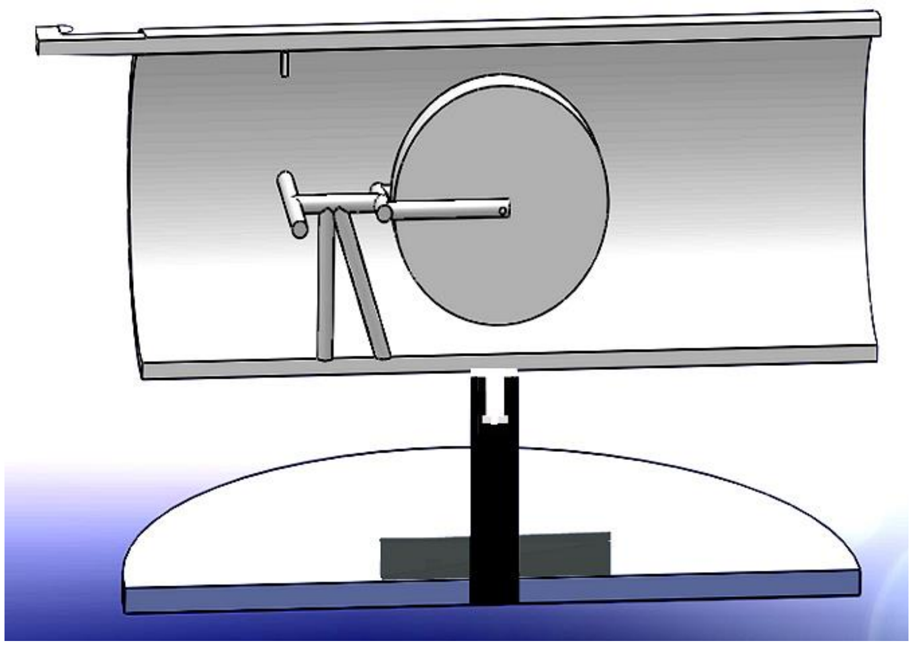

Fig.15.4. Cutaway view of Gyro-Ryder components.

STIMULATORY DEVICE TO TREAT MANIC-ABUSIVE AUTISM

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INTRODUCTION

Our client is a thirteen-year old autistic boy with self-abusive tendencies who slaps or pinches his neck, often breaking the skin. The goal of our project is to identify and test techniques that reduce injury to the neck. We took several approaches to minimize hand contact with the neck. The most successful of these is a neck vibrator. We modified a commercially available vibrating pillow by adding a remote push button switch that straps to our client's arm. When the button is pushed, a motor in the cushion vibrates. This design provides not only physical protection by surrounding the neck, but also a means for harmless self-stimulation.

SUMMARY OF IMPACT

Self-abusive behavior is particularly difficult to handle in autistic individuals. They are often unable to communicate what is bothering them or causing the manic behavior. Our client appeared to slap because he needs to stimulate himself. Our design provides a separate channel for stimulation that he can control. The device does help deter client's self-abuse, but it was not always accepted by our client. The need for novelty, or lack of novelty, is common in people with autism disorders. Consequently we added a number of changeable covers with different colors and tactility, so that the teachers would have flexibility with using the device.

The lead teacher acknowledged that they had "a very difficult situation," and reported that "... I do see a decrease in the incidents of self-abuse in our student."

TECHNICAL DESCRIPTION

We chose to modify a commercial product for the stimulator, the Homedics NMSQ-200 Neck & Shoulder Massager (amazon.com), because it (a) had all the necessary components, (b) it was battery operated, (c) was lightweight, (d) was cost-effective because of mass production, and (e) had a proven safety record.

We bypassed the vibrator intensity controls and removed the heating elements. Added wires connected the battery directly to the vibrator motor through the remote normally open-momentary contact push button switch (Jameco #26623).

The wires connecting the switch to the pillow went through a standard inline 1/8" audio jack and plug (Radio Shack 274-333 and 274-286). This allows easy button replacement and provides a safety "breakaway" feature should the wires become entangled.

The push button is encased by a Belkin Silicone Armband Case for 80/120 GB iPod classic 6G (amazon.com N14312). This case has adjustable straps, is easy to don and doff, and is comfortable to wear.

Approximate cost: $39.48.

Fig.15.5. The stimulation device with button cable and connectors.

A VIOLIN BOWING PROSTHESIS

Designers: Hudson Chien, Joan Lien, and John Pitre, Jr.
Client coordinator: T. Fryer, Ochsner Hospital, New Orleans
Supervising Professors: Dr. David Rice, Dr. Cedric Walker
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INTRODUCTION

Our client is learning to play the violin. She has a congenital transradial amputation of her right arm and uses a myoelectric prosthesis to grip the bow. It does not work well because the gripping action can't hold the bow securely at the proper angle and the battery and motors make the prosthesis too heavy to hold in position for long. The best our client could manage with her existing prosthesis was fifteen minutes of light playing. We designed an alternative, the Violin Bowing Prosthesis (VBP), to minimize these problems.

SUMMARY OF IMPACT

Our design maintains controlled bow position and minimizes total weight, so the user can comfortably practice for extended periods of time. On our client's first trial run with the VBP, she was able to don the device, strap the bow into the clamp, and practice for over an hour without fatiguing.

TECHNICAL DESCRIPTION

Figure 15.7 shows the assembled prosthesis, and Figure 15.8 shows an exploded view of the VBP. This design comprises several component groups: The socket (A), the connecting rod (B), the clamp mount (D-H), and the bow clamp (I-K). Aluminum or thermoplastic form all parts except for the stainless steel screws.

The custom fitted socket with rod mount (A) is made of Duraplast, a standard thermoplastic for prosthetics. Shaping the socket was particularly challenging because below the elbow sockets typically have a lip that goes over the elbow to keep them from falling off. This lip reduces the range of elbow flexion, so a careful tradeoff between retention and range of motion needed to be made.

The rod (C) is an aluminum tube that is fixed to the socket by spring-pin (B). We used a pin, rather than a screw mount, because we needed to limit the rotation of the rod. Interchangeable rods of different

Fig.15.6. The violin bowing prosthesis in action.

Fig. 15.7. View of prosthesis without bow.

length permit large prosthesis extension adjustment.

The clamp mount (G) grips inside the tube by friction when drawbolt (H) pulls wedges (E) and (F) together. Pin (D) prevents wedge rotation during tightening. This arrangement is similar to a standard bicycle handlebar quill or stem assembly, and it allows fine angular and extension adjustments.

Rapid prototyping in ABS thermoplastic formed the bow clamp (I) and (K). The bow is placed between the two custom pieces. A hook and loop fastener (not shown) holds the pieces together. The process can be done easily with one hand. The clamping is firm and, unlike some commercially available bow clamps, no metal will touch the bow which minimizes risk to the bow finish.

The final cost of the VBP was $ 73.20.

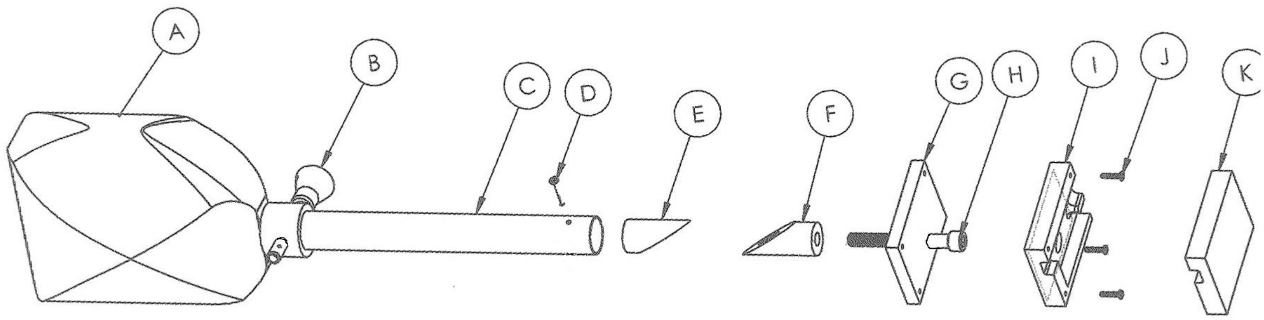

Fig.15.8. Exploded view of the VBP. See text for details.