Reotherapy Provides Functional Gains in Traumatic Brain Injury Patient Four Years After Completing "Traditional" Therapy Services (Case Study)

John Heinz, Allied Health Services- Wilkes Barre, PA

Patient Background

- The patient was involved in a Motor Vehicle Accident in November of 2002. He was diagnosed with a Traumatic Brain Injury and received traditional inpatient and outpatient therapy for 6 months prior to being discharged in 2003. Since 2003, he has been living at home with his parents. He was unable to return to school yet still continued to perform his hobbies such as strength training at home and playing on the computer. He was referred back to therapy four years later to trial the ReoGo system in October of 2007.

Patient Information and Evaluation

Age:	23
Gender:	Male
Diagnosis:	Traumatic Brain Injury secondary to Motor Vehicle Accident
Date of Onset:	11/02/02
Initial Functional Status:	Left Upper Extremity weakness and poor coordination; Right upper extremity ataxia; Patient requires increased time to complete Activities of Daily Living. He is able to ambulate independently without a device.
Date therapy restarted:	10/24/07

Intervention Method

- **The patient was treated using the ReoGO exclusively, 20-45 minute sessions/2X per week for 12 weeks.** Treatment sessions began with planar exercises given minimal assistance from the robot (follow assist mode) and an introduction of 3 dimensional exercises with the robot providing a lot of assistance. The therapist targeted the patient's problem areas by using a variety of exercises. The patient continued with a combination of these planar and 3-D exercises through a progression of modes from more passive to more active. He was able to complete anywhere from 54 to **over 215** Maximal Arm Movements (MAM) per session depending on the length of treatment session. A MAM is defined as moving from the root to a target and back. This varies with the structure of the exercise. A specialized elbow exercise was created for the patient, and the therapist also individualized the force to each exercise as appropriate.

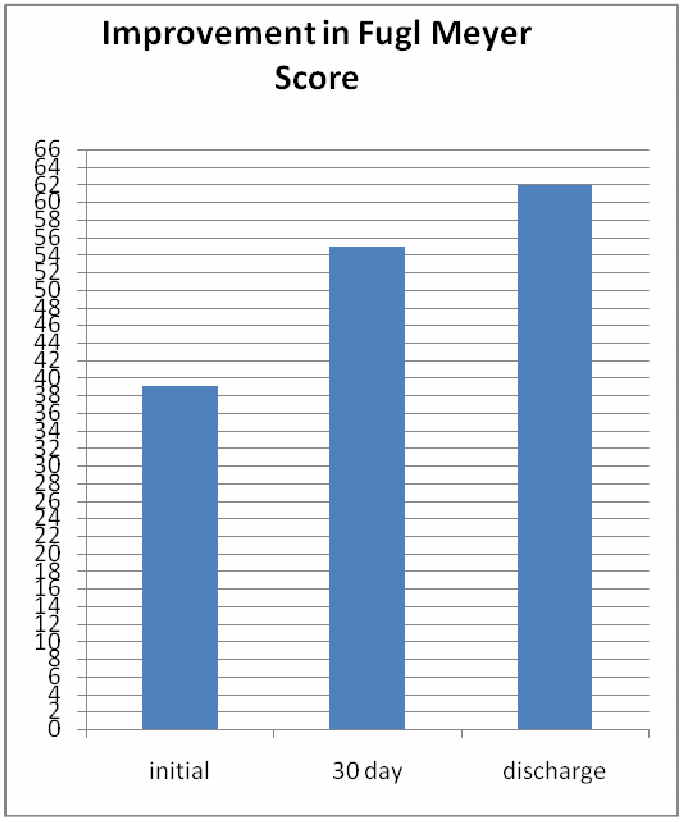
Clinical Results

Clinical use of the ReoGo system resulted in an increase of **~28** degrees range of motion throughout the upper extremity for this patient. He also showed improved strength with an increase of 15lbs. in grip strength and an increase of ~5lbs. in pinch strength. His Fugl Meyer Score improved significantly by **23** points from 39/66 to 62/66.

Improvements in Musculoskeletal Status

Right Upper Extremity	Initial Evaluation	Discharge
ROM • Shoulder abduction • External Rotation • Elbow flexion • Wrist Flexion • Wrist Extension	 95 45 125 65 55	 160 72 145 90 90
Grip Strength	60 lbs.	75lbs.
Pinch Strength • Lateral • 3 jaw • 2 point	 26lbs 10lbs. 10lbs.	 30lbs. 16lbs. 14lbs.
Nine Hole Peg	1 min. 47 secs.	1 min.

Traumatic Brain Injury (case study) continued



**The Fugl Meyer is a quantitative assessment of physical performance post stroke. It is highly recommended as both a clinical and research tool (Duncan, P. etal, 1983). For the purpose of this case study, the focus was solely on the upper extremity portion. The maximum score is 66.

Clinical Value of Reotherapy

- Reotherapy offers a new standard of rehabilitation via a robot-assisted platform to provide mass practice for patients recovering from a neurological event. Current literature supports the idea that mass repetition promotes cortical reorganization.
- Reotherapy provides a challenging environment with the idea of **progressive engagement** through various modes. Patients can work anywhere from more passive modes to more active modes or a combination of both so that they can be challenged at their highest level of functional ability.
- Reotherapy's unique library of exercises and games provide functional movement patterns with proprioceptive, visual and auditory feedback for increased engagement and learning for a patient with neurological deficits.
- Reo has shown to improve tone on those patients with hypertonicity following a traumatic brain injury. It also can be used for those patients with low tone to elicit muscle activation with the appropriate positioning attachments.
- The Reo can be used with patients who have difficulty following commands as it only requires the patient to follow a one step command. In addition, the multisensory feedback helps the post traumatic brain injury patient to improve his/her overall attention and increase perceptual awareness of the affected side.

Conclusions

- Reotherapy provides a new tool to improve functional upper extremity recovery for patients post traumatic brain injury. Exclusive use of the ReoGo platform resulted in both improvement at the impairment level as well as functional gains. The results are even more significant as they demonstrate improvements in a chronic patient who had complete "traditional" therapy four years earlier.

Patient Testimonial

- Throughout the course of his Reo Therapy, patient reported, "I really feel my shoulder working." "I am able to use my left arm more when I'm lifting weights." His parents also noted increased spontaneous use of his Left Upper Extremity with feeding and grooming activities.

References

Duncan, P. etal. "Reliability of the Fugl-Meyer Assessment of Sensorimotor Recovery Following Cerebrovascular Accident". Phys Ther 63:10, 1983.

Spinal Cord Injury Patient Shows Movement Out of Synergistic Patterns and Improved Distal Function after Using Reotherapy

John Heinz, Allied Health Services- Wilkes Barre, PA

Patient Background

- The patient was diagnosed with cervical herniation at levels C4-C5 and presented with quadriplegia. She underwent a cervical laminectomy with fusion of C3-C7. She received traditional inpatient and outpatient therapy prior to discharge from therapy in the summer of 2006. She lives in a two story home with her children. The patient received a referral to restart therapy over a year after discharge to trial Reotherapy.

Patient Information and Evaluation

Age:	46
Gender:	Female
Diagnosis:	Cervical Herniation at levels C4-C5 presenting with quadriplegia
Date of Onset:	5/23/06
Initial Functional Status:	Presents with quadriplegia, a flexed posture and compensatory patterns throughout the right upper extremity. She is able to use her right arm as an independent stabilizer but has no gross grasp. The patient is able to perform basic Activities of Daily Living at a modified Independent level, requiring adaptive devices and increased time. She is only able to use her left hand for these tasks. The patient is unable to drive at this time, but she can ambulate with a quad cane. She requires assistance for home management tasks and has with difficulty using her right arm to assist.
Date therapy restarted:	9/06/07

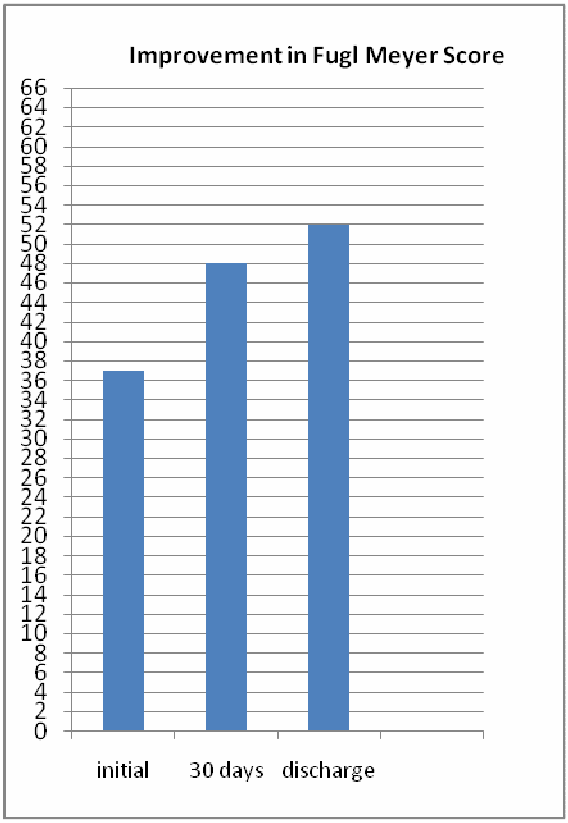
Intervention Method

- **The patient was treated using the Reo 15-40 minute sessions/3X per week for 8 weeks.** Training sessions began with the robot providing maximal assistance in planar exercises and the patient passively moving though 3 dimensional exercises. The therapist took individual exercises and progressively engaged the patient from more passive modes to more active modes during the session. In time, she created a combination of different exercises all progressing in modes to challenge the patient to her maximal functional ability. Another important basis to her treatment plan included mass repetition. The patient completed anywhere from 54-**143** Maximal Arm Movements (MAM) per session depending on the length of the treatment session. A MAM is defined as moving from the root to a target and back. This varies with the structure of the exercise. She also introduced more complex 3 dimensional exercises and created a personalized elbow flexion/extension exercise. In addition, the therapist changed the force, speed and scaling to individualize the treatment plan.

Clinical Results

- Clinical use of Reotherapy in conjunction with other technology demonstrated an increase of **~31** degrees in Range of motion throughout the upper extremity. She also showed a **15** point improvement in Fugl Meyer Score from 37/66 to 52/66. Another significant result was an increase in independence from synergistic patterns. The patient could now perform gross grasp and release and show improved isolation of digits.

Incomplete Spinal Cord Injury Case Study (continued)



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****Beth also demonstrated normal arm swing with gait.**

Left Upper Extremity	Initial	Discharge
Range of Motion	**(degrees)**	**(degrees)**
Shoulder		
• **Flexion**	0-90	0-110
• **Abduction**	0-95	0-120
• **External Rotation**	0-30	0-65
• **Internal Rotation**	0-45	0-70
Elbow Extension	**-80**	**-25**
Wrist		
• **Flexion**	0-45	0-55
• **Extension**	0	**0-50**
Shoulder Pain		
• **On Average**	5/10	4-5/10
• **At work**	9/10	6/10
Tone		
• **Modified Ashworth**	4/4	2/4
• **Brunnstrom**	Level 3- Beginning voluntary movement but only in synergy	Level 5- Independence from basic synergies
Grasp	Unable	Able to make fist, open hand and use spherical grasp
Opposition	Independent to index finger only	Independent to index, middle and ring finger
Timed Up and Go	23 seconds	20 seconds

Clinical Value of Reotherapy

- Reotherapy offers a new standard of rehabilitation for neurological patients via a robot-assisted platform. The ReoGo system meets the needs of the Spinal Cord Injury patient as it focuses on the proximal upper extremity and targets muscles for stabilization and strengthening.
- Reo has shown to improve tone on those patients with hypertonicity following a neurological event. A variety of attachments is available to appropriately position and support the arm whether or not the patient has distal function.
- Another unique feature is that every exercise can be "fit" to the patient's available range of motion to accommodate tone or pain. The therapist can also fit the targets to help patients relearn normal movement patterns. Targets are later scaled out for increased range as the patient improves.
- Reotherapy **progressively engages** the patient**,** advancing from more passive modes to more active modes or a combination of both. In this way, the patient is challenged at his/her highest level of functional ability. Reotherapy's flexibility in parameters provide therapists with the ability to further customize exercises the Spinal Cord Injury patient's level of impairment and functioning.

Conclusions

- Clinical use of the Reotherapy showed notable improvements in upper extremity recovery at both the impairment and functional level after an incomplete Spinal Cord Injury. The robot assisted technology also was also beneficial in helping to Increase independence from synergistic patterns, decrease tone and improve distal function.

Patient Testimonial

- She reports that she has increased use of her right upper extremity as a functional assist with Activities of Daily Living and increased ability to release items. She also notes, "I can use my right arm when I get dressed…Now I can hold bottles and wash and dry dishes".

References: Duncan, P,etal. "Reliability of the Fugl-Meyer Assessment of Sensorimotor Recovery Following Cerebrovascular Accident". Phys Ther 63:10, 1983.

Patient with Guillain Barre Syndrome Makes Significant Gains in Range of Motion and Coordination with Reotherapy

John Heinz, Allied Health Services- Wilkes-Barre, PA

Patient Background

- The patient was in his usual state of health until a sudden onset of progressive weakness occurred one day in 2006. He was diagnosed with the neuromuscular disease known as Gillian-Barre Syndrome. In September of 2007, the progressive nature of the diagnosis had caused muscle paralysis, affecting his respiratory muscles as well. He was admitted to the ICU, followed by 1 month of inpatient therapy before being discharged home with his wife. In December of 2007, the patient began outpatient therapy service.

Patient Information

Age:	67
Diagnosis:	Guillain Barre Syndrome
Date of Onset:	2006
Functional Status;	Able to ambulate with the use of a rolling walker and Contact Guard Assist. He required minimal assistance for bathing and was able to perform other basic Activities of Daily Living with modified Independence using primarily his left hand. He was able to use right hand as gross assist and his FMC was severely impaired. He was noted to have 1+/4 tone throughout his right arm.
Date therapy resumed:	December 20, 2007

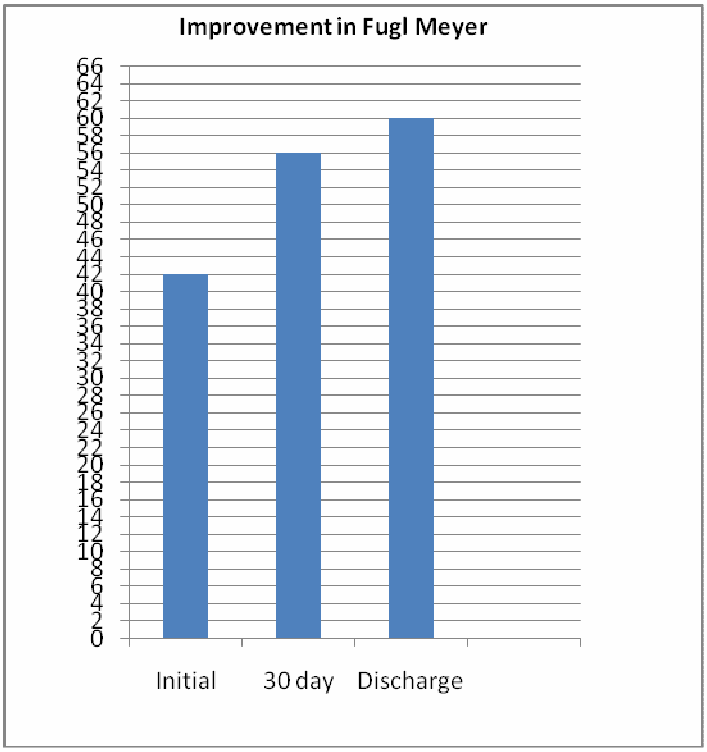
Intervention Method

- **The patient was treated on the Reo for 20 minutes 3x/week for 12 weeks.** Treatment sessions began alternating planar and 3 dimensional exercises between modes for passive and minimal assistance from the robot to provide guidance in the different movement patterns. The patient then alternated between planar and 3 dimensional exercises in more active modes (follow assist) with more repetitions. The therapist used a combination of exercises that so that patient completed anywhere from 85 to **over 160** Maximal Arm Movements (MAM). A MAM is defined as moving from the root to a target and back. This varies with the structure of the exercise. The therapist also created an individualized external rotation exercise. The patient worked on higher levels of resistance to give him more feedback on movement patterns. He initially used the gyro with grip handle but was able to progress to the knob handle as coordination and strength improved.

Clinical Results

- Clinical use of Reotherapy on a patient with Guillain Barre Syndrome produced a significant **18** point improvement in Fugl Meyer Score from 42/66 to 60/66. His therapists noted improved quality of movement and decreased use of compensatory strategies for fine motor tasks. He showed a 60% increase in grip strength as well as an increase of ~38 degrees in Range of Motion throughout the arm. The patient reported that he is now able to perform his Activities of Daily Living using his Right Upper Extremity Independently.

Guillain-Barre Syndrome Case Study (continued)



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Improvements in Musculoskeletal Status		
Right Upper Extremity	Initial	Discharge
Range of Motion (degrees)		
• **Shoulder Flexion**	115	180
• **Shoulder abduction**	140	170
• **Internal rotation**	35	WNL's
• **Elbow flexion**	150	WNL's
• **Forearm supination**	45	WNL's
• **Wrist flexion**	45	70
• **Wrist Extension**	20	60
Grip Strength	26 lbs.	42.08 lbs
9-hole peg test	(unable to perform)	39 seconds
Pain (at worst)	4/10	1/10

Clinical Value of Reotherapy

- Reotherapy offers a new a robot assisted treatment tool used to achieve greater arm function during rehabilitation. This robot-assisted platform meets the needs of the patient with Guillain Barre who often has muscle weakness and poor gross motor control and coordination.
- Reotherapy provides a challenging environment with the idea of **progressive engagement** through various modes. Patients can work anywhere from more passive modes to more active modes or a combination of both so that they can be challenged at their highest level of functional ability.
- Reotherapy's own library of exercises and games provide functional movement patterns with multisensory feedback. This proprioceptive, visual and auditory feedback is ideal for the Guillain Barre patient who is working towards increased coordination. Each target is "fit" the individual patient's range of motion and can be gradually scaled out or re-fit as the patient improves.
- The telescoping feature of the ReoGo mast allows the patient to work in both planar and 3-dimensional planes as strength and range of motion improve. In addition, the therapist can further challenge the patient by changing the parameters,

Conclusions

- Clinical use of the ReoGo system resulted in both improvements in musculoskeletal status and functional gains. It is significant to note that the patient was able to achieve full range of motion overhead above the telescoping height of the robotic mast. The robotic system also helped the patient to regain distal function even though exercises were geared toward shoulder and elbow range of motion and strengthening.

Patient Testimonial

- The patient reports that he is able to participate in home management task and care for his wife with increased independence. He states, "I am now able to use my electric shaver, comb my hair and brush my teeth with my right hand. I can feed myself better now too…I feel I've made a ton of progress with my right arm".

References

Duncan, P,etal.(1983) "Reliability of the Fugl-Meyer Assessment of Sensorimotor Recovery Following Cerebrovascular Accident". Phys Ther 63 (10)1606-1610.

Sample treatment sessions

TBI-Session 15

Exercise	Reps	Mode
Forward Reach 3D	6	Guided
Forward Reach	5	Follow Assist
Circle	5	Follow Assist
Diagonal Right Downward	2	Follow Assist
Diagonal Left Downward	2	Follow Assist
Diagonal Right Upward	2	Follow Assist
Diagonal Left Upward	2	Guided
	Time	**40:43 mins.**

A sample session follows:

SCI-Session 4

Exercise	Reps	Mode
Forward Reach 2D	1	Guided
Forward Reach 2D	3	Follow Assist
Forward Reach3D	1	Initiated
Forward Reach 3D	1	Step Initiated
Forward Reach 3D	1	Follow Assist
Forward Thrust	5	Step Initiated
Forward Thrust	2	Follow Assist
Forward Thrust	5	Guided

A sample session is as follows:

G.B.-Session 6

Exercise	Reps	Mode
Forward Reach 2D	3	Guided
Forward Reach 2D	5	Initiated
Forward Reach 2D	3	Follow Assist
Forward Reach 3D	2	Follow Assist
Brian's Ext. Rotation Exercise	20	Initiated