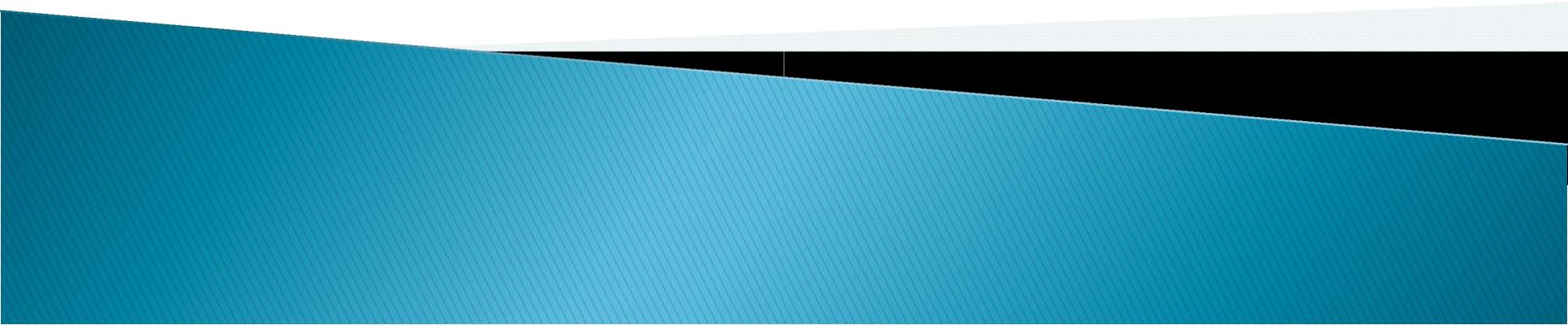
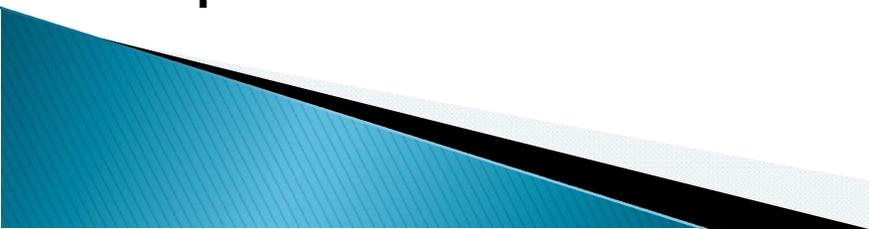


# Dynamic Bracing and Post Polio A Case Study

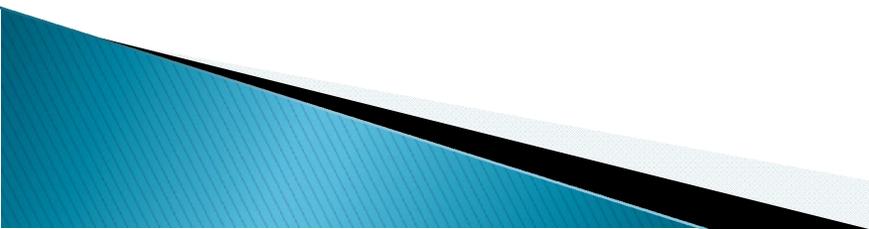
David P. Guy, PT, MS



# Background

- ▶ PPS manifested by neurologic musculoskeletal and general manifestations
  - ▶ 440,000 polio survivors may be at risk for PPS
  - ▶ 25–50% of polio survivors will contract PPS
  - ▶ The weakness of PPS is related to the degeneration of individual nerve terminals in motor units that survive the original polio.
  - ▶ Multiple studies point to the irreversible and permanent denervation of supraspinal nerves.
- 

# Subject:

- ▶ 72 year old retired physician
  - ▶ Diagnosed with polio at age 17
  - ▶ Multiple surgeries including complete fusion of spine
  - ▶ Non-ambulatory for 17 years
  - ▶ Unstable left knee
  - ▶ No motor function left lower extremity
- 

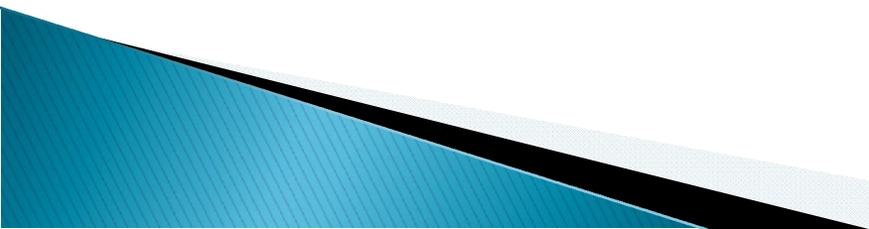
# Initial Muscle Strength

- ▶ Rectus abdominus 0/5
- ▶ Internal oblique 0/5
- ▶ External oblique 0/5
- ▶ Left biceps femoris 1.5/5
- ▶ Vastus medialis L 0/5
- ▶ Rectus femoris L 0/5
- ▶ Fibularis longus L 0/5
- ▶ Gastrocnemius L 1/5
- ▶ Anterior tibialis L 2.5/5

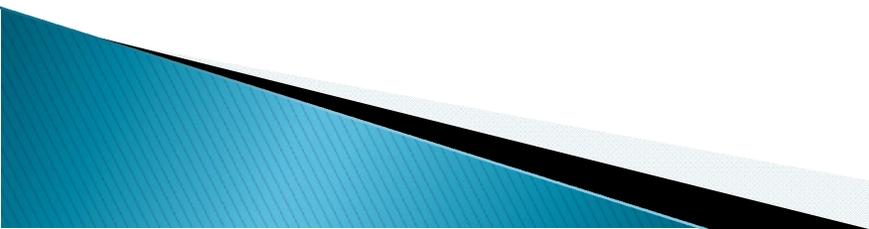
# Upper Body Strength

- ▶ Upper extremities 4.5/5
- ▶ Trunk strength 0/5–2/5

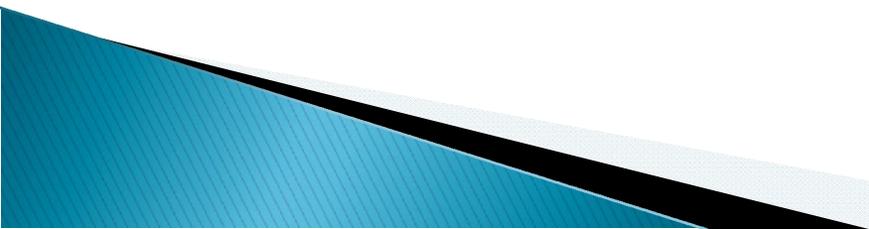
# Coordination and Cooperation

- ▶ To make this system of treatment work there must be close and continued interaction between the physician, the therapist and the orthotist. The orthotist and therapist must be able to establish and maintain a close working rapport. Joint treatment sessions with both the orthotist and therapist present are extremely helpful and need to occur at least monthly.
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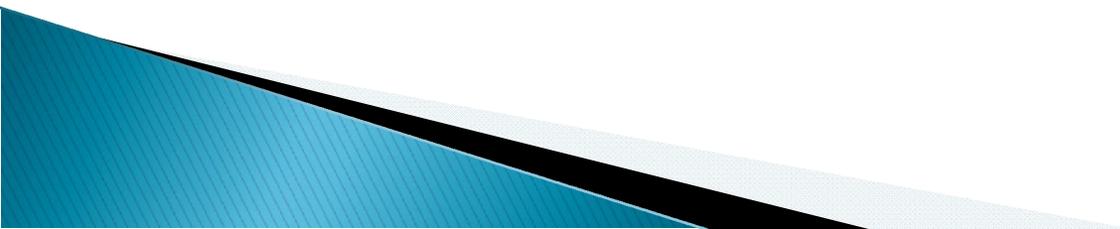
# Interventions

- ▶ Orthotics
  - ▶ Exercises
    - a. PNF exercises
    - b. EMG facilitation exercises
    - c. Breathing exercises
    - d. Transfer training
    - e. Pelvic and core stabilization
  - ▶ Gait training
- 

# Exercise / Gait Stopped if:

- ▶ Pain
  - ▶ Diaphoresis
  - ▶ Gait Instability
  - ▶ Increased knee recurvatum
  - ▶ Decreased gait speed
  - ▶ Limited toe clearance or toe drag
  - ▶ Inability to speak during exercise
- 

# Orthotic Interventions Used by the Subject in order of use

- ▶ Traditional AFO
  - ▶ Swedish knee cage
  - ▶ Carbon fiber floor reaction AFO
  - ▶ Dynamic Bracing Solutions orthosis
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# Double Action Joints, Dorsi-flexion assist AFO



# Carbon fiber–floor reaction AFO



# Dynamic Bracing Solutions orthosis (AP view)



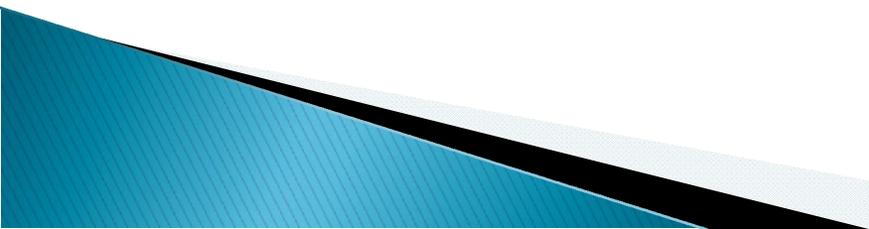
# Dynamic Bracing Solutions orthosis (oblique view)



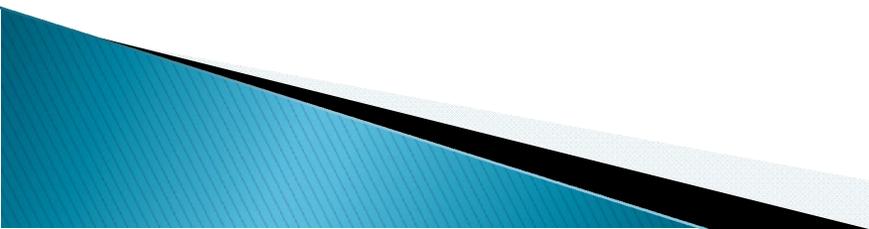
# Subject wearing DBS



# Exercises

- ▶ Pelvic stability exercises
  - ▶ Trunk stability exercises
  - ▶ Breathing exercises
  - ▶ Upper extremity strengthening
  - ▶ Posture exercises
  - ▶ Transfer training
  - ▶ ADL training
- 

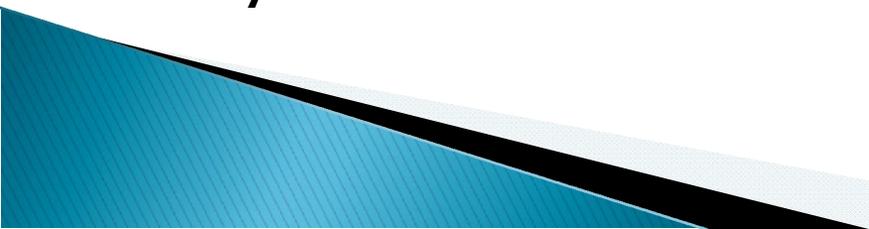
# Treatment Sessions

- ▶ 50–70 minutes 3 x weekly
  - ▶ EMG muscle strengthening
  - ▶ Gait training
  - ▶ Breathing exercises
  - ▶ Pelvic and core stabilization
- 

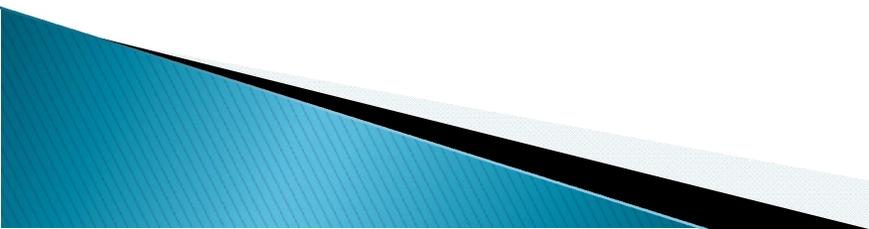
# Safety of Exercise

- ▶ National Institute of Neurological Disorders and Stroke report that exercise is safe and effective when carefully prescribed and monitored.

# Testing

- ▶ Data collection was completed weekly
  - ▶ Patient was given a day of rest prior to testing
  - ▶ Patient arrived on scooter and did no exercises prior to testing
  - ▶ Surface EMGs were placed on several muscles and the subject was given verbal encouragement to contract the muscle and move the appropriate joint.
  - ▶ If the goal was achieved, the goal was revised by 10 microvolts.
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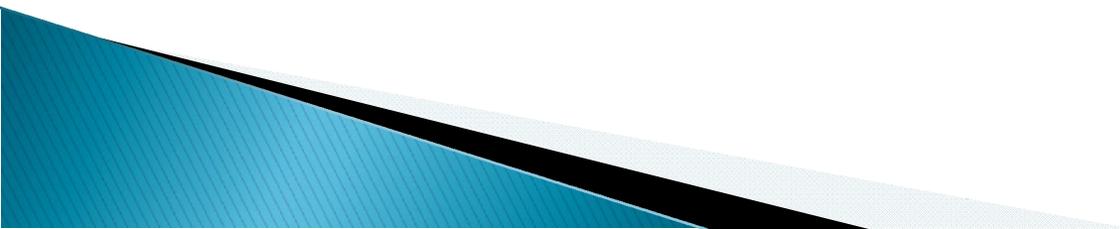
# Gait Training

- ▶ After resting from the EMG activities for 15 minutes, gait training began
  - ▶ Subject used the DBS orthosis, Lofstrand crutches and 2 point gait
  - ▶ Distance was measured in feet
  - ▶ Subject was monitored for pain, diaphoresis, genu-recurvatum, gait stability and gait speed, and toe clearance.
  - ▶ If any of the above occurred gait training was halted.
- 

# Respiratory Exercises

- ▶ Chest expansion was measured at nipple line
- ▶ “Kleenex” exercises
- ▶ Diaphragmatic breathing
- ▶ Huff and puff

# Data Analysis–Vital Capacity

- ▶ Initial = 45% of expected
  - ▶ Post treatment = 54% of expected
  - ▶ Subject reports marked increase in energy, fewer rest breaks and ability to complete more activities at home without fatigue
- 

# Data Analysis–50 Foot Test

## Initial (2<sup>nd</sup> session with DBS use)

	B/P	Heart Rate	Respirations
Start	146/76	68	15
Finish	148/78	72	21

Time to walk 50 ft. = 59.9 seconds

Miles per hour = 0.5 mph

## Post Treatment (21<sup>st</sup> session with DBS use)

	B/P	Heart Rate	Respirations
Start	128/74	60	12
Finish	135/75	61	12

Time to walk 50 ft = 22 seconds

Miles per hour = 1.58 mph

# EMG Activity

Muscle	Session 1	Session 2	Session 3	Session 4	Session 5	Session 6	% Change
Biceps femoris	105	117	141	188	204	210	50%
Vastus medialis	48	52	78	101	145	140	66%
Rectus Femoris	26	62	81	98	106	150	83%
Anterior tibialis	180	180	180	180	198	198	9%
Fibularis longus	149	162	152	191	198	204	27%
Gastrox	161	201	201	201	201	221	27%
Rectus Abdom.	22	41	44	50	98	104	79%
Internal obliques					58	110	47%
External obliques					54	75	28%
Overall % Change of all muscles							46%

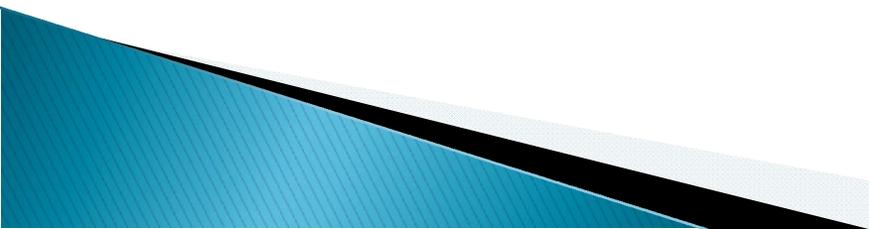
# Ambulation Distances

Measurement Sessions	Distance Ambulated
1	40 feet
2	80 feet
3	480 feet
4	600 feet
5	540 feet
6	640 feet
7	1940 feet

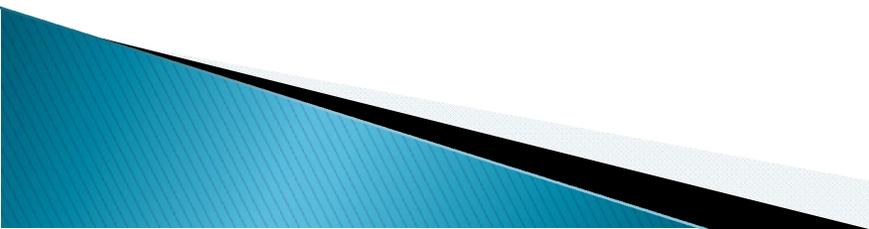
# Muscle Strength

Muscle	Initial Strength	Current Strength
Rectus Abdominus	0/5	2.5/5
Internal Oblique	0/5	2.5/5
External Oblique	0/5	2.5/5
Biceps Femoris	1/5	2.5/5
Vastus Medialis	0/5	2.5/5
Rectus Femoris	0/5	2.5/5
Anterior Tibialis	2.5/5	4.5/5
Fibularis Longus	0/5	4.5/5
Gastrocnemius	1/5	4.5/5

# Discussion

- ▶ All measures show improvement
  - ▶ Subject states he is able to do more at home
  - ▶ Subject walks on his own over 2000 feet with no fatigue
  - ▶ Muscle strength continues to improve as the subject continues to ambulate
  - ▶ Subject is particularly pleased because he has no pain which was the major limiting factor to ambulation previously
- 

# Conclusion

- ▶ These data suggest that the initial motor changes caused by the polio virus are not permanent.
  - ▶ Muscles do improve with non-fatiguing exercise and use of a dynamic brace.
  - ▶ The dynamic brace provides not only stability but sensory and dynamic input that facilitates increases in motor strength.
  - ▶ Clearly, this study needs to be completed with a large cross section of patients.
- 

**Disclaimer: The following are unofficial notes which have not been read by or approved by the speaker.**

- PPS is truly no small problem.
- Multiple studies point to irreversible and permanent denervation of supraspinal nerves.
- Results of this study somewhat change this belief.
- Subject of study – 72-year-old retired physician who was diagnosed with polio at age 17. Polio affected his trunk and left lower extremity and he was non-ambulatory for 17 years. As a result of instability, he had considerable left knee pain.

- Pulmonary status was quite poor. Only one-half inch of chest expansion. His endurance was quite limited.
- Close coordination and cooperation between the physician, therapist and orthotist was important in treating this patient.
- For the first three or four weeks, joint sessions were held to modify the brace and treatment programs.
- Speaker indicated that frequently in his profession, there is not enough focus on breathing exercises.
- For this subject, it was central in getting the results he achieved.
- The team felt strongly that the lower extremity would not function well unless there was a stable platform.
- Started a course of exercises, then moved on to exercises on a Universal Gym and then gait training.
- Subject was closely monitored during treatment – rest and vital signs were checked.
- Subject used a traditional AFO (didn't help with knee instability or decrease knee pain), Swedish knee cage, and a carbon fiber floor reaction AFO (circumduction gait was causing more problems).
- Joint decision to move to Dynamic Bracing Solutions orthosis was made.
- Three components – heel lift, actual orthosis and shoe. It is a padded model and fitted to the patient.
- Subject's knee was in perfect position and remains that way today. He has no pain.
- Exercise sessions begin using a parallel bar or walker. As the patient improves, exercises are done without holding onto the parallel bars or walker.
- The National Institute of Neurological Disorders and Stroke report that exercise is safe and effective when carefully prescribed and monitored. This is taken very seriously. A good rapport with the subject's physician included receipt of the physician's progress notes.
- Breathing exercises are critical.
- Biggest problem with training is the subject did too much work at home and frequently came to the clinic exhausted because of the independence with the DBS brace.
- Data analysis showed that following treatment, subject had an increase in energy; time to walk 50' went from 59.9 seconds to 22 seconds; muscles worked or improved and distance walked increased for 40' to approximately 2,000'.
- Subject is pleased because he has no pain.
- Eleven other patients at two different sites had similar results.
- Currently involved in a second study and this will be a much larger study, getting pre- and post-brace study data...how far can you walk, what is the speed and balance, pain, joint stability and strength, any falls, cardio-pulmonary problems and any problems that we or the orthotist notices, etc.
- Brace is being used with other diagnoses as well.
- DBS has witnessed these results over the last 20 years and is very pleased.
- Question – what was this gentleman's muscle strength in the hip, was he strong?
  - Generally, strength was 2.5/5 using the standard PT Manual Muscle testing.
- Question – the reason he had not ambulated for 17 years was pain?
  - Yes, pain and instability.
- Question – do you think some of the gains you saw were because he was back up on his feet?
  - Yes, because he was able to ambulate again it increased his motor functions.

- Subject used a scooter. He did not try any bracing because he was told that unless he went to a long leg brace he could not ambulate again. He didn't want to use the long leg brace.
- Comment - We see improvements in PPS patients. This degree of change implies that there was something else going on. Perhaps he had a more recent decline and was rebounding. Just from the neurologic standpoint, I question the conclusion that these are results seen from simply strengthening the patient with a brace.
- Speaker was equally amazed with the changes. However, they have duplicated the same results with additional patients.
- Another patient, age 62, had bilateral weakness from polio and very limited knee extension and anterior tibialis and had the same results.
- Muscle testing was done by three different therapists with 100% agreement.
- Comment: Three different therapists rarely read anyone the same. The facts presented in this case study are impressive. The purpose of these calls is to challenge each other's thinking.
- Comment: Several people have had similar results – they are stronger in several muscle groups since using this brace.