A Treatment Proposal with Lower Extremity Robotic Devices: Performance of Postural Analysis and Determination of Exercises Using the REX Robot

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INTRODUCTION:

Multiple sclerosis (MS) is a chronic, autoimmune, degenerative disease of the central nervous system causing progressive disability in young adults. Subsequently, poor postural control occurs, which is considered one of the most disabling symptoms of the disease. Posture deterioration negatively effects mobility and independence, leading to falls and injuries, adversely affecting the overall quality of life. This deterioration, appearing in people afflicted with multiple sclerosis becomes more pronounced with significant disease progression.

❖ Deficits in balance control and poor posture are some common and often initially disabling symptoms of multiple sclerosis (MS) and spinal cord injury (SCI).

❖ Symptoms such as weakness, fatigue, visual problems and altered sensations can make it harder for the person to maintain a good posture.

❖ Posture deterioration negatively effects mobility and independence, leading to falls and injuries, adversely affecting the overall quality of life.

❖ The benefits of maintaining proper posture are numerous and well-documented: can improve the health of joints, muscle, ligaments, balance, and overall function.

❖ Postural Assessment can assist practitioners in determining the relationships among various body parts and in determining whether such relationships cause or contribute to pain or discomfort for specific individuals.

❖ The Physical Therapist can aid in the process of correcting posture by strengthening muscles that cause poor posture and also by increasing flexibility to reduce the strain on the body through a complete postural assessment and then determination of a suitable exercise plan.

❖ The objective of this project is to explore the use of robotic exoskeleton REX to design postural exercises for persons with neurological conditions (MS and SCI).

Comments from participant after ~ 30 minutes. of REX-Exercises that she was able to breath better, and felt like she could now actually take a deep breath. Upon sitting on the mat individual reported that she felt like she was sitting taller, and perform sit-->stand with less effort, and able to move her shoulders more. Participant was surprised that she was able to sit like a lady and impressed that her (R) LE was in front of her versus to the side. " It was so much easier to do the exercises in the Robot than in standing cause I did not have to worry about falling over. I usually can only stand for very short bouts of time like a minute or 2 and have lots of pain in my knee."

METHOD:

Participant will undergo a postural and core assessment in both sitting and standing before starting an exercise program utilizing the REX Robotic Exoskeleton System. Based on this postural evaluation 4 exercises will be determined to address impairments and dysfunction and any imbalances to be corrected.

PATIENT INFORMATION:

55 year old (R) handed female who was diagnosed with relaxing-remitting MS in Jan 1996. Patient is living independently, driving and is the mother of 3 children. Patient has a past history of a (L) hip injury after the birth of her 3rd child, a (L) patellar Fx in 1976, and (R) foot fx in 2010.

POSTURE ANALYSIS:

Sitting:

(R) tibia valgus, (R) Ankle eversion, Increased WB on medial aspect of foot on (R), (L) ankle and foot grossly normal
(R) slight tibial torsion
(R) abduction
(R) IR of the hip
(L) hip & knee grossly normal

Sitting Posture - Front   Sitting Posture - Side

Standing:

Increased Weight bearing on the left,
(R) foot forward
Increased valgus of the (R) LE compared to the (L)
(R) ankle eversion with increased WB on medial aspect & 1st ray
(B) adduction of LE, increased knee Flex (B), (L) worse then (R).
Increased ER of the (R) LE, and IR of the (L)
(R) ASIS anterior/ (L) Posterior
Flexed posture of the trunk, with elongation of the (R) side
(L) trunk protracted & (R) retracted

Standing Posture - Front   Standing Posture - Side

PROPOSED EXERCISES:

The following 4 exercises, were determined to be appropriate based upon Postural Assessment of a this individual who has been Diagnosed with MS:

1. Side bending to the right - to help retrain the trunk, and address elongation on the (R) and increased side bending to the (L). In addition addressing the height of shoulder, proper breathing, and rib mobility.

2. Trunk Rotation timed with breathing- to address scapular retraction on the (R), and protraction on the (L) as well as rotation of the rib cage and trunk.

3. Squat -to attempt to load (B) LE with equal weight bearing while participant performs isometric adduction. --This exercise will help (B) LE quad muscle to fire equal, and increase abdominal & core activation.

4. Forced Use of Right Lower Extremity Exercise in a lateral lunge position with Isometric trunk Extension-- to develop and improve proprioception into (R) LE including increased WB with normal alignment of hip, knee, and ankle and decrease valgus and abduction.

Side Bending to Right   Trunk Rotation Timed with Breathing

DISCUSSION:

Exercise is an intervention commonly used in the management of multiple sclerosis (MS). The more recent understanding is that exercise is a very important part of maintaining functional independence in individuals with MS. Many studies and research has shown that properly prescribed exercise programs can decrease impairments in MS, as well as improving activities of daily living, and quality of life. Standing exercises are very hard, and sometimes unsafe and very fatiguing, for individuals who suffer from the debilitating disease progression of MS. The REX allows individuals to stand in a safe manner and perform various exercises while maintaining proper alignment of the foot, ankle, knee, hip and trunk. Participants who use the REX can possibly stand for a longer duration, with potentially less fatigue, compared to regular standing activities but more research is needed to determine this. Individuals may feel more comfortable and safe while performing exercises in the REX due to increased stability and improved postural alignment. Various exercises can be performed in the REX to address postural dysfunction.

CONCLUSION:

Exercising patients with MS in the REX Robotic Exoskeleton System may improve posture with resulting benefits to the patient. Other neurologic conditions may also benefit from the same technique to determine appropriate exercises to perform in the REX. In order to investigate this effect further, we propose a Clinical Case Series of patients with MS, SCI, and other neurologic conditions using postural analysis to determine the exercise needs of these individuals followed by treatment and post-treatment postural analysis to assess the outcomes.