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EKSO GT AS A GAIT TRAINING DEVICE IN STROKE REHABILITATION

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Ability KC *(formally RIKC)*

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Objectives

1. The participant will be able to identify the appropriate patient population that will benefit from use of the Ekso GT device including indications, contraindications, and precautions.
2. The participant will be able to list benefits of using the Ekso GT as a gait trainer for individuals in stroke rehabilitation.
3. The participant will be able to demonstrate knowledge of the most recent evidence based practice regarding the Ekso GT for stroke rehabilitation.

Disclosures

- Natalie Brandt, DPT
  - Nothing to Disclose

What is Ekso??

"Ekso is a wearable bionic suit used in rehabilitation to enable individuals with any amount of lower extremity weakness or paralysis to stand up and walk over ground with a natural, *full weight bearing reciprocal gait*. Walking is achieved by the user's weight shifts to activate sensors in the device which initiate steps. Battery-powered motors drive the legs, replacing neuromuscular function."[1]

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What is Ekso??

- Provides a means for people with complete paralysis to stand and walk.

- **Helps patients re-learn proper step patterns and weight shifts using a functional based platform while facilitating intensive step dosage over ground.[1]**

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Suitable Patients

Patients with lower extremity weakness or paralysis resulting from:

- Spinal Cord Injury
- **Non- or pre-ambulatory individuals post-stroke**
- Acquired Brain Injury
- Multiple Sclerosis
- Guillain-Barre
- Generalized weakness caused by other conditions[2]

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Indications

- Screened and cleared by a physician prior to Ekso use
- Weigh 220 pounds or less
- Approximately between 5'0'' and 6'4'' tall
- Standing hip width of 18'' or less
- Have near normal range of motion in hips, knees, and ankles[2]

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Patient Requirements

- Maintain Balance
- Manage Assistive Device
- Shift weight over legs
- Contribute to actions based on programming
  - Initiate step

Contraindications

- Passive ROM deficits
- Leg length discrepancy
- Spinal instability
- Unresolved deep vein thrombosis
- Uncontrolled autonomic dysreflexia
- Spasticity that prevents joint motion
- Open skin ulcerations
- Pregnancy[1,2]

Precautions

- Cognitive impairments
- Uncontrolled orthostatic hypotension that limits standing tolerance
- Colostomy
- Active heterotopic ossification, hip dysplasia, hip axis abnormalities
- Subcutaneous cranial bone flap stored in abdomen[2]

Walk Modes

- FirstStep-PT controls stepping action
- ProStep-Patient initiates stepping by achieving a forward and lateral weight shift target
- **ProStep Plus-Patient initiates stepping by achieving lateral weight shift target on stance leg and unweighting trailing leg.**
- ActiveStep-Patient controls stepping using buttons attached to AD.[2]

Lower Extremity Assistance

- Bilateral-provides swing limb assistance and full stance stability to both LE's

- Left or Right Affected-provides swing limb assistance and full stance stability for selected limb only
  - Contralateral limb is automatically programmed to Free, with no motor assist for swing but may be programmed to support stance of the free leg.[2]

Forward Assist Options

- Maximum Assist-100% motor power
- Adaptive Assist-continually adapts dependent upon patients effort
- Fixed Assist-set max motor assist 0-100
- Free-no motor support[2]

Variable Assist

- Variable Assist allows individuals with any amount of lower extremity strength to contribute their own power from either leg while Ekso fills in the deficit.[1]
- "Variable assist software allows for necessary customization and it has become a game changer"[3]-Dr. Karen Nolan

Variable Assist Video

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Benefits of Ekso

- **High step dosage**
- Re-learn proper gait pattern
- Accelerated timeline of recovery process
- Reducing physical burden on clinicians
- Settings with adjustability while walking
- Highly adaptive to patients' needs
- Active NOT passive device
- Patient-technology Interaction
- Compact
- Fast set-up time[1-7]

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Step Dosage

- Kessler Foundation:
  - Initial evaluation: 0 to 8 feet
  - First Ekso GT exposure: 442-431 feet[3]
  - Average distance in traditional PT: 212 feet
  - Average distance in Ekso session: 551 feet[4]

Benefits of Ekso

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Proper Gait Pattern

- Deterring compensatory strategies
- Enforcing optimal weight shift
- Finding Midline
- Symmetry
- Improving upright posturing
- Every step completed correctly
  - "Successful ambulation does not come at the cost of poor leg path that will require braces down the road."[3] -Dr. Nolan

Proper Gait Pattern cont.

- Burke Rehabilitation and Research Institute
  - Increased stride length
  - Increased walking velocity
  - Decrease in double support phase percentage

  - Visually observed improved gait[5]

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Accelerated Timeline

- Weak patients up and walking sooner
- High intensity and repetitive rehab earlier **while brain is still healing**[3]

- Rehabilitation Institute of Chicago
  - All subjects able to walk in exoskeleton on first session.
  - Ekso able to walk with all abilities, one who was unable due to pushing syndrome.
  - After 4 Ekso sessions, all subjects able to complete 6 min walk test over ground, unable previously.[6]

Benefits of Ekso

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Benefit to Clinician

- Less strain to clinician to achieve more optimal steps
- Maintain optimal biomechanical alignment (therapist and patient)
- Reducing risk of injury to clinician
- Less man power required
- Decreased fatigue (therapist and patient)
- Overall Safety[1,3,7]

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- **Compact**
- **Fast set-up time**[1-7]

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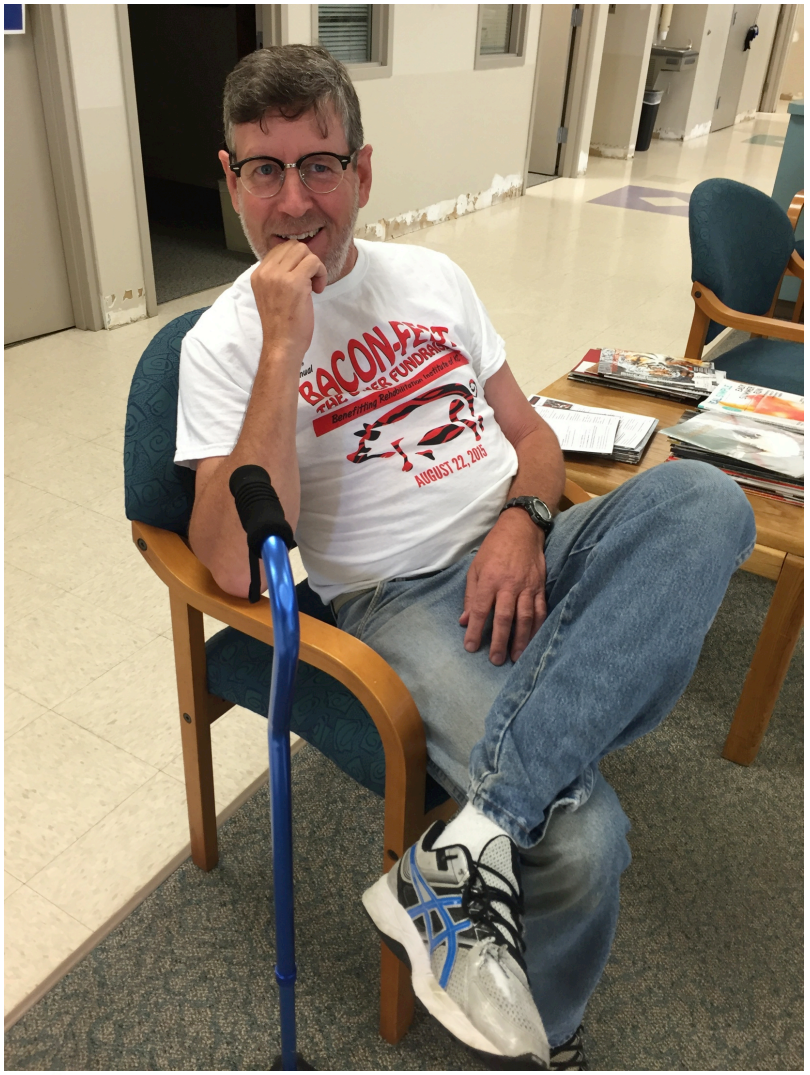
Limitations

- Lack of numerical data
- No long term studies
- Lack of protocols
- Size and fit
- New technology
- No pediatric studies[3,7]

Case Study #1

Hx: Right brain hemorrhagic stroke

- Admitted to RIKC 4 weeks s/p **(sub-acute)**
- Pre-gait status at time of admission



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Case Study #1

Impairments:

- Left hemiplegia
- Left neglect
- Severe sensory deficits
  - Absent to poor sensation and proprioception of (L) side
  - Poor body awareness
- Pushing syndrome*
- Little to no weight bearing on (L) tolerated during ambulation over ground

#1 Ekso Treatment

Completed 25 sessions in exoskeleton

- Frequency: 1-2x/week for 14 weeks
- Traditional PT: 5x/week for 8 wks, decreased to 3x/week for 6 wks

- 1st session: 289 steps
- Avg tx session: 700-900 steps
- Traditional PT 1st week: 50 feet
- Traditional PT avg: 150-450 feet

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Outcomes Video

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#1 Outcomes

- Decreased need for AFO usage
- Increased (L) muscle return
- Improved Motor planning
- Improved Body awareness with lack of sensory return
- Mitigated compensatory gait patterns

#1 Outcomes

- Timed Up and Go:
  - Initial: 65 sec
  - 3 weeks: 33 sec
  - 6 weeks: 24 sec
  - 14 weeks: 15 sec

- Berg Balance Test:
  - Initial: 33/56
  - 6 weeks: 47/56
  - 14 weeks: 51/56

- 6 Minute Walk Test:
  - Initial: unable
  - 6 weeks: 258 feet
  - 14 weeks: 500 feet

Case Study #2

Hx: Breast Cancer, Subarachnoid hemorrhage, AVM with shunt placement, hydrocephalus with VP shunt revision

- Admitted to RIKC 5 months s/p **(Sub-Acute to Chronic)**
- Traditional PT for 6 months prior to starting Ekso gait training
- Non-ambulatory

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Case Study #2

Impairments:

- Spasticity with full body ROM deficits
- Full body weakness, (L) side more effected
- Left neglect
- Sensory and motor planning deficits (L)

****Did not meet Ekso requirements at time of admission*

#2 Ekso Treatment

Completed 20 sessions In Ekso

- Frequency: 1-2x/week for 12 weeks
- Traditional PT for 6 months prior to starting exoskeleton gait training
  - Spasticity management
  - Standing program
  - Body weight supported gait training
  - Parallel bar gait training
- PT 3x/week at start of 12 week Ekso treatment

Gait Therapies Video

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#2 Outcomes

- 1st session: 286 steps
- Avg tx session: 500 steps
  - Progressed to 500 steps followed by 25-50 feet with RW over ground
  - Up time 30-45 minutes

- Over ground walking with RW:
  - Initial: 10 ft, 20 within session
  - 6 weeks: 40 ft, 80 within session
  - 12 weeks: 50 ft, 200 within session

#2 Outcomes

- Improved upright posturing
- Increased A/PROM in trunk and LE joints
- Improved LE strength/motor planning
- Increased endurance
- Improved balance
- Improved body awareness/symmetry

Pre-Ekso

12 weeks Ekso GT

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Outcomes Video

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Updated Patient Status

- Continued Ekso gait training as part of our "wellness program" 1x/week for ~30 weeks
  - Walks 150 feet, 450 feet within one session
  - Significantly decreased assist level
  - Updated Outcomes Video

Updated Outcomes Video

Case Study #3

- **Hx**: Subarachnoid Hemorrhage secondary to ruptured basilar apex aneurysm, hydrocephalus

- Readmitted for exoskeleton gait training just over 2 years s/p stroke **(chronic)**
- Household ambulator, RW with distant supervision
- Limited community ambulator, RW with SBA

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Case Study #3

Impairments:

- Mod-severe Ataxia
- Balance deficits
- Double vision
- Gait deficits
  - wide BOS
  - tense posturing
  - shortened right step/poor heel strike

#3 Ekso Treatment

Completed 10 sessions in exoskeleton

- Frequency: 1-2x week for 6 weeks
- Traditional PT: 3x/week, seen 6 session over ground
  - Balance training

- 1st session: 443 steps
- Avg tx session: 500-700 steps
- Traditional PT avg: 500-1000 feet with RW
  - 100-250 feet without AD

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Outcomes Video

#3 Outcomes

- Improved balance
- Subtly of weight shifts
- Improved fluidity of gait
- Improved upright posturing
- Ambulation without AD:
  - Improved confidence of single stance support
  - Decreased BOS
  - Decreased double stance support time
  - Increased step length
  - Improved heel strike

#3 Outcomes

- Berg Balance Test:
  - Initial: 24/56
  - 3 weeks: 40/56
  - 6 weeks: 46/56

- Timed Up and Go:
  - Initial w/ RW: 18 sec
  - 6 weeks w/ RW: 20 sec

  - Initial w/o AD: 26 sec ***with min A***
  - 6 weeks w/o AD: 25 sec ***with SBA***

Demonstration & Questions

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References

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