BENEFITS OF STANDING FOR ADULTS WITH NEUROMOTOR DISORDERS

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Altimate Medical, Inc.

Disclosure: Maryann Girardi is an employee of Altimate Medical, Inc.

LEARNING OBJECTIVES

List	Discuss	Describe
List a minimum of 3 neuromotor disorders that benefit from the use of standing technology.	Discuss the evidence supporting the use of standing technology for adults with neuromotor disorders	Describe how standing technology can be integrated into an individual's plan of care.

Caused by damage to the central nervous system

Can be developmental or acquired through injury/illness

Affects muscle tone, movement, posture, and gross/fine motor skills.

NEUROMOTOR DISORDERS

Https://pressbooks.bccampus.ca

STANDING UPRIGHT SYMBOLIZES:

- Moral rectitude
- Vigor
- Dignity
- Autonomy

Straus, E.W. 1966. Phenomenological psychology. New York: Basic Books.

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PERCEIVED BENEFITS

- 87% improved sense of well-being
- Sense of normality and enjoyment
- Increased participation in activities
- Sense of freedom
- 25% reported improved sleep

Dennett R, Hendrie W, Jarrett L, et al. "I'm in a very good frame of mind": a qualitative exploration of the experience of standing frame use in people with progressive multiple sclerosis. *BMJ Open*. 2020;10(10):e037680. Published 2020 Oct 28. doi:10.1136/bmjopen-2020-037680

Eng JJ, Levins SM, Townson AF, Mah-Jones D, Bremner J, Huston G. Use of prolonged standing for individuals with spinal cord injuries. *Phys Ther*. 2001;81(8):1392-1399. doi:10.1093/ptj/81.8.1392

BUT THESE ARE NOT MEDICALLY NECESSARY

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MEDICAL BENEFITS OF STANDING

- Bone Mineral Density
- Spasticity
- Range of Motion
- Motor Skills
- Respiration
- Bowel and Bladder Function

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STANDING PROVIDES

- Mechanical Loading
- Symmetrical alignment
- Prolonged stretch
- Stimulates proprioception, touch, and vestibular systems
- Initiates postural reactions

Toccolini BF, Osaku EF, de Macedo Costa CR, et al. Passive orthostatism (tilt table) in critical patients: Clinicophysiologic evaluation. *J Crit Ca. re* 2015;30(3):655.e1-655.e6556. doi:10.1016/j.jcrc.2014.12.018

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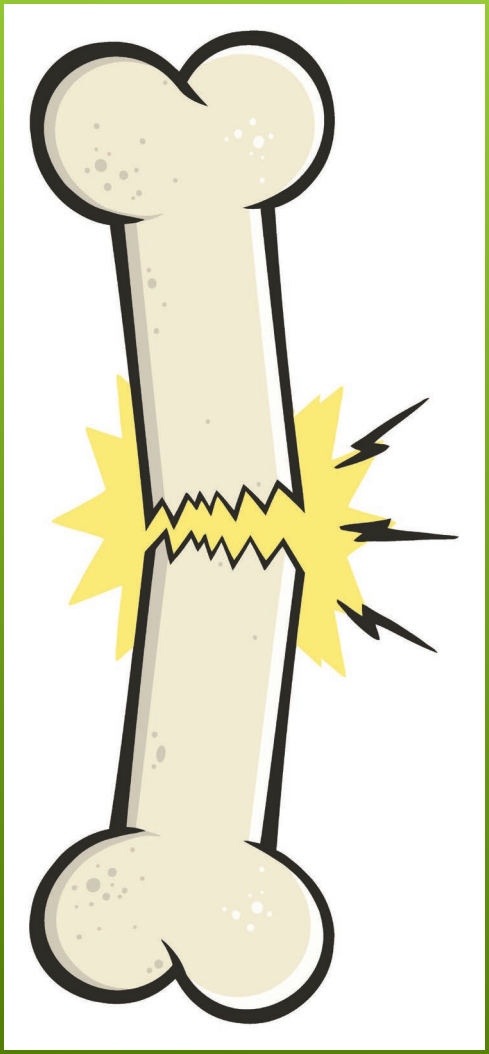
DISUSE OSTEOPOROSIS

- Bone loss due to local skeletal unloading
- Sclerostin levels increased
- High bone resorption and low bone formation
- Weightbearing decreases reabsorption

Rolvien T, Amling M. Disuse Osteoporosis: Clinical and Mechanistic Insights. *Calcif Tissue Int*. 2022;110(5):592-604. doi:10.1007/s00223-021-00836-1

BMD AND FRACTURES



1.5 million osteoporosis-related fractures each year

SCI-100 times fracture rate by age 50

Stroke-7 times fracture rate

MS-20-40% increased fracture rate

Contributing factors

- Immobility
- Mechanical unloading
- Time since injury

https://now.aapmr.org/osteoporosis-and-fractures-after-cns-injury/

BMD SCI

Initiated 1-4 weeks post injury

- Immobilization
- Standing
- Standing and walking

Immobilization loss 6.9%-9.4% of BMD

standing and standing and walking had moderate loss or moderate increase in bmd

de Bruin ED, Frey-Rindova P, Herzog RE, Dietz V, Dambacher MA, Stüssi E. Changes of tibia bone properties after spinal cord injury: effects of early intervention. *Arch Phys Med Rehabil*. 1999;80(2):214-220. doi:10.1016/s0003-9993(99)90124-7

BMD SCI

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Peak increased resorption 3 months post injury	
Supported standing 1 hour/day 5 days/week	• Initiated 8-12 weeks post SCI
BMD Loss during first year	• Standing 19.62% • Non-standing 24%
LE BMD at 2 years post SCI-	• Standing 1.018 g/cm^2 • Non-standing 0.91 g/cm^2

Alekna V, Tamulaitiene M, Sinevicius T, Juocevicius A. Effect of weight-bearing activities on bone mineral density in spinal cord injured patients during the period of the first two years. *Spinal Cord*. 2008;46(11):727-732. doi:10.1038/sc.2008.36

BMD STROKE

Majority of reduction is in the first 7 months

Non-ambulatory

- 10% loss on paretic side
- 5% loss on non-paretic side

Ambulatory

- 3% loss on paretic side

BMD dependent on

- ambulation
- amount of weight born on paretic leg

Jørgensen L, Jacobsen BK, Wilsgaard T, Magnus JH. Walking after stroke: does it matter? Changes in bone mineral density within the first 12 months after stroke. A longitudinal study. *Osteoporos Int*. 2000;11(5):381-387. doi:10.1007/s001980070103

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SPASTICITY

- 38% of stroke survivors experience spasticity within one year after a first stroke
- 84% of MS (34%, it affects their daily life)
- 62% of SCI
- 82.9% of CP

www.lifewithspasticity.com
www.cdc.gov/ncbddd/cp/data.html

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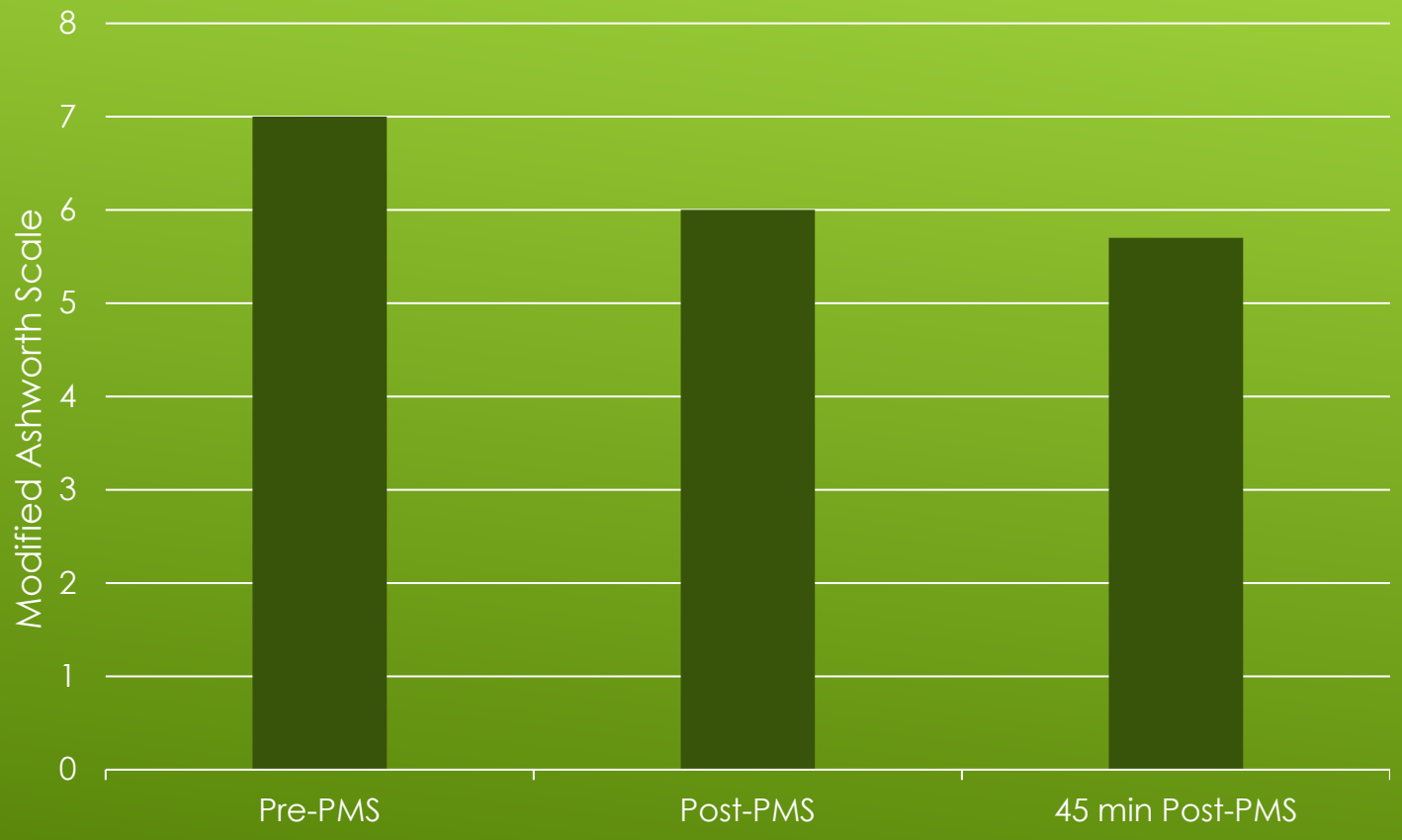
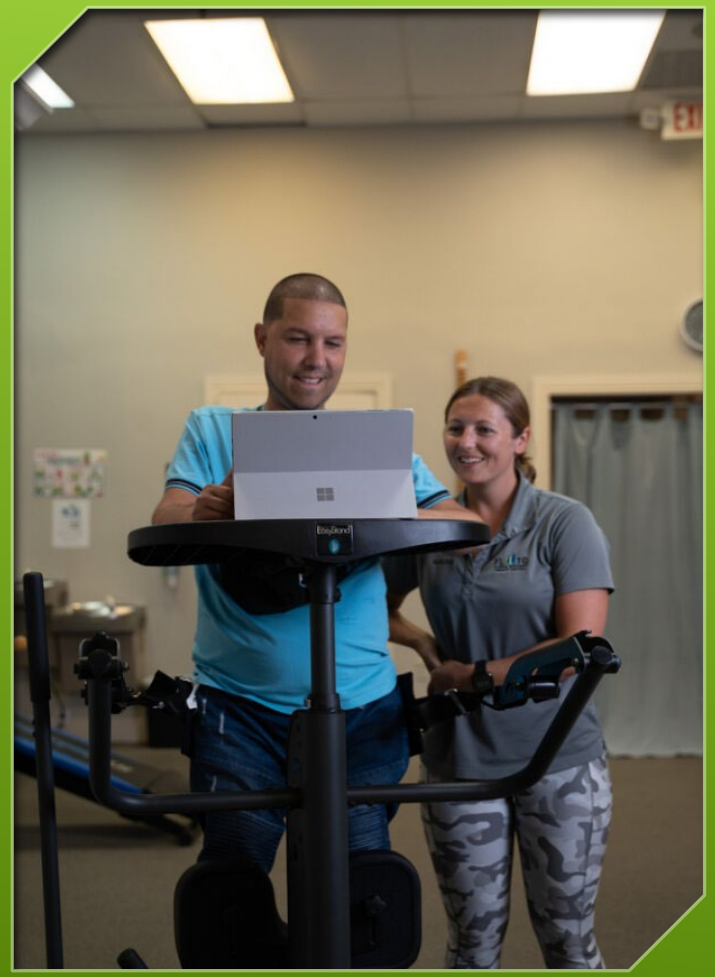
Spasticity STROKE

30 minutes of standing



Tsai KH, Yeh CY, Chang HY, Chen JJ. Effects of a single session of prolonged muscle stretch on spastic muscle of stroke patients. *Proc Natl Sci Counc Repub China B*. 2001;25(2):76-81.

SPASTICITY SCI



- 9 paraplegics
- 8 sessions on 4 consecutive days
- 30 min of stretch or weight load
- Stretching- braced in max dorsiflexion in supine
- 85° standing with 15° dorsi or plantarflexion
- Spasticity reduction
  - Standing-32% dorsiflexion and 26% plantarflexion
  - Stretching- 17%

Odéen I, Knutsson E. Evaluation of the effects of muscle stretch and weight load in patients with spastic paraplegia. *Scand J Rehabil Med*. 1981;13(4):117-121.

STRETCHING

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4 weeks of daily stretching did not change ankle ROM in recent SCI

Sustained stretching of longer duration more effective to improve range of motion and reduce spasticity

Harvey LA, Batty J, Crosbie J, Poulter S, Herbert RD. A randomized trial assessing the effects of 4 weeks of daily stretching on ankle mobility in patients with spinal cord injuries. *Arch Phys Med Rehabil*. 2000;81(10):1340-1347. doi:10.1053/apmr.2000.9168

Pin T, Dyke P, Chan M. The effectiveness of passive stretching in children with cerebral palsy. *Dev Med Child Neurol*. 2006;48(10):855-862. doi:10.1017/S0012162206001836

ROM SCI

- 20 patients with recent SCI
- 12-week standing program
- 30 min standing 3 x/week
- Mean increase
  - 4° ankle ROM
  - 0.005g/cm^2 increase BMD

Ben M, Harvey L, Denis S, et al. Does 12 weeks of regular standing prevent loss of ankle mobility and bone mineral density in people with recent spinal cord injuries?. *Aust J Physiother*. 2005;51(4):251-256. doi:10.1016/s0004-9514(05)70006-4

ROM MS

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- 6 adults dx with secondary progressive MS
- Single blind randomized crossover study
- Standing 30 m/d or daily exercise program cross over after 3 weeks
- Significant Improvements in hip and ankle ROM in standing phase
- Downward trend in Modified Ashworth scores

Baker, K., Cassidy, E., & Rone-Adams, S. (2007). Therapeutic standing for people with multiple sclerosis. *International journal of therapy and rehabilitation, 14*, 104-109.

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ROM TBI

- 36 adults with severe TBI and ankle plantar flexion contracture
- 6 week standing E-stim and ankle splinting vs standing alone
- Standing alone had an average of 3° more passive dorsiflexion

Leung J, Harvey LA, Moseley AM, Whiteside B, Simpson M, Stroud K. Standing with electrical stimulation and splinting is no better than standing alone for management of ankle plantarflexion contractures in people with traumatic brain injury: a randomised trial. *J Physiother*. 2014;60(4):201-208. doi:10.1016/j.jphys.2014.09.007

MOTOR FUNCTION

MS

MS patients 36 weeks home standing program

Significant increase (mean of 4.7 points)in motor score measure by Amended Motor Club Assessment

Significant increase in dynamic sitting balance

Freeman J, Hendrie W, Jarrett L, et al. Assessment of a home-based standing frame programme in people with progressive multiple sclerosis (SUMS): a pragmatic, multi-centre, randomised, controlled trial and cost-effectiveness analysis. *Lancet Neurol*. 2019;18(8):736-747. doi:10.1016/S1474-4422(19)30190-5

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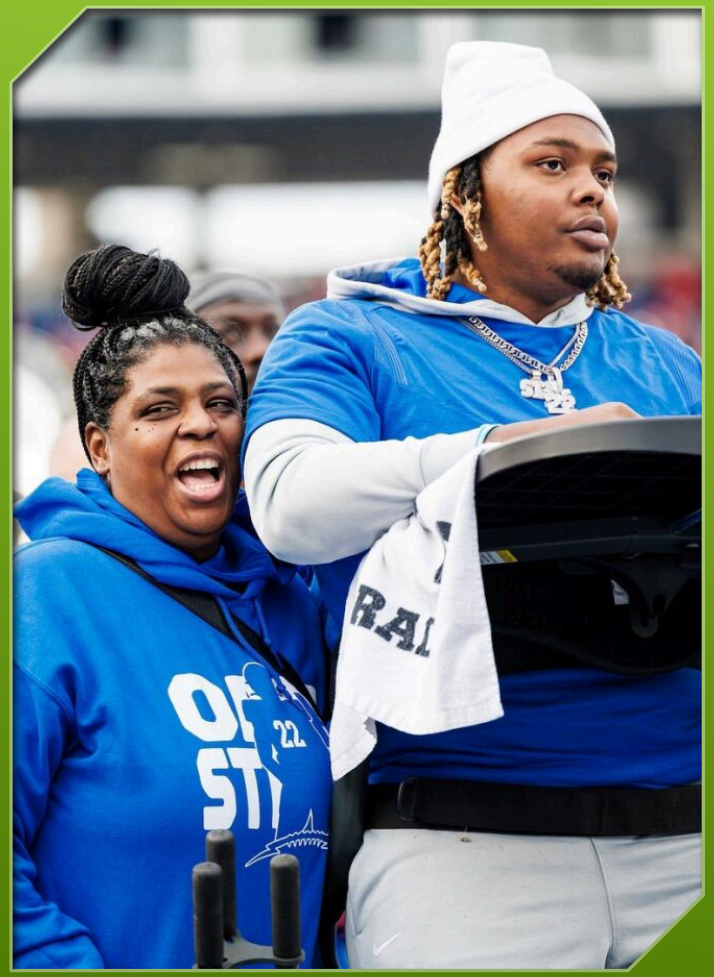
MOTOR FUNCTION

STROKE



Single Blinded Randomized controlled trial

50 Acute stroke patients 18+ years of age

Conventional therapy & 30 min standing **OR** Conventional therapy 5d/week for 2 weeks

Significant changes in both Berg Balance Scale and River Mead Motor Assessment

Rakesh RD, Hegde M, Chippala P. Effect of supported standing on functional ability in patients with acute stroke: a single-blinded randomized controlled trial. International Journal of Current Research and Review 2015; 7(19): 65.

LE FUNCTION

- 60 stroke patients
- Tilt table- 30 minutes daily for 3 weeks for test group
- LE function significantly increased compared to control group

Seo NS, Han MS, Lee JS. *Taehan Kanho Hakhoe Chi*. 2006;36(3):514-522. doi:10.4040/jkan.2006.36.3.514

MOTOR FUNCTION

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CP

Standing 30 min/day
3 days/week

- Head control > 30 seconds
- Functional stand pivot transfers

Murphy KP, Gueron L, McMillin C, Marben KB. Health Parameters in Standing and Nonstanding Nonambulatory Adults With Cerebral Palsy. *Arch Rehabil Res Clin Transl*. 2021;3(2):100110. Published 2021 Feb 16. doi:10.1016/j.arrct.2021.100110

Motor Function STROKE

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58-year-old male left hemiparesis & contraversive pushing (CoP) secondary to frontoparietal intracerebral hemorrhage

No active movement, impaired sensation and proprioception, increased tone and left inattention

Initially standing in therapy until tolerated standing consistently then group standing sessions

Measures Burke Lateropulsion Scale (BLS) and FIM

Date	BLS score	Total standing time	FIM Efficiency
Admit assessment	11/17 (Mod CoP)	0 min	
Admit + 24 days	0/17 (No CoP)	380 min	1.1

Gillespie J, Callender L, Driver S. Usefulness of a standing frame to improve contraversive pushing in a patient post-stroke in inpatient rehabilitation. *Proc (Bayl Univ Med Cent)*. 2019;32(3):440-442. Published 2019 May 14. doi:10.1080/08998280.2019.1593763

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MOTOR FUNCTION

- 13 SNF residents ages 71-93 years old
- 12-week physical activity in standing device
- Increase in LE strength and FIM scores
- 60% of those who required assistance to stand
  - Independent sit to stand
  - Independent standing 1 min
  - Walked 14 min with walker

Netz Y, Argov E, Burstin A, et al. Use of a device to support standing during a physical activity program to improve function of individuals with disabilities who reside in a nursing home. *Disabil Rehabil Assist Technol*. 2007;2(1):43-49. doi:10.1080/17483100601143371

RESPIRATORY ISSUES

3rd leading cause of death for individuals with a disability

Decreased

- Vital capacity
- Tidal volume
- Forced expiratory volume

Forman-Hoffman VL, Ault KL, Anderson WL, et al. Disability status, mortality, and leading causes of death in the United States community population. *Med Care*. 2015;53(4):346-354. doi:10.1097/MLR.0000000000000321Sezer N, Akkuş S, Uğurlu FG. Chronic complications of spinal cord injury. *World J Orthop*. 2015;6(1):24-33. Published 2015 Jan 18. doi:10.5312/wjo.v6.i1.24

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RESPIRATION

- Increased Vital capacity
- Increased forced expiratory volume
- 40% improved breathing

Sezer N, Akkuş S, Uğurlu FG. Chronic complications of spinal cord injury. *World J Orthop*. 2015;6(1):24-33. Published 2015 Jan 18. doi:10.5312/wjo.v6.i1.24

Lin F, Parthasarathy S, Taylor SJ, Pucci D, Hendrix RW, Makhsous M. Effect of different sitting postures on lung capacity, expiratory flow, and lumbar lordosis. *Arch Phys Med Rehabil*. 2006;87(4):504-509. doi:10.1016/j.apmr.2005.11.031

RESPIRATION

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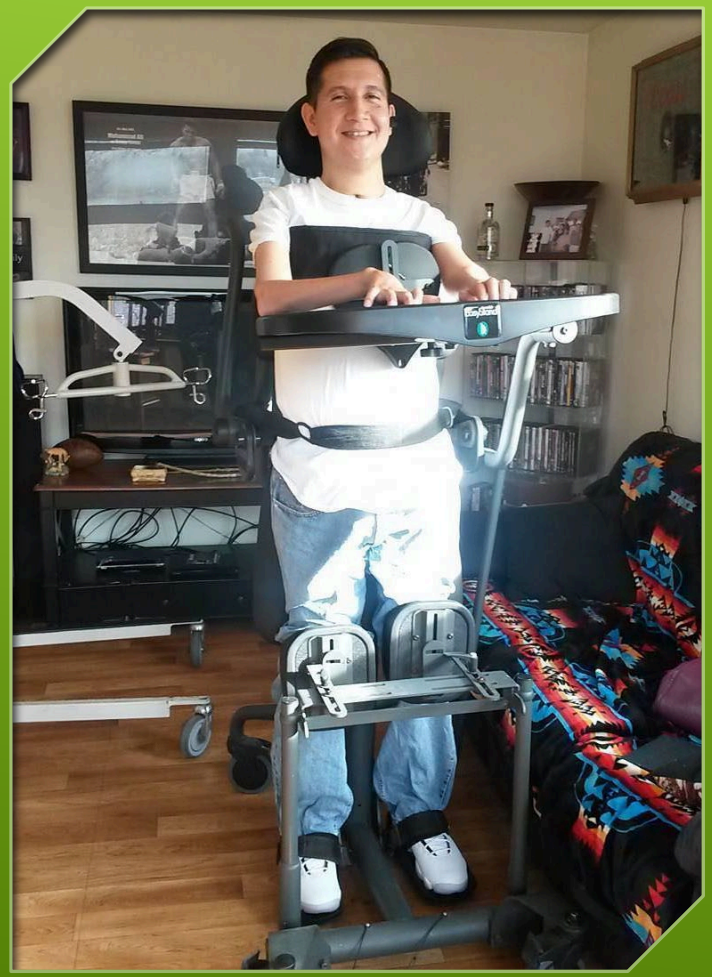

15 adults intubated and mechanically ventilated <5 days

Passive tilt 70°for 5 min

Increased

Minute ventilation	Tidal volume	Respiratory rate

Maintained during and immediately past tilt

Chang AT, Boots RJ, Hodges PW, Thomas JT, Paratz JD. Standing with the assistance of a tilt table improves minute ventilation in chronic critically ill patients. Arch Phys Med Rehabil 2004;84:1972–6.

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BOWEL FUNCTION

48% stroke
41% TBI
50% MS
58% SCI

SCI

- Stood 5 times/week
- Improvement in frequency of BMs
- Decreased bowel care time

Hoenig H, Murphy T, Galbraith J, Zolkewitz M. Case study to evaluate a standing table for managing constipation. *SCI Nurs*. 2001;18(2):74-77.
Li J, Yuan M, Liu Y, Zhao Y, Wang J, Guo W. Incidence of constipation in stroke patients: A systematic review and meta-analysis. *Medicine (Baltimore)*. 2017;96(25):e7225. doi:10.1097/MD.0000000000007225

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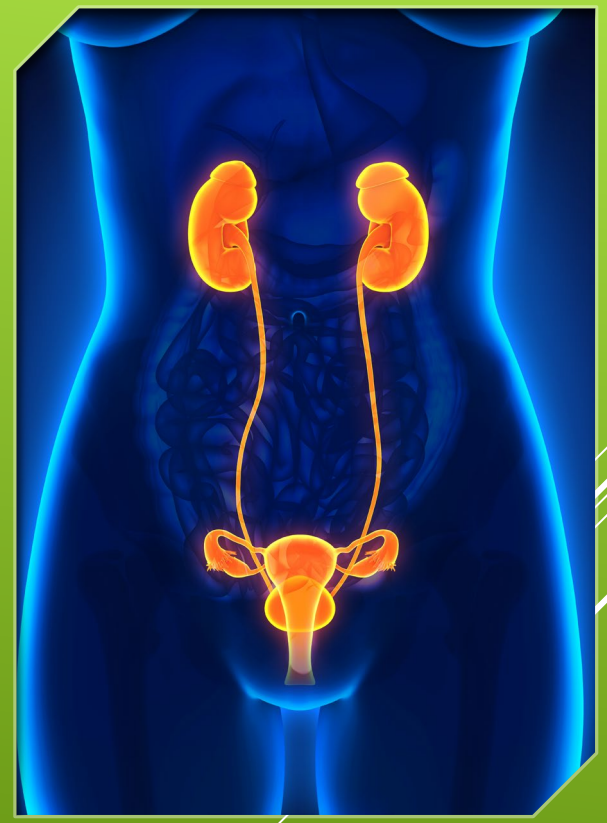
BLADDER FUNCTION

- Bladder distension most common trigger for Autonomic Dysreflexia
- Bladder pressure increased in standing
- Increased glomerular filtration rate
- 21% improved emptying
- Decreased calciuria



Glickman LB, Geigle PR, Paleg GS. A systematic review of supported standing programs. *J Pediatr Rehabil Med*. 2010;3(3):197-213. doi:10.3233/PRM-2010-0129

Eng JJ, Levins SM, Townson AF, Mah-Jones D, Bremner J, Huston G. Use of prolonged standing for individuals with spinal cord injuries. *Phys Ther*. 2001;81(8):1392-1399. doi:10.1093/ptj/81.8.1392

Ragnarsson KT, Krebs M, Naftchi NE, et al. Head-up tilt effect on glomerular filtration rate, renal plasma flow, and mean arterial pressure in spinal man. *Arch Phys Med Rehabil*. 1981;62(7):306-310.

DISORDERS OF CONSCIOUSNESS

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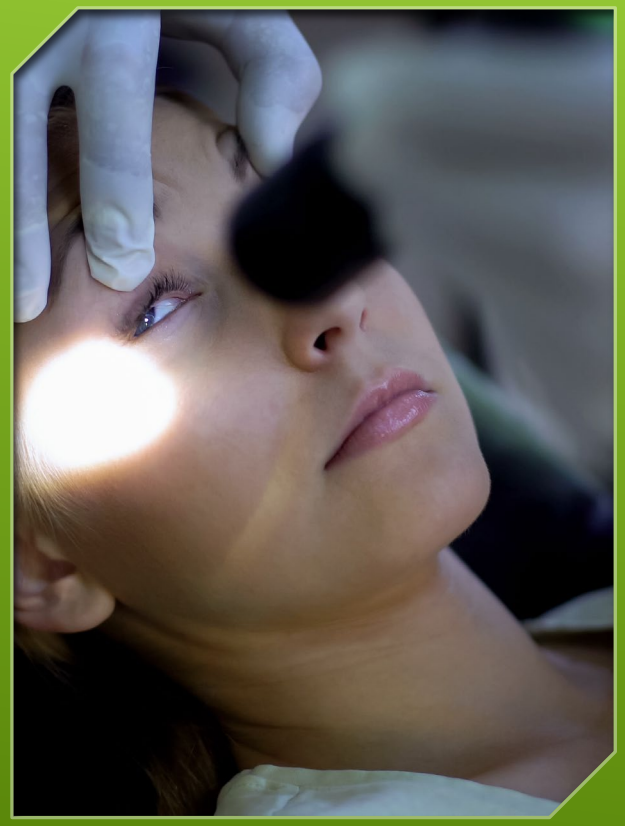

- 23 patients 18+ , intubated or tracheostomized and weaning from mechanical ventilation
- Daily verticalization
- Increased scores on Glasgow Coma Scale and Richmond Agitations-Sedation Scale

Toccolini BF, Osaku EF, de Macedo Costa CR, et al. Passive orthostatism (tilt table) in critical patients: Clinicophysiologic evaluation. *J Crit Ca. re* 2015;30(3):655.e1-655.e6556. doi:10.1016/j.jcrc.2014.12.018

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DOC STROKE

- Randomized blinded case control-study
- Verticalization started 8-11 days post onset
- 8-13 training sessions
- Increase in consciousness after 4-6 sessions
- No negative effects (orthostatic, CT/MRI changes)

Chernikova, L., Umarova, R., Trushin, I., & Domashenko, M. (2008). The early activation of patients with acute ischemic stroke using tilt table “Erigo”: the prospective randomized blinded case-control study. *Neurorehabil Neural Repair*, *22*, 514-640.

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PERCEIVED MEDICAL BENEFITS

SCI

- 74% improved circulation
- 61% improved reflex activity
- 53% improved bowel and bladder
- 45% improved digestion
- 42% reduced LE edema
- 39% improved respiration
- 32% decreased pain

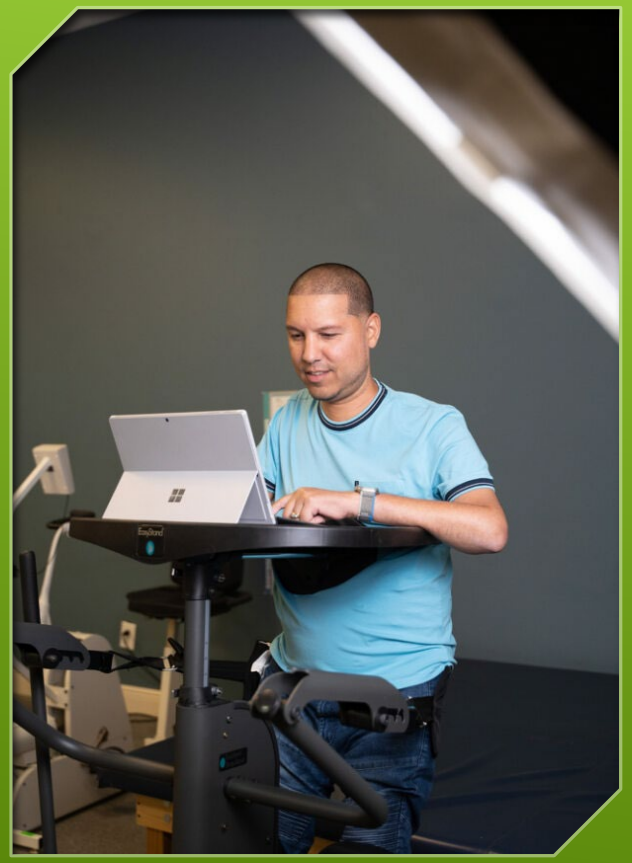
All Users

- 65% improved circulation
- 59% reduced tension/stiffness
- 41% improved BMD
- 41% prevents deformities
- 31% improved respiration
- 18% reduced risk of pressure

Nordström B, Näslund A, Eriksson M, Nyberg L, Ekenberg L. The impact of supported standing on well-being and quality of life. *Physiother Can*. 2013;65(4):344-352. doi:10.3138/ptc.2012-27
Eng JJ, Levins SM, Townson AF, Mah-Jones D, Bremner J, Huston G. Use of prolonged standing for individuals with spinal cord injuries. *Phys Ther*. 2001;81(8):1392-1399. doi:10.1093/ptj/81.8.1392

STANDING PROGRAMS

30 MIN/DAY 5 DAYS/WEEK



- Initiate as soon as possible
- Start in therapy and then incorporate into daily routine
- Identify activities that can be done in stander
  - Vocational
  - Recreational
  - Therapeutic
    - Active exercise
    - Stretching
    - UE activities

"Although experimental evidence is limited due to many factors, lived-experience and cohort data suggest that successful integration of standing programs into age-appropriate and meaningful activities may enhance function, participation, and overall health."

McLean, LJ, Paleg, GS, Livingstone, RW. Supported-standing interventions for children and young adults with non-ambulant cerebral palsy: A scoping review. *Dev Med Child Neurol*. 2022; 00: 1– 19. https://doi.org/10.1111/dmcn.15435

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QUESTIONS?

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Forman-Hoffman VL, Ault KL, Anderson WL, et al. Disability status, mortality, and leading causes of death in the United States community population. *Med Care*. 2015;53(4):346-354. doi:10.1097/MLR.0000000000000321Sezer N, Akkuş S, Uğurlu FG. Chronic complications of spinal cord injury. *World J Orthop*. 2015;6(1):24-33. Published 2015 Jan 18. doi:10.5312/wjo.v6.i1.24

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