

August 2020 Stroke Corner: Research Article Review: Kinematics After High-Intensity Step Training After Stroke

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Stroke Corner August 2020: Kinematics After High-Intensity Stepping Training after Stroke

Thanks to Molly Smith, DPT for Reviewing This Week's Article

Ardestani, Marzieh M., et al. "Locomotor Kinematics and Kinetics Following High-Intensity Stepping Training in Variable Contexts Poststroke." *Neurorehabilitation and Neural Repair*, vol. 34, no. 7, 2020, pp. 652-660., doi:10.1177/1545968320929675.

Things to consider:

- Recent studies suggest that high intensity locomotor training (LT) performed in variable contexts without attempts to normalize kinematics resulted in gains in gait speed.
- The concern then is despite these gains in speed - the biomechanical strategies used by patients post-stroke to achieve faster speeds can be concerning for clinicians and patients. (For example, asymmetric limb loading or altered kinematic patterns are often used to compensate for paretic limb deficits - which can be energetically inefficient). Traditional rehab theories discourage use of compensatory patterns
- The concern of focusing on high intensity LT without focus on kinematic patterns is that such practice may result in and reinforce compensatory strategies.

- HOWEVER: focusing on high intensity / challenging stepping tasks may result in neuromuscular adaptations that can contribute to enhanced functional and neurological recovery.

This article's goal was to investigate training induced changes in locomotor kinematics and kinetics following three different LT paradigms.

1. High intensity variable training (HV)
2. Low intensity training in variable contexts (LV)
3. High intensity training focused on only forward walking (high-forward, HF).

Prediction: The study anticipated that HV or HF vs LV would show greater improvements in kinetics due to greater neuromuscular activation strategies required during high intensity training. With the goal to provide insight into whether attention to specific biomechanical deficits during training may ameliorate abnormal movement strategies in patients post stroke.

Participants:

- Chronic hemiparesis (> 6 months post stroke)
- 18-85 y.o.
- Ability to walk for > 1 minute at 0.1 m/s with the use of handrails as needed

Interventions:

- Thirty one hour sessions of either HV / HF or LV over two months time with up to 40 minutes of stepping per session.
- Goals for each group:
 - Maximize the amount of successful stepping practice
 - Successful stepping defined as: positive bilateral step lengths, minimal limb collapse & maintaining upright posture in sagittal and frontal planes
 - Achieve cardiovascular intensities
 - HV or HF: 70-80% HR reserve
 - LV was 30-40% HR reserve
 - Increase difficulty of walking tasks as tolerated
- HV training: Sessions divided into 10 minute bouts;
 - Speed dependent treadmill training (with overhead harness with goals to increase speeds to reach intensities)
 - Skill dependent treadmill training (applying perturbations to challenge postural stability, propulsion and limb swing. It also included walking in multiple directions over inclines and obstacles with resisted propulsion provided with elastic bands, weighted vests and leg weights on paretic limb with limited handrail use as tolerated.
 - Over-ground training; focus on achieving fastest possible speeds or performing variable tasks with the use of gait belt or overhead mobilize or rail suspension
 - Stair climbing; performed over static or rotating stairs using reciprocal gait patterns and progression to faster speeds and reduced handrail use. And furthermore use of weights or weighted vests to target biomechanical deficits.
- HF: all of the above + 70-80% HR reserve, **BUT limited to only**

forward walking on treadmill or overground.

- LV; similar to HV training BUT 30-40% HR reserve

** all groups performed 1800-3500 steps/session over 32-38 minutes over 25-29 sessions.

Data collected:

- Peak TM speed; fasted speed that participants could walk for 1 minute
- Specific kinematic / kinetic variables of interest: specific spatiotemporal measures that describe walking patterns and those that may estimate patterns of recovery vs. compensation.

Results:

- Biomechanical data were available on 50 participants who could walk ≥ 0.1 m/s on a motorized treadmill. Significant differences in spatiotemporal parameters, kinematic consistency, and kinetics were observed between HV and HF vs LV. Resultant PC analyses were characterized by paretic powers and kinematic consistency following HV, while HF and LV were characterized by non-paretic power.

Discussion:

- Significant between-group differences were nonetheless observed for many variables;
 - Differences in spatiotemporal patterns and kinematic consistency between high vs low intensity groups are consistent with previous / preliminary studies and reinforce the notion that high intensity training does not entrain abnormal kinematic patterns. Rather such training appears to facilitate more normal movement strategies.
 - Analysis of joint powers further suggest that specific methods for delivering high intensity training may influence neuromuscular strategies
 - The PC analysis indicates greater loading of paretic limb changes with HV → this may be indicative of improvements in neurological recovery underlying gains in walking function.

Significance:

- Strategies that focus on providing large amounts of stepping practice during forward walking at high intensities may result in gains in locomotor function, although improvements may be more dependent on both “normal” and compensatory strategies.
- HV training that focused on paretic limb deficits resulted in greater recovery of neuromuscular strategies used prior to injury indicative of neurological recovery
- Further, greater gains in dynamic stability were observed following HV, where very little changes in balance are observed with HF training.
- The combined findings emphasize the potential significance of performing stepping training in variable context, and further highlight the importance of specificity of training to elicit desired motor outcomes post-stroke.

Conclusion:

- Providing stepping training at higher intensities resulted in

significant gains in spatiotemporal parameters, kinematic consistency and power generation as compared to lower intensity activities. Post-hoc comparisons and PC analyses suggest greater paretic- limb coordination and joint powers were observed following high-intensity training in variable context

- Whereas changes following high-intensity training targeting only walking forward resulted in a greater trend of bilateral improvements. The data support the hypotheses that focused attention to paretic limb deficits during variable stepping tasks at high- intensities can result in improved paretic kinematics and kinetics indicative of recovery vs compensation.

The Physical Therapy Profession Needs Your Help!

The physical therapy profession needs your support today!

Members of Congress need to hear from you so they take immediate action to stop the 9% cut to Medicare payment in 2021. There are template letters are available for both [members](#) and [non-members, including the general public](#) on these links. Encourage your colleagues and patients to connect with Congress too!

Not sure about the details about the Physician Fee Schedule Proposal? APTA has created a 35 minute presentation that provides an overview of the rule, APTA's efforts and ways to get involved. The webinar recording can [be found here](#), password is 5DvW!4&7

Thousands of APTA members have already voiced their concern but Congress needs to hear from all physical therapists. Connect today and help make a difference!

Save the Date: Rhythm & The Motor Systems Webinars

Hot Topic Webinar Series hosted by the ANPT Practice Committee Practical applications for clinical and telehealth environments

These webinars present theory and practical application of the use of rhythm as an intervention approach for gait training with potential implications for clinical and telehealth practice environments.

September 15, 2020: Rhythm and the Motor System: Gait Training in Persons Post Stroke Webinar Presented by: Lou Awad PT, DPT, PhD, Brian Harris MT-BC, NMT and Abigail Spaulding PT, DPT, NCS

Registration closes on September 11th.

[Click here](#) to register today.

ANPT Resources Index for Educators

An index of FREE neuro rehabilitation education resources is now available on the ANPT website <https://neuropt.org/professional-resources/educators-index/>!

These are listed by health condition, as many neurorehabilitation courses are organized in this way. There is also a section that pertains to multiple health conditions. All resources link to the original content and the index will be updated regularly.

Thank you to ANPT members Sue Perry, PT, DPT and Cindy Zabloutny, PT, DPT, NCS for developing this resource.

Core Outcome Measures Synapse Courses

A new series of five courses on the Core Outcome Measures has been released on the [ANPT Synapse Education Center](#). Focused on the CPG “A Core Set of Outcome Measures for Adults with Neurologic Conditions Undergoing Rehabilitation” these courses include nine action statements related to the recommended measures, use of the core set, and collaborative decision-making, interpretation, and continuum use. The Core Set includes:

- 10 Meter Walk
- 6 Minute Walk
- Berg Balance Scale
- Five Times Sit to Stand
- ABC Functional Gait Assessment Score

For additional resources from the CPG, visit the website [here](#).

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