

# High Intensity Gait Training Journal Club Guide



*This document is intended to provide guidance for navigating common topics and themes related to High Intensity Gait Training (HIGT) implementation for patients after stroke, incomplete SCI, and brain injury. It is not an exhaustive list of research, but rather a starting guide to examine the evidence in support of HIGT with your colleagues.*

*Please visit [neuropt.org](http://neuropt.org) > [Practice Resources](#) > [ANPT Clinical Practice Guidelines](#) > [Locomotion – chronic CVA, SCI, TBI CPG](#) for more resources on incorporating high intensity gait training into your clinical practice.*

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## What is HIGT? – Exploring the “Active Ingredients” to Improving Walking Function

<u>Theme</u>	<u>Recommended Articles</u>	<u>Guiding Discussion Points</u>
<b>Framework</b>	Holleran CL, et al. <a href="#">Feasibility and potential efficacy of high-intensity stepping training in variable contexts in subacute and chronic stroke.</a> <i>Neurorehabil Neural Repair.</i> 2014; 28(7): 643-651.	<ul style="list-style-type: none"> <li>• Discuss the recommended framework for analyzing patient performance &amp; implementing HIGT.</li> <li>• Are normalized kinematics emphasized in this treatment paradigm? What criteria define successful stepping in this paradigm?</li> <li>• What are the four biomechanical subcomponents of gait and how do they guide HIGT implementation?</li> <li>• How do these improvements compare to established MDC and MCID values?</li> </ul>
<b>Repetition</b>	Hornby, et al. <a href="#">Feasibility of Focused Stepping Practice During Inpatient Rehabilitation Poststroke and Potential Contributions to Mobility Outcomes.</a> <i>Neurorehabil Neural Repair.</i> 2015; 29(10): 923-932.	<ul style="list-style-type: none"> <li>• How was repetition measured in this paper?</li> <li>• Discuss the relationship between daily stepping and the 6MWT, BBS, and FIMs.</li> <li>• Do you have concerns about focusing this amount of time on stepping? Why or why not? Do the relationships between daily stepping and the BBS and FIMs address these concerns?</li> <li>• Do your clinical environment and current practice patterns allow for the stepping amount described in this paper? Why or why not? What are the barriers you face that limit stepping practice? How can you address these barriers?</li> </ul>
<b>Intensity &amp; Variability</b>	Hornby, et al. <a href="#">Contributions of Stepping Intensity and Variability to Mobility in Individuals Poststroke: A Randomized Clinical Trial.</a> <i>Stroke.</i> 2019; 50(9): 2492-2499.	<ul style="list-style-type: none"> <li>• Discuss the three experimental groups. What did treatment sessions consist of in each group?</li> <li>• How is intensity defined in this paper?</li> <li>• How did the two variable stepping groups compare? Is it enough just to prioritize stepping repetition and variability, or does it have to be at high intensity?</li> <li>• How did the two high intensity groups compare? Is it enough just to prioritize intensity during forward stepping practice, or does variability provide extra benefit?</li> <li>• When performing stepping practice, do you incorporate variability? Describe example tasks that incorporate variable stepping.</li> <li>• Do you target intensity as defined in this paper? Why or why not? What barriers may exist to monitoring intensity during treatment sessions? How might you address them in your clinical setting?</li> </ul>
<b>Specificity</b>	Lotter JK, et al. <a href="#">Task-Specific Versus Impairment-based Training on Locomotor Performance in Individuals with Chronic Spinal Cord Injury: A Randomized Crossover Study.</a> <i>Neurorehabil Neural Repair.</i> 2020; 34(7): 627-639.	<ul style="list-style-type: none"> <li>• How did the two groups compare? Is it enough to prioritize reaching a high intensity using impairment based treatments or does task specificity influence expected outcomes?</li> <li>• Specifically examine how the two groups compare regarding locomotor outcomes and non-locomotor outcomes. What does this suggest about the generalizability of variable stepping at high intensities vs impairment based therapy?</li> <li>• Does the impairment-based group accurately represent common practice following iSCI and other neurological diagnoses? How might this paper influence your plan of care with these patient populations?</li> </ul>

## Theory and Practice: Incorporating Neuroplasticity and Motor Learning Principles

<u>Theme</u>	<u>Recommended Articles</u>	<u>Guiding Discussion Points</u>
<b>Motor Learning</b>	Wulf & Lewthwaite. <a href="#">Optimal performance through intrinsic motivation and attention for learning: The OPTIMAL theory of motor learning</a> . <i>Psychon Bull Rev.</i> 2016; 23: 1382-1414.	<ul style="list-style-type: none"> <li>• Wulf &amp; Lewthwaite’s OPTIMAL theory focuses on autonomy, enhanced expectations, and an external focus of attention. Discuss how these factors are used in HIGT vs more traditional neurofacilitation techniques.</li> <li>• How can you incorporate an external focus of attention during HIGT to challenge various components of gait (limb advancement, stance support, balance, propulsion)?</li> <li>• Reflect on the cues you provide in your practice. Are they internal or external focuses?</li> </ul>
<b>Neuroplasticity</b>	Kleim & Jones. <a href="#">Principles of Experience-Dependent Neural Plasticity: Implications for Rehabilitation after Brain Damage</a> . <i>J Speech Lang Hear Res.</i> 2008; 51: S225-S239.	<ul style="list-style-type: none"> <li>• Kleim &amp; Jones discuss 10 “principles of experience-dependent plasticity.” Which principles are modifiable, and which are not?</li> <li>• How do the modifiable principles relate to the “active ingredients” utilized in HIGT?</li> <li>• How do traditional approaches such as impairment-based or neurofacilitation treatment relate to these principles?</li> </ul>
<b>ANPT Position Statement on Current Evidence vs. Current Practice</b>	Scheets PL, et al. <a href="#">Moving Forward</a> . <i>JNPT.</i> 2021; 45(1): 46-49.	<ul style="list-style-type: none"> <li>• Reflect on the historical treatment paradigms discussed in this paper. Which of these do you or your colleagues utilize in the clinic?</li> <li>• Which training parameters “offer the greatest probability of harnessing the effects of neuroplasticity and functional gains”? How are or could you better implement these parameters into your clinical practice?</li> <li>• This paper discusses the dissonance between current evidence and current practice/education. What treatment approaches were you taught? How do these compare to the key training parameters discussed in this paper?</li> <li>• What resources can you utilize to expand your knowledge base and implement current evidence-based interventions?</li> </ul>

## Should I Target “Normal” Walking Patterns During Gait Training?

Theme	Recommended Articles	Guiding Discussion Points
<b>Practicing “Normal”</b>	<p>Dobkin B, et al. <a href="#">Should Body Weight-Supported Treadmill Training and Robotic-Assisted Steppers for Locomotor Training Trot Back to the Starting Gate?</a> <i>Neurorehabil Neural Repair</i>. 2012; 26(4): 308-317.</p> <p>Hornby TG, et al. <a href="#">Enhanced Gait-Related Improvements After Therapist- Versus Robotic-Assisted Locomotor Training in Subjects with Chronic Stroke: A Randomized Controlled Study.</a> <i>Stroke</i>. 2008; 39(6): 1786-1792.</p> <p>Duncan PW, et al. <a href="#">Body-weight supported treadmill rehabilitation after stroke.</a> <i>N Engl J Med</i>. 2011; 364(21): 2026-2036.</p>	<ul style="list-style-type: none"> <li>Describe the underlying theory of Body Weight Support Treadmill Training (BWSTT) and Robotic-Assisted Step Training (RAST). Does providing optimal sensory feedback, task-oriented training, and mass practice drive neuroplasticity as anticipated?</li> <li>The Locomotor CPG highly recommends high intensity gait training but does not recommend robotics or BWSTT that focuses on kinematics. Which motor learning and neuroplasticity principles are limited by BWSTT and RAST? How might they be utilized in HIGT?</li> <li>Does practicing “normal” walking patterns via BWSTT or RAS result in more normal walking? Does it result in improvements in walking speed or distance?</li> <li>What cardiovascular intensities were reached by patients in Duncan et al? How does this compare to the recommended intensity in HIGT?</li> </ul>
<b>What if we target asymmetry?</b>	<p>Ryan, H., Husted, C. and Lewek, M. <a href="#">Improving Spatiotemporal Gait Asymmetry Has Limited Functional Benefit for Individuals Poststroke.</a> <i>JNPT</i>. 2020; 44(3): 197-204.</p>	<ul style="list-style-type: none"> <li>Discuss common rationale for improving gait symmetry. What functional tasks would you expect would improve if symmetry improved? Which aspects of gait would you expect to improve?</li> <li>Describe the relationship between improvements in gait symmetry and the outcomes assessed in this paper. Does improved symmetry result in improvements in the functional tasks or aspects of gait you discussed above?</li> <li>Discuss if therapists need to target symmetry during treatment sessions.</li> </ul>
<b>Recovery vs Compensation</b>	<p>Ardestani MM, et al. <a href="#">Compensation or Recovery? Altered Kinetics and Neuromuscular Synergies Following High-Intensity Stepping Training Poststroke.</a> <i>Neurorehabil Neural Repair</i>. 2019; 33(1): 47-58.</p> <p>Leech KA, et al. <a href="#">Effects of Locomotor Exercise Intensity on Gait Performance in Individuals With Incomplete Spinal Cord Injury.</a> <i>Phys Ther</i>. 2016; 96(12): 1919-1929.</p>	<ul style="list-style-type: none"> <li>How is recovery defined in Ardestani et al? How is compensation defined? Discuss both concepts. How do you approach each of these concepts in your current practice?</li> <li>How did paretic and non-paretic joint powers change pre- and post-intervention in Ardestani et al? How did muscle activations change? Which was more strongly correlated with peak speeds?</li> <li>What do these results suggest our treatments should be targeting as it relates to recovery and compensations?</li> <li>Clinicians may be concerned that a focus on HIGT will result in worsening of abnormal kinematic patterns. In these papers does it appear that HIGT contributes to increases in abnormal kinematic patterns? What impact did high-intensity training have on spatiotemporal parameters and joint kinematics? What about aberrant muscle activity?</li> </ul>

**Transference to Non-Locomotor Domains: Being Efficient with Our Time**

<u>Theme</u>	<u>Recommended Articles</u>	<u>Guiding Discussion Points</u>
<p><b>Carry-Over to Balance &amp; Transfers</b></p>	<p>Lotter JK, et al. <a href="#">Task-Specific Versus Impairment-based Training on Locomotor Performance in Individuals with Chronic Spinal Cord Injury: A Randomized Crossover Study</a>. <i>Neurorehabil Neural Repair</i>. 2020; 34(7): 627-639.</p> <p>Hornby TG, et al. <a href="#">Variable Intensive Early Walking Poststroke (VIEWS): A Randomized Controlled Trial</a>. <i>Neurorehabil Neural Repair</i>. 2016; 30(5): 440-450.</p> <p>Moore JL, et al. <a href="#">Implementation of High-Intensity Stepping Training During Inpatient Stroke Rehabilitation Improves Functional Outcomes</a>. <i>Stroke</i>. 2020; 51: 563-570</p>	<ul style="list-style-type: none"> <li>• How did gait outcomes differ between groups within each study (Lotter et al &amp; Hornby et al)? How did non-gait (balance and transfer gains) outcomes differ? By not explicitly practicing static balance and transfers and only focusing on intensive stepping practice, were gains in balance and transfers sacrificed? How does this relate to the concept of transference?</li> <li>• Clinicians may be concerned that focusing on HIGT will not allow time to practice transfers and improve balance. How might the transference effect of HIGT impact a clinician’s efficiency with their treatment?</li> <li>• Which of the HIGT training variables might carryover to balance and transfer ability? Discuss why this might be and how to incorporate them into your practice.</li> <li>• Working at high cardiovascular intensities appears to be a key ingredient to improving locomotor function. Lotter et al explore whether task specificity matters when working at high intensities. Is it enough to work at a high intensity, or does task specificity increase benefit?</li> <li>• Discuss the study design in Moore et al and the results in gait and non-gait outcomes. Did implementation of a HIGT protocol negatively impact non-gait outcomes? Were there any differences in safety, time, or resources available before and after HIGT implementation?</li> </ul>

## The Value of Using Outcome Measures

<u>Theme</u>	<u>Recommended Articles</u>	<u>Guiding Discussion Points</u>
<b>Gait Speed</b>	<p>Fritz S &amp; Lusardi M. <a href="#">White Paper: Gait Speed: The Sixth Vital Sign</a>. <i>J Geriatr Phys Ther</i>. 2009; 32(2): 2-5.</p>	<ul style="list-style-type: none"> <li>• This paper suggests that an outcome measure should be safe, cost effective, and easy to administer, grade, and interpret. Discuss methods to allow gait speed to be easily assessed in the clinic. What types of data should be readily available to improve interpretation?</li> <li>• A raw gait speed number means very little to a patient. How does this paper help provide functional correlates to that number?</li> <li>• Discuss how tracking gait speed provides guidance for your plan of care and discharge recommendations.</li> </ul>
<b>6-Min Walk Test</b>	<p>Fulk, et al. <a href="#">Predicting Home and Community Walking Activities Poststroke</a>. <i>Stroke</i>. 2017; 48(2): 406-411.</p> <p>Woodward JL, et al. <a href="#">Cardiopulmonary Responses During Clinical and Laboratory Gait Assessments in Individuals with Chronic Stroke</a>. <i>Phys Ther</i>. 2019; 99(1): 86-97.</p>	<ul style="list-style-type: none"> <li>• What criteria were used to assign patients to each functional walking category in Fulk et al?</li> <li>• Discuss the ability of the 6MWT to predict a patient’s ambulatory status. What combination of outcomes provided the highest predictive power?</li> <li>• Were you surprised with the cardiovascular response during the 6MWT in Woodward et al? Could patients be achieving “high intensity” zones during the 6MWT and therapists not realize it? How might this affect how comfortable therapists are in targeting 70-85% HRmax during HIGT?</li> <li>• Discuss how your clinic administers the 6MWT. How can inter and intra-reliability be maximized?</li> </ul>
<b>Berg Balance Scale</b>	<p>Henderson CE, et al. <a href="#">Predicting Discharge Walking Function With High-Intensity Stepping Training During Inpatient Rehabilitation in Nonambulatory Patients Poststroke</a>. <i>Arch Phys Med Rehabil</i>. Available online 202 Nov 2020.</p> <p>Free clinical prediction rule calculator available here: <a href="https://www.knowledgetranslation.org/prediction-in-inpatient-stroke-rehabilitation?rq=predict">https://www.knowledgetranslation.org/prediction-in-inpatient-stroke-rehabilitation?rq=predict</a></p>	<ul style="list-style-type: none"> <li>• What was the mean Berg score for patients at admit to inpatient rehab? How does this patient population and setting relate to your clinical environment?</li> <li>• Discuss the two clinical prediction rules (CPR) presented in this paper. Would one or both be feasible to use with your patients?</li> <li>• For CPR#2, were you surprised with how low a Berg score after 1 week of HIGT can predict walking without physical assistance at discharge?</li> <li>• Is there value in scoring a Berg for a patient who is “low level”? Discuss how long you might track a “low level” patient’s progress on the Berg.</li> <li>• What are the potential barriers to performing the Berg on a “low level” patient? Is it feasible to administer this test on most incoming patients?</li> </ul>
<b>Outcome Measure CPG</b>	<p>Moore JL, et al. <a href="#">A Core Set of Outcome Measures for Adults With Neurologic Conditions Undergoing Rehabilitation</a>. <i>JNPT</i>. 2018; 42: 174-220.</p>	<ul style="list-style-type: none"> <li>• What are the core recommended outcome measures for neuro rehab?</li> <li>• Which of these measures do you use? Are any new to you?</li> <li>• Discuss how outcome measures can be used for patient education, monitoring progress, goal writing, and discharge planning.</li> </ul>

## Other Common Therapist Apprehensions

<u>Theme</u>	<u>Recommended Articles</u>	<u>Guiding Discussion Points</u>
<b>Safety</b>	<p>Woodward JL, et al. <a href="#">Cardiopulmonary Responses During Clinical and Laboratory Gait Assessments in Individuals with Chronic Stroke</a>. <i>Physical Therapy Journal</i>. 2019; 99(1): 86-97.</p>	<ul style="list-style-type: none"> <li>• Discuss the percentage of HRmax achieved during the self-selected 6MWT, fast 6MWT, and GXT. Are these intensities in the suggested range for HIGT? How might this affect how comfortable therapists feel in targeting 70-85% HRmax during HIGT?</li> <li>• Discuss the ECG results and adverse events or lack thereof. With proper monitoring of vitals, does exercise at this intensity appear safe?</li> <li>• Discuss the relationship between stroke related impairments and increased HR response. Were the two related? What variables were related to increased HR response?</li> <li>• Discuss how you monitor vitals during the 6MWT and other exercise. How might this test help you anticipate your patient's tolerance to higher cardiovascular intensity zones?</li> </ul>
<b>Feasibility with Low Level Patients</b>	<p>Hornby et al. <a href="#">Feasibility of Focused Stepping Practice During Inpatient Rehabilitation Poststroke and Potential Contributions to Mobility Outcomes</a>. <i>Neurorehabil and Neural Repair</i>. 2015; 29(10): 923-932.</p> <p>Henderson CE, et al. <a href="#">Predicting Discharge Walking Function With High-Intensity Stepping Training During Inpatient Rehabilitation in Nonambulatory Patients Poststroke</a>. <i>Arch Phys Med Rehabil</i>. Available online 202 Nov 2020.</p> <p>Danilovic, et al. <a href="#">Feasibility and Impact of High-Intensity Walking Training in Frail Older Adults</a>. <i>Journal of Aging and Physical Activity</i>. 2017; 25: 533-538.</p>	<ul style="list-style-type: none"> <li>• Discuss the scores at admission for patients in these papers. Would you feel comfortable walking with these patients? Why or why not? What were the scores at discharge for these patients after HIGT?</li> <li>• Henderson et al discuss that a BBS score of at least 6 at admission for patients post-stroke was related to an increased likelihood of walking at contact guard or better at discharge (treating with HIGT). Review the BBS and discuss what that patient with that score might look like.</li> <li>• Hornby et al similarly found that patients with low scores on the BBS and other functional outcomes improved significantly at discharge. Discuss the value of administering and tracking outcome measures, even with very low level patients.</li> <li>• Danilovic et al performed HIGT within a senior living community. What was the mean age of study participants? The paper describes various methods of utilizing HIGT with minimal equipment. Discuss the ways in which the therapists in the paper performed HIGT. How can you use available resources in your own clinic to implement HIGT?</li> </ul>
<b>Wide-Scale Implementation</b>	<p>Moore JL, et al. <a href="#">Implementation of High-Intensity Stepping Training During Inpatient Stroke Rehabilitation Improves Functional Outcomes</a>. <i>Stroke</i>. 2020; 51: 563-570.</p>	<ul style="list-style-type: none"> <li>• Describe the experimental design. What are the groups being compared? How did outcomes compare pre- and post- implementation of HIGT?</li> <li>• Discuss the average length of stay at both facilities and for both groups. Did HIGT increase the average length of stay for patients?</li> <li>• Fidelity measures of HIGT include increasing stepping practice and cardiovascular intensity during physical therapy sessions. Were these two goals achieved during the implementation process?</li> <li>• Adverse events were monitored throughout both phases of this study. Were there any significant differences in adverse events between the two phases? What does this suggest regarding the safety of HIGT?</li> </ul>

## How Can I Get Started?

<u>Theme</u>	<u>Recommended Resources</u>	<u>Guiding Discussion Points</u>
<b>Knowledge Translation</b>	Graham ID, et al. <a href="#">Lost in knowledge translation: time for a map?</a> <i>J Contin Educ Health Prof.</i> 2006; 26(1): 13-24.	<ul style="list-style-type: none"> <li>• What is knowledge translation?</li> <li>• What is the Knowledge to Action framework and how could you see yourself using it in the clinic?</li> <li>• Common implementation barriers of HIGT include categories like equipment, therapist knowledge gaps, therapist beliefs, administrator support, and workflow issues. When considering HIGT implementation for yourself and your facility, what specific barriers would you anticipate?</li> <li>• Brainstorm strategies that could help you address HIGT implementation barriers specific to your clinic and your practice. How would you know if those strategies were successful?</li> </ul>
<b>ANPT Website Support</b>	<a href="#">Locomotor Training CPG Website</a>	<ul style="list-style-type: none"> <li>• After exploring the website resources, what did you find helpful?</li> <li>• What other issues do you wish were addressed regarding HIGT?               <ul style="list-style-type: none"> <li>○ <i>Let us know in the Feedback box on the website page!</i></li> </ul> </li> </ul>