

Supplement 2. High-intensity agility exercise training designed to reduce Parkinson's disease patients' postural control-related constraints

Constraint	Exercise to reduce a specific constraint	Exercise principles	Parameter to manipulate stimulus intensity
Postural instability	<ul style="list-style-type: none"> • Trunk and limb movements executed with a corrected posture • Strengthening of trunk and limb muscles using functional exercises with and without added weights to trunk and limbs • Execute movements with visual pacing by holding a manipulating objects • Standing, walking, running, and jumping on surfaces of varying stiffness and base size with added weight to trunk and limbs placed near or away from trunk 	<ul style="list-style-type: none"> • Self- and externally perturbed displacement of center of mass • Modify inertial properties of trunk and weight • Trunk and limb movements executed in response to visual stimuli • Continuous and complex loading of trunk • Motor-motor and motor-cognitive dual tasking 	<ul style="list-style-type: none"> • X-box Kinect programs: increase movement amplitude, range of motion, and speed from a low-to-medium-to-high level • Increase movement amplitude, range of motion, speed by competing with a peer within the X-box environment • Mass and size of exercise balls: low, medium, high • Support surface size: small, medium, large • Tasks executed in standing, then walking with and
Poor proprioception, somatosensory integration	<ul style="list-style-type: none"> • Stand and sit on unstable surfaces while manipulating weighted hand apparatuses • Execute limb and trunk movements in response to auditory cues and correct asymmetric, slow, and incorrect movements individually • Perform rhythmic and reciprocal limb and trunk movements with increasing speed with and without external visual and auditory cues • Perform very small and very large steps on unstable surfaces • Perform exaggerated and narrow arm, shoulder movements on unstable surfaces and while sitting, walking, and running • Execute stepping movement with precision by stepping into the eye of rope ladder laid on unstable surfaces • Stepping up onto exercise blocks of varying stiffness and height • Using X-box Reflex Ridge, Space Pop, and Just Dance apps • Walking through agility ladder with and without trunk and entire body rotation. • Walking by stepping over hurdles of different height. 	<ul style="list-style-type: none"> • Improve joint position sense, force, velocity consciously and unconsciously • Integrate proprioceptive signals to detect limb and trunk movements • Task-intrinsic feedback • Auditory cueing 	<ul style="list-style-type: none"> • Movement speed: slow, medium, fast • Resistance to movement: low, medium, high • Step height: level, low, medium, high • Target speed set by X-box apps: low, medium, high • Movement target amplitude set by X-box apps: narrow, medium, wide • Loudness and frequency of auditory cues: low, medium, high • Hurdle height: low, medium, high • Level of external support (by peer, exercise leader, holding onto support): No, little, a lot
Poor interlimb coordination, movement timing, bradykinesia	<ul style="list-style-type: none"> • Responding rapidly to predictable and unpredictable cues • Concurrent execution of simple and complex arm and trunk movements (rotations) while sitting, standing, walking, running, and jumping • Kinect Adventur Reflex module: Requires patients to reflexively respond to discrete visual cues rapidly and accurately. Online scoring. • Kinect Space Pop module: Requires patients to continuously avoid oncoming virtual spatial targets rapidly and accurately appearing on the projectin screen within 6 m2 area. Online scoring. • Kinect Just Dance module: Requires patients to imitate a peer's rhythmic movements. Music serves as external rhythm cue. Online scoring of deviation from movement template. • Execution of asymmetrical movements • Predictable and unpredictable start and stop of limb and trunk movements • Exercises in sitting, standing, and walking using hand-held sticks with ball-shaped weights added to both ends 	<ul style="list-style-type: none"> • Reactive movements to external auditory and visual stimuli • Anticipatory postural adjustments • Augmented feedback • Action observation • Auditory cueing • Multisensory stimulation 	<ul style="list-style-type: none"> • Improving own score and score against peer in exergaming • Urging faster response time to cues • Completion of longer and longer exergaming bouts customized for each patient • Increase distance for spatial targets: short-medium-long