Table S1. Steady state, proactive and reactive balance activities included in the training for the experimental and control group

Steady state exercises				
Patient position: seated, with feet on the ground/ standing, with double leg base of support				
Exercise: Balance on static seat/base				
Task description: the subject is seated/standing on a static seat/base and has to maintain his load in the centre of the seat/base as much as possible, mantaining a correct postion of the trunk				
	Modality of execution	**Experimental condition**	**Difficulty regulation**	**Feedback**
Control	static base with therapist support	Open eyes Closed eyes	--	Verbal on postural allignment, based on observation
Experimental	*hunova* with static seat/base: the subject has to maintain the CoP in a defined area of confidence	Open eyes Closed eyes	CoP Area of confidence	*Visual* (CoP position on the seat/base; trunk inclination on sagittal and frontal plane) based on seat/base force torque sensors and IMU sensor *Auditory*, for high trunk oscillation based on IMU sensor
Exercise: Balance on unstable seat/base				
Task description: the subject is seated/standing on an unstable surface and has to maintain stability and balance as much as possible, mantaining a correct postion of the trunk				
	Modality of execution	**Experimental condition**	**Difficulty regulation**	**Feedback**
Control	proprioceptive wooden board/ Bobath ball	Open eyes Closed eyes	--	Verbal on postural allignment, based on observation
Experimental	*hunova* with unstable seat/base: the subject has to maintain the degree of seat/base oscillation in a defined area of confidence	Open eyes Closed eyes	Seat/base maximum workspace Seat/base oscillation area of confidence Type of instability (proprioceptive, elastic or fluid dynamic) Instability level	*Visual* (angular displacement of the seat/base; trunk inclination on sagittal and frontal plane) based on seat/base position sensors and IMU sensor *Auditory*, for high trunk oscillation based on IMU sensor

Proactive balance exercises				
1) Patient position: seated, with feet on the ground				
Exercise: Pelvis mobilization				
Task description: the subject is seated on a moving/movable surface and movements for pelvis mobilization are performed				
	Modality of execution	**Experimental condition**	**Difficulty regulation**	**Feedback**
Control	Discosit chinesport/ Bobath ball The patient perform active pelvis movements in the sagittal and frontal plane	Upper limbs in support or not	--	Verbal on postural allignment, based on observation

	Modality of execution	Experimental condition	Difficulty regulation	Feedback
Experimental	*hunova* with moving seat (**passive mobilization**) The seat moves the patient's pelvis into a sagittal/frontal plane or following different trajectories The patient has to stabilize the upper trunk maintaining the trunk inclination in a defined area of confidence	Upper limbs in support or not	Amplitude of passive mobilization (degrees) Velocity of movement Trunk Area of confidence	Visual (trunk inclination on sagittal and frontal plane) based on IMU sensor *Auditory*, for high trunk oscillation based on IMU sensor
Experimental	*hunova* with unstable seat (**active mobilization**) the subject has to active move the seat for reaching targets on the screen in sagittal or frontal plane or in random directions. The exercise is associated with a gaming on the screen.		Amplitude of active mobilization Target positions	Visual (angular displacement of the seat; trunk inclination on sagittal and frontal plane) based on seat position sensors and IMU sensor *Auditory*, for high trunk oscillation based on IMU sensor

Exercise: Sit to stand				
Task description: The patient has to stand up (sit to stand)				
	Modality of execution	Experimental condition	Difficulty regulation	Feedback
Control	static base with therapis support			Verbal on postural allignment, based on observation
Experimental	*hunova* with static seat The patient has to stand up maintaining the load distribution in a defined area of confidence	Seat inclined of about 15° Seat horizontal	Inclination of the seat Load Area of confidence	*Visual* (load distribution during the sit to stand movement) based on base torque/force sensor

2) Patient position: seated, with feet on the ground or standing, with double leg base of support				
Exercise: Head and trunk rotation on static seat/base				
Task description: the subject has to perform trunk or head rotations while maintaining a correct postural alignment and balance				
	Modality of execution	Experimental condition	Difficulty regulation	Feedback
Control	static base with therapis support	Open eyes Closed eyes	--	Verbal on postural allignment, based on observation
Experimental	*hunova* with static seat/base The subject has to maintain the CoP in a defined area of confidence	Open eyes Closed eyes	CoP Area of confidence	*Visual* (CoP position on the seat/base; trunk inclination on sagittal and frontal plane) based on seat/base force torque sensors and IMU sensor *Auditory*, for high trunk oscillation based on IMU sensor
Exercise: Motor dual task on static seat/base				
Task description: the subject has to perform movement with the upper libs while sitting on a static support				
	Modality of execution	Experimental condition	Difficulty regulation	Feedback
Control	static base with therapis support The patient has to reach targets in the peri-personal space and extra-personal space.	--	--	Verbal on postural allignment, based on observation
Experimental	*hunova* with static seat/base The patient has to reach targets on the touch screen with the upper limbs.	--	--	*Visual* (CoP position on the seat/base; trunk inclination on sagittal and frontal plane) based on

				seat/base force torque sensors and IMU sensor *Auditory*, for high trunk oscillation based on IMU sensor

3) Patient position: standing, with double leg base of support				
Exercise: Limits of stability				
Task description: the subject stands on a moving/movable base and is requested to lean in different directions reaching his limits of stability				
	Modality of execution	**Experimental condition**	**Difficulty regulation**	**Feedback**
Control	Discosit chinesport with therapis support	Open eyes Closed eyes	--	Verbal on postural allignment, based on observation
Experimental	*hunova* with passive moving base The base moves the patient's ankles into a sagittal/frontal plane or following different trajectories The patient has to stabilize the upper trunk maintaining the trunk inclination in a defined area of confidence	Open eyes Closed eyes	Amplitude of passive mobilization (degrees) Velocity of movement Trunk Area of confidence	Visual (trunk inclination on sagittal and frontal plane) based on IMU sensor *Auditory*, for high trunk oscillation based on IMU sensor
Experimental	*hunova* with unstable base the subject has to mobilize the base for reaching targets on the screen in sagittal or frontal plane or in random directions. The exercise is associated with a gaming on the screen.		Amplitude of active mobilization Target positions	Visual (angular displacement of the platform; trunk inclination on sagittal and frontal plane) based on base position sensors and IMU sensor *Auditory*, for high trunk oscillation based on IMU sensor

4) Patient position: standing, with asymmetric bipodalic base of support				
Exercise: Load bearing				
Task description: the subject has to shift the load changing from double leg base of support to one leg base of support				
	Modality of execution	**Experimental condition**	**Difficulty regulation**	**Feedback**
Control	Standing with one leg on a static base/ Discosit chinesport /foam surface with therapist support 1) shifting the load to unimpaired /impaired leg 2) mainteining balance in asymettric bipodalic support with the unimpaired /impaired leg on a step 3) mainteining balance in asymettric bipodalic support with the unimpaired/impaired leg while reaching different positions with the unimpaired leg	Step height and consistency Footrest surface cosistency	Step heigh and consistency	Verbal on postural allignment, based on observation
Experimental	*hunova* with static/unstable base 1) the patient is in a bipodalic standing position and has to move toward a monopodalic condition on the unimpaired /impaired leg 2) mainteining balance in asymettric bipodalic support with the unimpaired /impaired leg on hunova and the unimpaired /impaired leg on a step	With static base With unstable base	With static base: CoP Area of confidence Trunk Area of confidence With unstable base: Platform maximum workspace Platform oscillation area of confidence Type of instability (proprioceptive, elastic or fluid dynamic)	*Visual* (CoP position on the base/ angular displacement of the base; trunk inclination on sagittal and frontal plane) based on base force torque/position sensors and IMU sensor *Auditory*, for high trunk oscillation based on IMU sensor

			Instability level	
	3) The patient is in a monopodalic standing position with the unimpaired/impaired leg on hunova and has to move the unimpaired leg for reaching different positions

the patient has to stabilize the upper trunk maintaining the trunk inclination in a defined area of confidence | | | |

Reactive balance exercises

Patient position: seated, with feet on the ground/ standing, with bipodalic base of support

Exercise: Response to perturbations – Reative balance

Task description: the subject has to maintain balance reacting to perturbations

	Modality of execution	**Experimental condition**	**Difficulty regulation**	**Feedback**
Control	Bobath ball/ Discosit chinesport

The therapist induces perturbations to the subject | Upper limbs in support or not | --- | Verbal on postural allignment, based on observation |
| *Experimental* | *hunova* with passive moving seat/base

The seat/base moves inducing random perturbations

The patient has to stabilize the upper trunk maintaining the trunk inclination in a defined area of confidence | Upper limbs in support or not | Amplitude of perturbations (degrees)

Velocity of perturbations

Trunk Area of confidence | Visual (trunk inclination on sagittal and frontal plane) based on IMU sensor

Auditory, for high trunk oscillation based on IMU sensor |

Exercise: Motor dual task on unstable seat/base

Task description: the subject has to perform movements with the upper limbs while sitting on a dynamic support

	Modality of execution	**Experimental condition**	**Difficulty regulation**	**Feedback**
Control	Bobath ball/ Discosit chinesport

The patient has to reach targets in the peri-personal space and extra-personal space. | Upper limbs in support or not | -- | Verbal on postural allignment, based on observation |
| *Experimental* | *hunova* with unstable seat/base

The subject has to maintain the degree of seat/base oscillation in a defined area of confidence while reaching targets on the touch screen with the upper limbs. | Upper limbs in support or not | Seat/base maximum workspace

Seat/base oscillation area of confidence

Type of instability (proprioceptive, elastic or fluid dynamic)

Instability level | *Visual* (angular displacement of the seat/base; trunk inclination on sagittal and frontal plane) based on seat position sensors and IMU sensor

Auditory, for high trunk oscillation based on IMU sensor |

	ID	T0	Berg Balance Scale (BBS)		T0	MiniBEST Test (MBT)		T0	Trunk Impairment Scale (TIS)	
			T1-T0 (% change T0-T1)	T2-T0 (% change T0-T2)		T1-T0 (% change T0-T1)	T2-T0 (% change T0-T2)		T1-T0 (% change T0-T1)	T2-T0 (% change T0-T2)
EXPERIMENTAL	**1**	49	0 (0%)	2 (4.08%)	15	2(13.33%)	-1(-6.66%)	13	-1(-7.69%)	1(7.69%)
	2	50	0 (0%)	6 (12%)	17	2(11.76%)	2(11.76%)	14	0(0%)	0(0%)
	6	47	9 (19.14%)	4 (8.51%)	17	4(23.52%)	0(0%)	13	5(38.46%)	2(15.38%)
	9	45	6 (13.3%)	2 (4.44%)	11	5(45.45%)	5(45.45%)	10	5(50%)	4(40%)
	11	47	4 (8.51%)	1 (2.12%)	16	2(12.5%)	-1(-6.25%)	14	2(14.28%)	-1(-7.14%)
	13	46	3 (6.52%)	0 (0%)	9	11(122.22%)	5(55.55%)	12	4(33.33%)	1(8.33%)
	15	47	9 (19.14%)	8 (17.02%)	21	1(4.76%)	2(9.52%)	12	2(16.66%)	-1(-8.33%)
	17	41	4 (9.75%)	6 (14.63%)	15	0(0%)	2(13.33%)	9	3(33.33%)	2(22.22%)
	21	48	0 (0%)	0 (0%)	18	1(5.55%)	1(5.55%)	12	3(25%)	0(0%)
	22	54	1 (1.85%)	1 (1.85%)	21	1(4.76%)	1(4.76%)	13	0(0%)	2(15.38%)
	23	49	0 (0%)	1 (2.04%)	11	3(27.27%)	3(27.27%)	12	0(0%)	1(8.33%)
	25	56	0 (0%)	0 (0%)	24	0(0%)	1(4.16%)	15	0(0%)	6(40%)
	29	51	1 (1.96%)	4 (7.84%)	21	0(0%)	0(0%)	16	-1(-6.25%)	0(0%)
	30	44	1 (2.27%)	0 (0%)	11	6(60%)	0(0%)	11	5(45.45%)	-1(-9.09%)
CONTROL	**3**	54	1 (1.85%)	2 (3.70%)	16	3(18.75%)	5(31.25%)	14	3(21.42%)	3(21.42%)
	4	54	0 (0%)	2 (3.70%)	21	1(4.76%)	2(9.52%)	13	0(0%)	0(0%)
	5	51	5 (9.80%)	5 (9.80)	22	2(9.09%)	2(9.09%)	13	1(7.69%)	2(15.38%)
	7	50	3 (6%)	3 (6%)	16	5(31.25%)	5(31.25%)	14	7(50%)	2(14.28%)
	12	46	-5 (-10.86%)	-5 (-10.86%)	13	0(0%)	-5(-38.46%)	13	1(7.69%)	-1(-7.69%)
	14	53	1 (1.88%)	-4 (-7.54%)	19	5(26.31%)	0(0%)	12	4(33.33%)	3(25%)
	16	50	6 (12%)	4 (8%)	21	1(4.76%)	1(4.76%)	12	3(25%)	0(0%)
	18	41	0 (0%)	0 (0%)	2	0(0%)	2(100%)	10	0(0%)	0(0%)
	19	42	0 (0%)	1 (2.38%)	10	3(30%)	2(20%)	13	1(7.69%)	-2(15.38%)
	20	51	1 (1.96%)	2 (3.92%)	18	1(5.55%)	3(16.66%)	13	2(15.38%)	0(0%)
	24	56	0 (0%)	0 (0%)	23	0(0%)	-3(-13.04%)	15	-1(-6.66%)	-2(-13.33%)
	27	41	1 (2.43%)	2 (4.87%)	8	0(0%)	1(12.5%)	4	6(150%)	1(25%)
	28	52	3 (5.76%)	3 (5.76%)	21	1(4.76%)	-1(-4.76%)	13	1(7.69%)	-1(-7.69%)

Table S2. Invidual subjects improvements for BBS, MiniBEST Test and Trunk Impairment Scale. For each subject are reported baseline values (T0), improvement at T1 (and the relative % of improvement with respect to T0) and the improvement at T2 (and the relative % of improvement with respect to T0)

	Direction of perturbation			
Performance at T1	**Forward (# of subjects)**	**Backward (# of subjects)**	**Affected side (# of subjects)**	**Not-affected side (# of subjects)**
Stable at 8 degrees	18 (8E-10C)	15 (7E-8C)	19 (9E-10C)	17 (10E-7C)
Improved	5 (4E-1C)	7 (5E-2C)	5 (3E-2C)	7 (2E-5C)
Decreased		1 (1C)	1 (1C)	
Stable below 8 degrees	2 (2C)	2 (2C)		1 (1C)
Test not performed	2 (1E-1C)	2 (1E-1C)	2 (1E-1C)	2 (1E-1C)

Table S3. Reactive balance test performance at T1 with respect to T0. E= experimental group; C=control group.