Table 7. Systematic Reviews Assessing Different Strategies and/or Balance Interventions for Standing Balance Outcomes in Patients With SCI

Authors Year; Country Date included in the review Number of articles Level of Evidence Type of Study AMSTAR Score	**Method Databases Outcomes Measures**	**Conclusions**
Benn et al. (2025); Canada Reviewed published articles up to June 2023 N=26 **Level of evidence:** Modified Downs and Black (D&B) tool **Type of study:** 14 pre-post 8 RCT 4 cross-over **AMSTAR:** 7	**Method:** This systematic review and meta-analysis aimed to describe and compare the efficacy and dosage of interventions targeting upright balance control, balance confidence, and falls for adults with motor-incomplete SCI/D. **Database:** APA PsycINFO (Ovid), CINAHL, Embase (Ovid), Emcare Nursing (Ovid), Web of Science Core Collection, and Medline ALL (Ovid). **Outcome Measures:** • Standing balance control: BBS, kinetic variables measured via force plates, Five Times Sit to Stand Test (FTSTS), Mini-BESTest, Community Balance and Mobility scale, Functional Reach Test, and Tinetti Scale. • Balance confidence: ABC scale and Falls Efficacy Scale - International (FES-I). • Occurrence of falls.	1. Methodological quality of the included studies: Of the included studies, 12 (46%) were deemed to have good (i.e., modified D&B Checklist score >19) methodological quality, while the remaining studies (n=14, 54%) were deemed to have moderate (i.e., modified D&B Checklist score=11-19) quality. 2. Study participants and setting: A total of 500 participants participated in the studies, with sample sizes of individual studies ranging from 4-95 participants. The time since injury ranged from 1-37 years, and the neurologic level of injury ranged from C1 to L3. More participants were rated AIS D (n=266) than AIS C (n=110). 3. The interventions studied were: BWSTT (n=5), VR combined with standing balance activities (n=6), robotic BWSTT (n=2), robotic resistance treadmill training (n=2), VFT (n=2), stepping training (n=2), stepping training + visual feedback balance training (VFBT) (n=1), perturbation-based balance training (n=1), FES + VFT (n=1), underwater treadmill training (UTT) (n=1), walking training on a walking track with differing surfaces (n=1), skill training (n=1), and community-specific ambulation training in various community locations (n=1). 4. Dosage: The included interventions ranged from 4-20 weeks in length, at a frequency of 2-15 sessions/week, and 0.37-1.5 hours per session; resulting in a

		total of 5.4-180 hours of therapy and 12-180 sessions. The results of the meta-regressions indicated that total dosage did not predict outcomes on the BBS (P=0.34) or ABC Scale (P=0.81). 5. AEs: Minor AEs (increased tone and spasticity with robotic resistance treadmill training, a controlled fall in Perturbation-based Balance Training, minor skin abrasions in BWSTT and robotic BWSTT, falls and ankle soreness in task-specific training, fatigue and muscle soreness with stepping training, and neuropathic and musculoskeletal pain within VR were reported in 8 (30.77%) of the included studies, and no serious AEs were reported. 6. Pooled effects: a. For upright balance control as measured with the BBS, there was a significant pooled effect, meaning upright balance control improved with balance interventions (Hedge's g=.51; 95% CI, .36-.66; I^2=.60). When the effect was examined by category of balance intervention, the pooled effects were significant for walking interventions (Hedge's g=.55; 95% CI, .29-.82; I^2=.63) and upright balance with visual feedback interventions (Hedge's g=.57; 95% CI, .17-.97; I^2=.63), but not for conventional physiotherapy (Hedge's g=.42; 95% CI, .12 to .97; I^2=.62). b. Similarly, when the FTSTS score was examined as a measure of upright balance control, there was a significant pooled effect (Hedge's g= .73; 95% CI, 1.18 to .27; I^2=.99), with all studies that used this measure evaluating walking interventions. c. There was a significant pooled effect for balance confidence as measured with the ABC Scale, meaning balance confidence improved with balance interventions (Hedge's g=.40; 95% CI, .13-.67; I^2=.56). In this case, only

		walking interventions showed significant pooled effects (Hedge's g=.22; 95% CI, .02-.42; I^2=.00) and not interventions targeting upright balance with visual feedback (Hedge's g=.38; 95% CI, .22 to .98; I^2=.79). d. There was no significant pooled effect on the number of fallers (Hedge's g=.97; 95% CI, 6.32 to 8.27; I^2=.98), with the studies included in this analysis focused on walking interventions. 7. Evaluation of the certainty of the evidence: a. The quality of the evidence suggesting that walking-specific interventions and interventions focused on upright balance with visual feedback improve upright balance control, as measured with the BBS, is "very low. Similarly, the quality of the evidence suggesting conventional physiotherapy does not affect upright balance control was deemed "very low." b. For the outcome of balance confidence, there was "low" quality evidence suggesting walking-specific interventions improve confidence and "very low" quality evidence suggesting the opposite for interventions with visual feedback. c. "Very low" quality evidence suggested walking-specific interventions do not affect falls.
Walia et al. (2023); India Reviewed published articles up to March 2021 N=14	**Method:** This systematic review and meta-analysis aimed to assess the methodological quality and effectiveness of various rehabilitation interventions offered for improving standing balance in individuals with incomplete SCI. **Database:** SCOPUS, PEDro, PUBMED, and Web of Science. **Outcome Measures:** BBS, Tinetti test, TUG, normalized jerk and	1. Participant characteristics: a. RCT: The pooled sample of studies included a total of 222 individuals with iSCI. Injury level: Cervical (59%), thoracic (29.7%), and lumbar (8,56%). AIS: AIS C (20.7%) and AIS D (53.6%). b. Non-RCT: The pooled sample of studies included a total of 967 individuals with iSCI. Injury level: Cervical (71%), thoracic

Level of evidence: PEDro scale for RCT and modified checklist of the Downs and Black tool for non-RCT **Type of study:** 10 RCTs 8 pre-post 4 prospective observational cohort study 1 cross-over study 1 prospective study 1 quasi-experimental **AMSTAR:** 6	root mean of sway, postural sway length as measured by a forceplate, and static and dynamic stability test using Stabilan-01 stabiloplatforms, forward functional reach test, and lateral functional reach test.	(26.5%), and lumbar (1%). AIS: AIS C (30.5%) and AIS D (69.3%). 2. Quality of trials: a. RCT: The average PEDro score for all trials was 7/10 (good quality). b. Non-RCT: The average modified Downs and Black score for the trials was 6/9 (moderate quality). 3. Interventions: a. The pooled SMD for controlled and uncontrolled trials of body-weight supported training interventions was -0.26 (95% CI, -0.70 to 0.18; p=.25) and 0.46 (95% CI, 0.33 to 0.59; p<.001), respectively. b. The pooled effect size of-0.98 (95% CI, -1.93 to -0.03; p=.04) indicated significant improvements in balance after a combination of body-weight supported training and stimulation. c. Pre-post studies analyzing the effect of VR training interventions on BBS scores in individuals with iSCI reported a MD of 4.22 (95% CI, 1.78 to 6.66; p=.0007). d. Small effect sizes were seen in pre-post studies of VR+stimulation and aerobic exercise training interventions indicating no significant improvements after training on standing balance measures.
Lorusso et al. (2022); Italy Reviewed published articles up to December 2021 N=19 (n=15 focused on technology-assisted rehabilitation)	**Method:** The aim of this review was to explore the technology-assisted strategies to assess and rehabilitate balance function in people with SCI. **Database:** MEDLINE, Embase, Scopus, Cochrane Library and IEEE Xplore. **Outcome Measures:** In the 15 studies based on technology-assisted rehabilitation device effects on balance (most of these studies considered the balance rehabilitation as a side effect of gait training) were analyzed by means of clinical scales (N=11)	1. Most of the studies reached a “moderate” quality score (D&B score: 13.8 ± 2.14), while the remaining 4 studies were classified as “poor” (D&B score: 8.75 ± 1.5). 2. 327 participants (n=270 persons with SCI) were enrolled in the selected studies. 3. The technological devices used for balance rehabilitation were grouped into three main categories: Treadmill-Based Devices (no guidance, pelvis guidance, hip-knee guidance and lower-leg guidance), Over Ground

Level of evidence: Downs and Black (D&B) tool **Type of study:** 2 RCTs 3 cohort studies 2 cross-over trial 1 descriptive study 1 case series study 1 Non-RCT 5 case reports 1 correlational study 2 cross sectional studies 1 not reported **AMSTAR:** 4	(BBS, TUG, the mFRT, the functional reach test (FRT), the ABC scale, the T-shirt test and the Tinetti scale), instrumental assessment (N=7) (body's Centre of Mass and CoP), or both clinical and instrumental assessments for balance analysis.	Devices (hip-knee guidance: Ekso and ReWalk) and Tilt Table Devices. 4. The training protocols (number of sessions, frequency and duration) were heterogeneous and sometimes not reported. 5. Five studies reported AEs during training and showed that skins abrasions, pain and various levels of ulceration were the most frequent; with no serious AEs reported. 6. Six studies did not report significant changes in any balance outcome addressed (N=1: Over Ground Devices and Treadmill-Based Devices; N=3: Treadmill-Based Devices hip-knee guidance; N=2: Over Ground Devices knee guidance). 7. The significant changes were: a. For each one of the different Treadmill-Based Devices categories at least one study with significant changes due to training was identified. b. The training with Over Ground Devices allowed statistically significant effects on balance only in the case of hip-knee guidance. c. For the Tilt Table Devices category (Erigo device), the improvement in BBS was statistically significant in persons with post-acute SCI.
Tamburella et al. (2022); Italy Reviewed published articles up to December 2020 N=41 **Level of evidence:**	**Method:** The aim of this systematic review was to explore the current state of the art of the overground lower limb exoskeletons its effects on walking and on secondary health conditions in people with SCI. **Database:** MED-LINE, Embase, Scopus, Web of Science and Cochrane Library (Cochrane Central Register of Controlled Trials). **Outcome Measures:** Walking domain (N=27) (e.g., 10MWT, 2MWT 6MWT, kinematics, WISCI II); balance (N=5) (e.g., TUG);	1. Methodological quality was reflected as "poor" or "moderate". 2. A total sample of 566 participants was analyzed. 3. Different exoskeletons devices (Ekso, n=20; ReWalk, n=14; Indego, n=4; HAL, n=2; and Rex, n=2) were analyzed. 4. Thirteen studies reported different AEs during training, showing the skin lesions as the most frequent AEs. 5. The average total number of sessions across the studies ranged from 1 to 55; and for session frequency, 3 sessions per week were performed in 42% of the studies included.

Downs and Black (D&B) tool **Type of study:** RCTs of parallel-group or cross-over design and n-RCTs (such as cohort studies, case–control, case series and pilot studies) **AMSTAR:** 8	muscle strength (N=6) (e.g., LEMS); activities of daily living (N=5) (e.g., FIM, SCIM, Barthel Index).	6. Effects on balance domain (n=12): a. All exoskeletons trainings reported a positive trend in TUG (n=8) performance regardless of AIS and time since injury. b. Other different indexes were proposed by single studies to address balance domain (n=3) and results indicated significant early improvements, which were not maintained at follow-up.