Author Year; Country Score Research Design Total Sample Size	Methods	Outcome Measures
Esfandiari et al. 2017 Israel Pre-Post Level 4 N=61	**Objective:** The aim of this study was to investigate the therapeutic effect of traditional wooden toothbrush usage on most severe constipation, which usually occurs in spinal cord injury (SCI) patients. **Population:** N=61 Level: 6 cervical, 32 thoracic, 14 lumbar, 8 thoracolumbar (classification not defined) Age: Mean 41 years, SD 12.35 years Duration: >2 years % female: 18% Timeline: Jan- Feb 2013 **Treatment:** 6 weeks of using of a wooden toothbrush for brushing teeth after breakfast and dinner for at least 5 minutes comparing: before vs. after, gender, level of injury **Outcome Measures:** NBD and Constipation Assessment Scale (CAS; lower score better)	1. CAS mean score decreased (from 3.34 to 1.73; p<0.001) with the following symptoms decreased significantly: abdominal distension/bloating, flatulence, bowel movement infrequency, liquid stool, rectal pain with bowel movement, small volume of stool, and inability to pass stool. 2. NBD scores improved (from 8.95 to 3.03; *p*<0.0001). 3. NBD score improved for individuals with thoracic (p<0.0001), or thoracolumbar injuries (p=0.031), but not individuals with cervical or lumbar injuries 4. CAS score significantly improved for individuals with thoracic (p=0.0001), or lumbar (p=0.019) but not individuals with cervical or thoracolumbar. 5. NBD scores improved for individuals who were 30-40 years old, but not other age demographics. 6. No difference in results between woman and men.
Juszczak et al. 2018 USA Pre-post Level 4 N=45	**Objective:** To explore changes in secondary health conditions that may result from using a powered exoskeleton as well as their potential impact on QoL. **Population:** N=45 Female: 19% Age: 35 y (SD= 12.65) Time since injury: 3.9 y (SD= 5.13, range, 0.25-23.75 y)	1. No negative changes in bowel and bladder were reported; positive changes were reported by 20% and 9% of participants with respect to bowel and bladder management. 2. There were no statistically significant changes in SWLS sum score from baseline to conclusion of study (20.4 +/- 8.0 to 21.3 +/- 7.6; p>.05).

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	Level: 60.1% Upper paraplegia (T1-T8) 39.9% lower paraplegia (T9-L2) Severity: 67% A complete 11% B incomplete 22% C incomplete **Treatment:** this study was to explore changes in secondary health conditions that may result from using a powered exoskeleton for independent walking for 26 sessions, as well as their potential impact on QoL. **Outcome Measures:** self-reported assessments of pain, spasticity, bladder/bowel function, Satisfaction with Life Scale (SWLS), and Modified Ashworth Scale (MAS).	
Chun et al. 2020 USA Pre-post Level 4 N=10	**Objective:** To explore the effects of exoskeletal-assisted walking (EAW) on bowel function in persons with spinal cord injury (SCI). **Population:** N=10, (one participant was lost due to early withdrawal) Female: 9% Age: 31-45 yrs – 4 participants; 46-60 yrs – 4 participants; 61-65 yrs – 2 participants Level: 100% Thoracic, T1-T11 Severity: All motor complete paraplegia 82% AIS A, 18% AIS B Time since injury: 1- 5 yrs – 6 participants; 6-10 yrs – 2	1. 5/10 reported improved frequency of bowel evacuations over the past week, 5/10 reported reduced time in minutes spent on having a bowel movement per bowel day, 6/10 reported fewer bowel accidents over the past month, and 7/10 reported decreased frequency of laxative and/or stool softener use over the past week post-EAW training. 2. 6/10 participants reported improved overall satisfaction with their bowel programs over the past month and, in 8/10 participants, ratings of stool consistency changed from either too hard or too watery to “ideal” (4–5) post-EAW training. 3. Seven participants reported a ≥10%

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	participants; 11-15 yrs – 2 participants **Treatment:** To explore the effects of exoskeleton-assisted walking (EAW) on bowel function in persons with spinal cord injury (SCI) Participants were asked to attend 3–4 Exoskeleton Assisted Walking (EAW) sessions weekly with a goal of completing at least 25 sessions in 12–14 weeks. Each session consisted of donning the device, checking vitals, performing sit to stand, then walking for 30–90 minutes in the device, with occasional rest periods as required. **Outcome Measures:** The International Standards for Neurological Classification of SCI (ISNCSCI) Exam was used to classify participants as complete (AIS A) or motor complete/sensory incomplete (AIS B) as well as to determine their neurological level of injury. Modified Lynch Gastrointestinal (GI) Survey, Bristol Stool Scale (BSS), SCI-QOL Bowel Management Difficulties (Short Form)	improvement on the SCI-QOL Bowel Management and one participant who reported worsening score. This individual also reported increased bowel accidents and medication use post-EAQ training without changes in frequency of bowel evacuations, time spent on bowel management per bowel day, or overall satisfaction with regards to bowel program post-EAW training. Also a slight softening in stool consistency on the BSS
Brinkemper et al. 2023 Germany Cross-sectional Level 5 N=35	**Objective:** To explore whether bowel and bladder management can be influenced by locomotion therapy with HAL Robot Suit. **Population:** N=35 Level: Incomplete paraplegia 1	Wexner Score- Bowel Incontinence 1. Over all patients (N=35), there was a significant change from 8.89 ± 4.62 points to 6.51 ± 4.92 points (*P*=.008) 2. For acute injury participants, average Wexner score of 7.77 ± 5.56 points

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	AIS B, 22 AIS C, 7 AIS D Complete paraplegia 5 AIS 5 Group was divided into two subgroups of acute and chronic SCI patients Time since injury: 13 participants less than 1 year since injury, average 3.85 ± 2.58 months, 46.85 ± 13.98 years 22 participants more than one year since injury, average 71.73 ± 60.71 months, average age of 48.95 ± 13.81 years **Treatment:** to explore whether bowel and bladder management can be influenced by locomotion therapy with HAL Robot Suit **Outcome Measures**: Bowel incontinence measured using the Wexner Score, constipation by the Cleveland Clinic Constipation Scoring System and bladder function using a self-developed questionnaire before and after completion of a 12-week training period with HAL	before training reduced to 5.62 ± 3.52 points after exoskeleton training (p=0.109) (ns) 3. 6/13 acute injury patients showed significant decrease in Wexner Score from 12.83 ± 3.06 points before training to 7.5 ± 2.74 points after training (*P*=.016) 4. For chronically paraplegic patients (N=22), score significantly improved from average of 9.55 ± 3.96 points to 7.05 ± 5.59 points (*P*=.039) 5. Analysis of 7 participants with a baseline score > 7 (N=16) showed significant improvement in scores from 11.44 ± 2.53 points to 7.94 ± 5.64 points after locomotion training (*P*=.013) Cleveland Clinic Constipation Scoring System- Constipation 1. Overall (N=35) CCCS decreased from 6.86 ± 4.28 points to 5.69 ± 4.95 points (*P*=0.212) (ns)
Forchheimer et al. 2016 USA Cross-sectional Level 5 N=246	**Objective:** To describe management of neurogenic bowel in individuals with chronic SCI and to explore associations between behaviors and outcomes. **Population**: N=246 Level: 14.2% incomplete paraplegic, 31.3% complete	1. Most individuals who exercised less than 30 minutes per week reported often or always spending time on bowel management, while most individuals who exercise at least 1 hour per week reported never or rarely spending time on bowel management (p=0.02)

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	paraplegic, 26.8% incomplete tetraplegic, 27.6% complete tetraplegic Age: Mean 49.73 years, SD 12.8 years Duration: Mean 18.73 years, SD 10.2 years % Female: 26% **Treatment:** N/A **Outcome Measures:** Bladder and Bowel Behavioral Management Questionnaire, and Bowel and Bladder Treatment Index, SF-36, Qualiveen	
Uchikawa et al. 2007 Japan Cross-sectional Level 5 N=20	**Objective:** To study the effectiveness of a modified washing toilet seat equipped with a CCD camera monitor and an electronic bidet to facilitate precise hitting of the anal area with water streams to stimulate bowel movement in patients with spinal cord injury (SCI). **Population:** 11 participants with cervical, 7 with thoracic, and 2 with lumbar SCI; AIS level: 8 A, 4 B, 4 C, and 4 D; all male; Age: mean (range) 46.3 (18-73) yrs; all were at least 5 months post injury **Treatment:** Newly developed procedure to induce bowel movement involving a toilet seat equipped with an electronic bidet (provides water flow), a charge-coupled device (CCD)	1. Time needed for bowel management was shorter with the intervention than that with participants' usual manner of bowel care. 2. 35% (n=7) of participants originally spent less than 30 minutes for usual defecation compared to 75% (n=15) with modified device. 3. Residual stools found in 8/15 participants who successfully defecated within 30 minutes with the device. 4. Success of defecation not related significantly with injury level or AIS impairment scale.

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	camera monitor and a light (facilitates location of anorectal area). **Outcome Measures:** Time required for successful bowel movement, amount of residual stool in rectum	