**Patient and Therapist Satisfaction**

There are 37 known articles that examine patient and therapist satisfaction with using an exoskeleton. Seven of the articles include therapists’ perspectives. Of the articles that ask for patient perspectives, the majority (22) analyzed people with spinal cord injury (SCI) while seven used participants with stroke (CVA). Different tools were used to assess perspectives and satisfaction. The most frequently used assessment method was questionnaire/survey, used in 16 articles. This was followed by interviews and focus groups which were used in 12 articles. The most commonly used device was Ekso 1.1/GT/NR, referred to as “Ekso” in this paper, though many articles encompassed participants who used a variety of stationary or overground exoskeletons.

Overall, most of the feedback garnered by both patients and therapists was positive, with recommendations that these stakeholders be involved with future developments of exoskeleton technology.1,2

*Review Articles*

There are 3 known review articles that examine satisfaction in overground exoskeleton users. In one, 23 articles were reviewed including 19 clinical trials.3 These utilized 14 different exoskeleton devices and patients with SCI, CVA, and MS.3 Overall, satisfaction was high.3 For those studies that utilized the Quebec User Evaluation of Satisfaction with Assistive Technology (quest) scale, the average individual question score was 3.7/5 regardless of patient diagnosis.3 The highest rated aspects of exoskeletons included safety, efficacy, and comfort.3 The worst rated aspects were ease of adjustment, size and weight, and ease of use.3 A second review reported no true satisfaction results, but instead noted the importance of including consumer priorities for continued development of exoskeleton technologies, as well as identifying barriers to use.4 A review article which looked at 15 articles examined just that: It included 480 patients with the goal of identifying barriers and facilitators to using lower extremity exoskeletons.5 Facilitators included age, age at injury, BMI, and active lifestyle, while barriers were more fear based including fear of skin lesions and loss of balance.5

*Spinal Cord Injury (SCI)*

Patients with SCI were the most surveyed and interviewed patients in the research. Most patients had positive perceptions of using an exoskeleton. Patients reported improvements in both physical and psychological areas. Participants enjoyed being eye level with family and friends.6 Other perceived improvements included strength7–9, endurance7, balance7, flexibility7,10, blood circulation7, mental health8,9,11, intestinal transit6,7,12,13, and spasticity14, though some users also reported worsening spasticity with use.6 On a scale from 0-100, respondents were unanimously satisfied with a locomotor training program using an exoskeleton (95.7±0.7%) and provided positive feedback about the exoskeleton itself (82.3±6.9%).8 On the same scale, they also averaged low scores (i.e. disagreed or were dissatisfied) regarding perceived risks including fear of falling (22.2±30.4%) and fear of exacerbating neurogenic pain (3.1±4.2%).8 Another study noted an average satisfaction score of 6.6±2.2/10 for Ekso compared to 7.2±1.9/10 for Lokomat.15 Patients felt safe using a device, scoring an average of 4.67±0.58 out of 5.13 Happiness with the weight and comfort of the device itself was also noted8,12,16–18, though some expressed that these could still be improved. In a sample of patients who largely had not trialed an exoskeleton themselves, devices were seen as positive and desirable by 74.4% of survey respondents while 60% desired an exoskeleton for home use.19 A negative observed in one study where participants completed between 13-25 sessions of Ekso was that the treatment was too short, indicating that participants felt this treatment was enjoyable and useful to them.9

A unique study examined 14 participants who utilized ReWalk in their home and community for up to three weeks. They were mostly satisfied with D-QUEST scores of 3.7±0.4 (scale is out of 5) and System Usability Scale score of 72.5 (scale is out of 100).20 Participants also anecdotally noted improvements in mental and social health, spasticity, pain, and range of motion.20 Twenty-eight experienced exoskeleton users reported that exoskeletons were not yet ready for home use, however it is important to note that this article is from 2020.6

Another study examining 25 participants with spinal cord injuries conducted focus groups for potential users of exoskeletons to determine their perceptions of device benefits and limitations.21 Some participants had no knowledge of robotic exoskeletons, many had questions about the future of these devices and their usability, and others were able to identify perceived benefits of using an exoskeleton.21

*Stroke (CVA)*

Patients with a CVA were very positive regarding use of an exoskeleton. In a study of 46 participants between 13 and 155 days post-CVA, they were very positive of their experience regarding comfort, enjoyment, and usefulness, and also agreed that they would recommend exoskeleton treatment to others.22 In another study, using a scale from 1-5, median scores of two items (patient satisfaction and usefulness of training) for the 26 patients were both 5, indicating a level of very satisfied/very useful.23 The median score on the same scale for the item asking about disadvantages experienced as a result of training was 1, indicating no inconvenience was noted by participants.23 Patients reported fatigue from the exoskeleton training but agreed that it accelerated their recovery.24 Patients tolerated sessions well and reported their time in an exoskeleton was well spent (mean score >3.5 out of 4).25 They also noted that they were able to move better after sessions (mean score >3 out of 4), and some patients preferred it to other gait training methods.26 Likert scales in another study showed that device comfort was rated highly (7.95 out of 10), as was naturalness of walking (7.05 out of 10).25 A study that examined technology assisted training using a variety of technology for the upper and lower extremities including Ekso, HAL, and Lokomat had 7 of the 14 participants reporting meaningful improvements, while 5/14 noted a clinically meaningful change.27

*Multiple Sclerosis (MS)*

There is one known article examining patient satisfaction using the Ekso in persons with MS. After at least 3 sessions with Ekso, high levels of satisfaction were found with scores of 31.3±5.70 out of 40 for patients.28 There was a moderate correlation between number of sessions and satisfaction.28

A second article using participants with a variety of neurological diagnoses with the majority (42.86%) having MS had participants trial both the Ekso and Rex devices with a washout period in between.29 They were more satisfied with the ease of transferring into Rex and the transportability of Ekso.29 In regards to expectations for home use, they believe the Ekso would be a better option over the Rex.29

*Therapists*

Some therapists reported high levels of satisfaction. Therapists working with patients with MS who utilized the Ekso reported a high level of satisfaction (38.50±3.67 out of 45 points) with an excellent correlation between their length of experience in neurological rehabilitation and satisfaction.28 All three therapists who were interviewed in one study commented on how using Ekso has enhanced their practice and increased what they can do with their patients, which in turn has benefited patient outcomes.30 They also reported that exoskeletons allow them to walk further with patients because they do not become exhausted as quickly as other gait training methods.30–32 Another study pointed out the advantage of having the objective data that the exoskeleton provides.31

Some therapists were utilizing devices as part of a research study. Six therapists who were interviewed spoke on some common themes including an initial learning hurdle, the ability to achieve earlier and better-quality walking practice, and challenges foreseen with implementation in subacute CVA rehabilitation.24 Another mixed-result study provided online surveys and interviews to 5 Rex and ReWalk therapists, though two therapists only had 1-3 months of exposure to the exoskeleton and reported infrequent use.32 The whole sammple reported the importance of the exoskeleton aligning with the patient’s goals and enjoyed the ability to perform activities with patients that wouldn’t otherwise be possible.32

Others had more negative views of exoskeletons. In one study that assessed 10 therapists, some who were formally trained and others who only had clinical exposure to a device, a steep learning curve was noted to be a big barrier to implementation.33 It is important to note that the training and software described in this article have been improved and modified since this time.

Therapists also commented that their facility needs to have certain infrastructure to run a successful exoskeleton program including time26,30,33, personel33, support for training30, and storage space for the device26. Cost was also identified as a barrier.31,34 Other impediments to successful implementation include patient population30 (some patients are anxious and unwilling to try a device) and length of stay26,35 (patients with short stays may need to focus mostly on family training leaving minimal time for other interventions). Notably, one study that provided a survey about feasibility directly after training on the Ekso and 6 months later showed improvement in feasibility at the six month mark, indicating that initial barriers to implementation may be improved or resolved with time.26

*Conclusion*

Patients and therapists overall reported satisfaction using an exoskeleton device in therapy and the community. There were many perceived health benefits of using an exoskeleton. Some barriers were also recognized. It is important that patient and therapist feedback be taken into account when manufacturers continue to develop robotic technology.

**References**

1. Muijzer-Witteveen H, Sibum N, Van Dijsseldonk R, Keijsers N, Van Asseldonk E. Questionnaire results of user experiences with wearable exoskeletons and their preferences for sensory feedback. *J NeuroEngineering Rehabil*. 2018;15(1):112. doi:10.1186/s12984-018-0445-0

2. Herrera-Valenzuela D, Díaz-Peña L, Redondo-Galán C, et al. A qualitative study to elicit user requirements for lower limb wearable exoskeletons for gait rehabilitation in spinal cord injury. *J NeuroEngineering Rehabil*. 2023;20(1):138. doi:10.1186/s12984-023-01264-y

3. Cumplido-Trasmonte C, Molina-Rueda F, Puyuelo-Quintana G, et al. Satisfaction analysis of overground gait exoskeletons in people with neurological pathology. a systematic review. *J NeuroEngineering Rehabil*. 2023;20(1):47. doi:10.1186/s12984-023-01161-4

4. Hill D, Holloway CS, Morgado Ramirez DZ, Smitham P, Pappas Y. WHAT ARE USER PERSPECTIVES OF EXOSKELETON TECHNOLOGY? A LITERATURE REVIEW. *Int J Technol Assess Health Care*. 2017;33(2):160-167. doi:10.1017/S0266462317000460

5. Pinelli E, Zinno R, Barone G, Bragonzoni L. Barriers and facilitators to exoskeleton use in persons with spinal cord injury: a systematic review. *Disability and Rehabilitation: Assistive Technology*. 2024;19(6):2355-2363. doi:10.1080/17483107.2023.2287153

6. Kinnett-Hopkins D, Mummidisetty CK, Ehrlich-Jones L, et al. Users with spinal cord injury experience of robotic Locomotor exoskeletons: a qualitative study of the benefits, limitations, and recommendations. *J NeuroEngineering Rehabil*. 2020;17(1):124. doi:10.1186/s12984-020-00752-9

7. Vincent C, Dumont FS, Rogers M, et al. Perspectives of wheelchair users with chronic spinal cord injury following a walking program using a wearable robotic exoskeleton. *Disability and Rehabilitation*. Published online February 15, 2024:1-9. doi:10.1080/09638288.2024.2317994

8. Gagnon DH, Vermette M, Duclos C, Aubertin-Leheudre M, Ahmed S, Kairy D. Satisfaction and perceptions of long-term manual wheelchair users with a spinal cord injury upon completion of a locomotor training program with an overground robotic exoskeleton. *Disability and Rehabilitation: Assistive Technology*. 2019;14(2):138-145. doi:10.1080/17483107.2017.1413145

9. Charbonneau R, Loyola-Sanchez A, McIntosh K, MacKean G, Ho C. Exoskeleton use in acute rehabilitation post spinal cord injury: A qualitative study exploring patients’ experiences. *The Journal of Spinal Cord Medicine*. 2022;45(6):848-856. doi:10.1080/10790268.2021.1983314

10. Stampacchia G, Rustici A, Bigazzi S, Gerini A, Tombini T, Mazzoleni S. Walking with a powered robotic exoskeleton: Subjective experience, spasticity and pain in spinal cord injured persons. *NRE*. 2016;39(2):277-283. doi:10.3233/NRE-161358

11. Chang SH, Zhu F, Patel N, Afzal T, Kern M, Francisco GE. Combining robotic exoskeleton and body weight unweighing technology to promote walking activity in tetraplegia following SCI: A case study. *The Journal of Spinal Cord Medicine*. 2020;43(1):126-129. doi:10.1080/10790268.2018.1527078

12. Sale P, Russo EF, Scarton A, Calabrò RS, Masiero S, Filoni S. Training for mobility with exoskeleton robot in spinal cord injury patients: a pilot study. *Eur J Phys Rehabil Med*. 2018;54(5). doi:10.23736/S1973-9087.18.04819-0

13. Sale P, Russo EF, Russo M, et al. Effects on mobility training and de-adaptations in subjects with Spinal Cord Injury due to a Wearable Robot: a preliminary report. *BMC Neurol*. 2016;16(1):12. doi:10.1186/s12883-016-0536-0

14. Zeilig G, Weingarden H, Zwecker M, Dudkiewicz I, Bloch A, Esquenazi A. Safety and tolerance of the ReWalkTM exoskeleton suit for ambulation by people with complete spinal cord injury: a pilot study. *J Spinal Cord Med*. 2012;35(2):96-101. doi:10.1179/2045772312Y.0000000003

15. Corbianco S, Cavallini G, Dini M, et al. Energy cost and psychological impact of robotic-assisted gait training in people with spinal cord injury: effect of two different types of devices. *Neurol Sci*. 2021;42(8):3357-3366. doi:10.1007/s10072-020-04954-w

16. Thomassen GKK, Jørgensen V, Normann B. “Back at the same level as everyone else”—user perspectives on walking with an exoskeleton, a qualitative study. *Spinal Cord Ser Cases*. 2019;5(1):103. doi:10.1038/s41394-019-0243-3

17. Platz T, Gillner A, Borgwaldt N, Kroll S, Roschka S. Device-Training for Individuals with Thoracic and Lumbar Spinal Cord Injury Using a Powered Exoskeleton for Technically Assisted Mobility: Achievements and User Satisfaction. *Biomed Res Int*. 2016;2016:8459018. doi:10.1155/2016/8459018

18. Koljonen PA, Virk AS, Jeong Y, et al. Outcomes of a Multicenter Safety and Efficacy Study of the SuitX Phoenix Powered Exoskeleton for Ambulation by Patients With Spinal Cord Injury. *Front Neurol*. 2021;12:689751. doi:10.3389/fneur.2021.689751

19. Van Silfhout L, Hosman AJF, Van De Meent H, Bartels RHMA, Edwards MJR. Design recommendations for exoskeletons: Perspectives of individuals with spinal cord injury. *The Journal of Spinal Cord Medicine*. 2023;46(2):256-261. doi:10.1080/10790268.2021.1926177

20. Van Dijsseldonk RB, Van Nes IJW, Geurts ACH, Keijsers NLW. Exoskeleton home and community use in people with complete spinal cord injury. *Sci Rep*. 2020;10(1):15600. doi:10.1038/s41598-020-72397-6

21. Heinemann AW, Kinnett-Hopkins D, Mummidisetty CK, et al. Appraisals of robotic locomotor exoskeletons for gait: focus group insights from potential users with spinal cord injuries. *Disabil Rehabil Assist Technol*. 2020;15(7):762-772. doi:10.1080/17483107.2020.1745910

22. Goffredo M, Guanziroli E, Pournajaf S, et al. Overground wearable powered exoskeleton for gait training in subacute stroke subjects: clinical and gait assessments. *Eur J Phys Rehabil Med*. 2020;55(6). doi:10.23736/S1973-9087.19.05574-6

23. Høyer E, Opheim A, Jørgensen V. Implementing the exoskeleton Ekso GT TM for gait rehabilitation in a stroke unit – feasibility, functional benefits and patient experiences. *Disability and Rehabilitation: Assistive Technology*. 2022;17(4):473-479. doi:10.1080/17483107.2020.1800110

24. Louie DR, Mortenson WB, Lui M, et al. Patients’ and therapists’ experience and perception of exoskeleton-based physiotherapy during subacute stroke rehabilitation: a qualitative analysis. *Disability and Rehabilitation*. 2022;44(24):7390-7398. doi:10.1080/09638288.2021.1989503

25. McDonald C, Fingleton C, Murphy S, Lennon O. Stroke survivor perceptions of using an exoskeleton during acute gait rehabilitation. *Sci Rep*. 2022;12(1):14185. doi:10.1038/s41598-022-18188-7

26. Swank C, Sikka S, Driver S, Bennett M, Callender L. Feasibility of integrating robotic exoskeleton gait training in inpatient rehabilitation. *Disability and Rehabilitation: Assistive Technology*. 2020;15(4):409-417. doi:10.1080/17483107.2019.1587014

27. Schuster-Amft C, Kool J, Möller JC, et al. Feasibility and cost description of highly intensive rehabilitation involving new technologies in patients with post-acute stroke—a trial of the Swiss RehabTech Initiative. *Pilot Feasibility Stud*. 2022;8(1):139. doi:10.1186/s40814-022-01086-0

28. Fernández-Vázquez D, Cano-de-la-Cuerda R, Gor-García-Fogeda MD, Molina-Rueda F. Wearable Robotic Gait Training in Persons with Multiple Sclerosis: A Satisfaction Study. *Sensors*. 2021;21(14):4940. doi:10.3390/s21144940

29. Poritz JMP, Taylor HB, Francisco G, Chang SH. User satisfaction with lower limb wearable robotic exoskeletons. *Disability and Rehabilitation: Assistive Technology*. 2020;15(3):322-327. doi:10.1080/17483107.2019.1574917

30. Read E, Woolsey C, McGibbon CA, O’Connell C. Physiotherapists’ Experiences Using the Ekso Bionic Exoskeleton with Patients in a Neurological Rehabilitation Hospital: A Qualitative Study. *Rehabilitation Research and Practice*. 2020;2020:1-8. doi:10.1155/2020/2939573

31. Herold L, Bosques G, Sulzer J. Clinical Uptake of Pediatric Exoskeletons: A Pilot Study Using the Consolidated Framework for Implementation Research. *Am J Phys Med Rehabil*. Published online November 22, 2023. doi:10.1097/PHM.0000000000002371

32. Ehrlich-Jones L, Crown DS, Kinnett-Hopkins D, et al. Clinician Perceptions of Robotic Exoskeletons for Locomotor Training After Spinal Cord Injury: A Qualitative Approach. *Arch Phys Med Rehabil*. 2021;102(2):203-215. doi:10.1016/j.apmr.2020.08.024

33. Mortenson WB, Pysklywec A, Chau L, Prescott M, Townson A. Therapists’ experience of training and implementing an exoskeleton in a rehabilitation centre. *Disability and Rehabilitation*. 2022;44(7):1060-1066. doi:10.1080/09638288.2020.1789765

34. Postol N, Barton J, Wakely L, Bivard A, Spratt NJ, Marquez J. “Are we there yet?” expectations and experiences with lower limb robotic exoskeletons: a qualitative evaluation of the therapist perspective. *Disability and Rehabilitation*. Published online March 2, 2023:1-8. doi:10.1080/09638288.2023.2183992

35. Gillespie J, Arnold D, Trammell M, et al. Utilization of overground exoskeleton gait training during inpatient rehabilitation: a descriptive analysis. *J NeuroEngineering Rehabil*. 2023;20(1):102. doi:10.1186/s12984-023-01220-w

| **Title** | **Authors** | **Journal** | **Device** | **Diagnosis** |
| --- | --- | --- | --- | --- |
| Barriers and facilitators to exoskeleton use in persons with spinal cord injury: a systematic review | Pinelli E, Zinno R, Barone G, Bragonzoni L | Disabil Rehabil Assist Technol. 2024 Aug;19(6):2355-2363 | Unknown | SCI |
| Clinical Uptake of Pediatric Exoskeletons: A Pilot Study Using the Consolidated Framework for Implementation Research | Herold L, Bosques G, Sulzer J | Am J Phys Med Rehabil. 2024 Apr 1;103(4):302-309 | Unknown | Therapists |
| "Are we there yet?" expectations and experiences with lower limb robotic exoskeletons: a qualitative evaluation of the therapist perspective | Postol N, Barton J, Wakely L, Bivard A, Spratt NJ, Marquez J | Disabil Rehabil. 2024 Mar;46(5):1023-1030 | ReWalk, Rex | Therapists |
| Perspectives of wheelchair users with chronic spinal cord injury following a walking program using a wearable robotic exoskeleton | Vincent C, Dumont FS, Rogers M, Hu T, Bass A, Aubertin-Leheudre M, Karelis AD, Morin SN, McKerral M, Duclos C, Gagnon DH | Disabil Rehabil. 2024 Feb 15:1-9 | Ekso | SCI |
| A qualitative study to elicit user requirements for lower limb wearable exoskeletons for gait rehabilitation in spinal cord injury | Herrera-Valenzuela D, Díaz-Peña L, C Redondo-Galán 4, José Arroyo M, Cascante-Gutiérrez L, Gil-Agudo A,  Moreno JC,  Del-Ama AJ | J Neuroeng Rehabil. 2023 Oct 17;20(1):138 | Unknown | SCI |
| Utilization of overground exoskeleton gait training during inpatient rehabilitation: a descriptive analysis | Gillespie J, Arnold D, Trammell M, Bnennett M, Ochoa C, Driver S, Callender L, Sikka S, Dubiel R, Swank C | J Neuroeng Rehabil. 2023 Aug 4;20(1):102 | Ekso | SCI, CVA, ABI |
| Satisfaction analysis of overground gait exoskeletons in people with neurological pathology. a systematic review | Cumplido-Trasmonte C, Molina-Rueda F, Puyuelo-Quintana G, Plaza-Flores A, Hernández-Melero M, Barquín-Santos E, Destarac-Eguizabal MA, García-Armada E. | J Neuroeng Rehabil. 2023 Apr 18;20(1):47 | Multiple – Review Article | SCI, CVA, MS |
| Design recommendations for exoskeletons: Perspectives of individuals with spinal cord injury | van Silfhout L, Hosman AJF, van de Meent H, Bartels RHMA, Edwards MJR | J Spinal Cord Med. 2023 Mar;46(2):256-261 | Unknown | SCI |
| Patients' and therapists' experience and perception of exoskeleton-based physiotherapy during subacute stroke rehabilitation: a qualitative analysis | Louie DR, Mortenson WB, Lui M, Durocher M, Teasell R, Yao J, Eng JJ | Disabil Rehabil. 2022 Dec;44(24):7390-7398 | Ekso | CVA, Therapists |
| Exoskeleton use in acute rehabilitation post spinal cord injury: A qualitative study exploring patients' experiences | Charbonneau R, Loyola-Sanchez A, McIntosh K, MacKean G, Ho C | J Spinal Cord Med. 2022 Nov;45(6):848-856 | Ekso | SCI |
| Stroke survivor perceptions of using an exoskeleton during acute gait rehabilitation | McDonald C, Fingleton C, Murphy S, Lennon O | Sci Rep. 2022 Aug 19;12(1):14185 | Ekso | CVA |
| Feasibility and cost description of highly intensive rehabilitation involving new technologies in patients with post-acute stroke | Schuster-Amft C, Kool J, Moller JC, Schweinfurther R, Ernst MJ, Reicherzer L, Ziller C, Schwab ME, Wieser S, Wirz M | Pilot Feasibility Stud. 2022 Jul 5;8(1):139 | Ekso, HAL, Lokomat | CVA |
| Implementing the exoskeleton Ekso GT for gait rehabilitation in a stroke unit – feasibility, functional benefits and patient experiences | Høyer E, Opheim A, Jørgensen V | Disabil Rehabil Assist Technol. 2022 May;17(4):473-479 | Ekso | CVA |
| Therapists’ experience of training and implementing an exoskeleton in a rehabilitation centre | Mortenson WB, Pysklywec A, Chau L, Prescott M, Townson A | Disabil Rehabil. 2022 Apr;44(7):1060-1066 | Ekso | Therapists |
| Energy cost and psychological impact of robot-assisted gait training in people with spinal cord injury: effect of two different types of devices | Corbianco S, Cavallini G, Dini M, Franzoni F, D'Avino C, Gerini A, Stampacchia G | Neurol Sci. 2021 Aug;42(8):3357-3366 | Ekso, Lokomat | SCI |
| Wearable Robotic Gait Training in Persons with Multiple Sclerosis: A Satisfaction Study | Fernández-Vázquez D,  Cano-de-la-Cuerda R,  Gor-García-Fogeda MD,  Molina-Rueda F | Sensors (Basel). 2021 Jul 20;21(14):4940 | Ekso | MS |
| Outcomes of a Multicenter Safety and Efficacy Study of the SuitX Phoenix Powered Exoskeleton for Ambulation by Patients with Spinal Cord Injury | Koljonen PA, Virk AS, Jeong Y, McKinley M, Latorre J, Caballero A, Hu Y, Wong YW, Cheung K, Kazerooni H | Front Neurol. 2021 Jul 19:12:689751 | Phoenix | SCI |
| Clinician Perceptions of Robotic Exoskeletons for Locomotor Training after Spinal Cord Injury: A Qualitative Approach | Ehrlich-Jones L, Crown DS, Kinnett-Hopkins D, Field-Fote E, Furbish C, Mummidisetty CK, Bond RA, Forrest G, Jayaraman A, Heinemann AW | Arch Phys Med Rehabil. 2021 Feb;102(2):203-215 | Ekso, ReWalk, Indego | SCI, Therapists |
| Appraisals of robotic locomotor exoskeletons for gait focus group insights from potential users with spinal cord injuries | Heinemann AW, Kinnett-Hopkins D, Mummidisetty CK, Bond RA, Ehrlich-Jones L, Furbish C, Field-Fote E, Jayaraman A | Disabil Rehabil Assist Technol. 2020 Oct;15(7):762-772 | Ekso, HAL, lokomat | SCI |
| Exoskeleton home and community use in people with complete spinal cord injury | van Dijsseldonk RB, van Nes IJW, Geurts ACH, Keijsers NLW | Sci Rep. 2020 Sep 24;10(1):15600 | ReWalk | SCI |
| Users with spinal cord injury experience of robotic locomotor exoskeletons: a qualitative study of the benefits, limitations, and recommendations | Kinnett-Hopkins D, Mummidisetty CK, Ehrlich-Jones L, Crown D, Bond RA, Applebaum MH, Jayaraman A, Furbish C, Forrest G, Field-Fote E, Heinemann AW | J Neuroeng Rehabil. 2020 Sep 11;17(1):124 | Ekso, Indego, ReWalk | SCI |
| Feasibility of integrating robotic exoskeleton gait training in inpatient rehabilitation | Swank C, Sikka S, Driver S, Bennett M, Callender L. | Disabil Rehabil Assist Technol. 2020 May;15(4):409-417 | Ekso | SCI, CVA, Therapists |
| User satisfaction with lower limb wearable robotic exoskeletons | Poritz JMP, Taylor HB, Francisco G, Chang SH | Disabil Rehabil Assist Technol. 2020 Apr;15(3):322-327 | Ekso, Rex | SCI, ABI, MS |
| Physiotherapists’ Experiences Using the Ekso Bionic Exoskeleton with Patients in a Neurological Rehabilitation Hospital: A Qualitative Study | Read E, Woolsey C, McGibbon CA, O’Connell C | Rehabil Res Pract. 2020 Jan 8:2020:2939573 | Ekso | Therapists |
| Combining robotic exoskeleton and body weight unweighing technology to promote walking activity in tetraplegia following SCI: A case study | Chang SH, Zhu F, Patel N, Afzal T, Kern M, Francisco GE. | J Spinal Cord Med. 2020 Jan;43(1):126-129 | Ekso | SCI |
| Overground wearable powered exoskeleton for gait training in subacute stroke subjects: clinical and gait assessments | Goffredo M, Guanziroli E, Pournajaf S, Gaffuri M, Gasperini G, Filoni S, Baratta S, Damiani C, Franceschini M, Molteni F | Eur J Phys Rehabil Med. 2019 Dec;55(6):710-721 | Ekso | CVA |
| "Back at the same level as everyone else"-user perspectives on walking with an exoskeleton, a qualitative study. | Thomassen GK, Jørgensen V, Normann B. | Spinal Cord Ser Cases. 2019 Dec 13:5:103 | Ekso | SCI |
| Satisfaction and perceptions of long-term manual wheelchair users with a spinal cord injury upon completion of a locomotor training program with an overground robotic exoskeleton | Gagnon DH, Vermette M, Duclos C, Aubertin-Leheudre M, Ahmed S, Kairy D | Disabil Rehabil Assist Technol. 2019 Feb;14(2):138-145 | Ekso | SCI |
| Questionnaire results of user experiences with wearable exoskeletons and their preferences for sensory feedback | Muijzer-Witteveen H, Sibum N, van Dijsseldonk R, Keijers N, and van Asseldonk E | J Neuroeng Rehabil. 2018 Nov 23;15(1):112 | ReWalk | SCI |
| Examining the Effects of a Powered Exoskeleton on Quality of Life and Secondary Impairments in People Living with Spinal Cord Injury | Juszczak M, Galle E, Bushnik T | Top Spinal Cord Inj Rehabil. 2018 Fall;24(4):336-342 | Indego | SCI |
| What Are User Perspectives of Exoskeleton Technology? A Literature Review | Hill D, Holloway CS, Ramirez DZM, Smitham P, Pappas Y | Int J Technol Assess Health Care. 2017 Jan;33(2):160-167 | Multiple – Review Article | SCI, CVA |
| Walking with a powered robotic exoskeleton: Subjective experience, spasticity and pain in spinal cord injured persons. | Stampacchia G, Rustici A, Bigazzi S, Gerini A, Tombini T, Mazzoleni S | NeuroRehabilitation. 2016 Jun 27;39(2):277-83 | Ekso | SCI |
| Effects on mobility training and de-adaptations in subjects with Spinal Cord Injury due to a Wearable Robot: a preliminary report. | Sale P, Russo EF, Russo M, Masiero S, Piccione F, Calabrò RS, Filoni S | BMC Neurol. 2016 Jan 28:16:12 | Ekso | SCI |
| Device-Training for Individuals with Thoracic and Lumbar Spinal Cord Injury Using a Powered Exoskeleton for Technically Assisted Mobility: Achievements and User Satisfaction. | Platz T, Gillner A, Borgwaldt N, Kroll S, Roschka S. | Biomed Res Int. 2016:2016:8459018 | ReWalk | SCI |
| Safety and tolerance of the ReWalkTM exoskeleton suit for ambulation by people with complete spinal cord injury: a pilot study. | Zeilig G, Weingarden H, Zwecker M, Dudkiewicz I, Bloch A, Esquenazi A. | J Spinal Cord Med. 2012 Mar;35(2):96-101 | ReWalk | SCI |

CVA = stroke, SCI = spinal cord injury, MS = multiple sclerosis, ABI = acquired brain injury