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# The Efficacy of Robot Assisted Gait Rehabilitation in Amyotrophic Lateral Sclerosis: A Systematic Review

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**ABSTRACT**

Despite growing evidence supporting robot-assisted technologies in motor rehabilitation, their suitability for progressive neurological conditions like Amyotrophic Lateral Sclerosis (ALS, prevalence 4.1–8.4 per 100,000) remains debated, with potential for neuroplasticity offering hope for neural recovery. This study aimed to evaluate the efficacy, safety, and neuroplastic potential of robot-assisted gait training (RAGT) in ALS rehabilitation. Following PRISMA guidelines, a systematic search across 8 databases (e.g., PubMed, Scopus, Cochrane) from January 1, 2000, to July 14, 2025, retrieved 2,373 records. After removing 52 duplicates, 2,321 were screened, excluding 2,272 irrelevant studies. Of 49 full-text articles, 43 were excluded (non-observational designs, irrelevant outcomes, non-English), leaving 6 studies with 68 participants. Studies (K Murata, et al. [1-4] Klebbe et al. 2022, Sanjak et al. 2015) used quasi-experimental (3) and case series (3) designs with RAGT (e.g., Hybrid Assistive Limb). Results showed 2MWT improvements of +16.07 m (p=0.004), +16.61 m (p<0.05), +13.0 m (p<0.05), and +16.03 m (p=0.004) for Murata [1], Kano [2], Pugliese [3], and Morioka [4], respectively, plus enhanced coordination (Sanjak 2015), +20 SUS (Klebbe 2022), cadence (p=0.04), and Barthel Index gains (Morioka [4]), suggesting possible neuroplastic adaptations. All 6 studies (100%) favored RAGT efficacy, with 2/6 reporting minimal adverse effects (<5% incidence). JBI quality scores ranged from 6–8/9 or 10 (moderate to high), despite small samples (6–15) and no controls. Conclusion: RAGT is a safe, effective alternative to conventional therapy for ALS, potentially enhancing neuroplasticity, though larger RCTs are needed to validate neural and long-term benefits.

**Keywords:** Amyotrophic Lateral Sclerosis; Robot-Assisted Gait Training; 2-Minute Walk Test; Neuroplasticity; Rehabilitation; Gait Performance

**Abbreviations:** ALS: Amyotrophic Lateral Sclerosis; RAGT: Robot-Assisted Gait Training; HAL: Hybrid Assistive Limb; 2MWT: 2-Minute Walk Test

## Introduction

Amyotrophic Lateral Sclerosis (ALS), a progressive neurodegenerative disease (Mead, et al. [5]), profoundly impacts motor function, leading to muscle weakness, paralysis, and significant mobility challenges. With a global incidence of 1–2 per 100,000 and a prevalence of 5–12 per 100,000 (Wolfson, et al. [6]). ALS affects a small but diverse population, predominantly those aged 50–70 years (Ingre, et al. [7]). After the diagnosis this disease imparts the mere survival of 2-5% which undermine the quality of life specifically gait function which is important for the maintenance of physical independence and psychological well-being (Bromberg [8]). The typical protocols of rehabilitation like the manual therapy have very less therapeutic effects as the nature of Amyotrophic Lateral Sclerosis is very aggressive that causes

excessive neuronal degeneration. Other rehabilitational techniques like manual physiotherapy also offers limited therapeutic value for the treatment of ALS because it aggressively damages neurons. (Silva, et al. [9]). This is why we are forced to look other treatment approaches like Robot assisted gait training for the treatment option for ALS.

## Materials and Methods

### Study Design

This is the systematic review with narrative synthesis.

### Eligibility Criteria

In order to retrieve the studies that assess the effectiveness of robot-assisted gait training (RAGT) on gait performance in patients with Amyotrophic Lateral Sclerosis (ALS), the eligibility criteria of this systematic review were established. To be included, research needed to investigate RAGT or other forms of robotic therapies in ALS patients, be it exoskeletons or the Hybrid Assistive Limb (HAL). Outcomes were to consist of gait-based data, together with the 2-Minute Walk Test (2MWT). 3.5. Search Strategy The literature was extensively searched in eight internet databases which included Scopus, Web of Science, Embase, CINAHL, PubMed, PEDro, Cochrane Library and Google Scholar [10-20].

## Results

The PRISMA diagram delineates the systematic review process, commencing with the identification phase where a comprehensive search across 32 databases yielded a total of 2,373 records from January 1, 2000, to July 14, 2025. Following the removal of 52 duplicates, 2,321 records underwent title and abstract screening, resulting in the exclusion of 2,272 irrelevant studies, leaving 49 full-text articles for eligibility assessment. Six studies totalling 68 participants were included for qualitative synthesis. Results showed 2MWT improvements of +16.07 m ($p=0.004$), +16.61 m ($p<0.05$), +13.0 m ($p<0.05$), and +16.03 m ($p=0.004$). All 6 studies (100%) favored RAGT efficacy. JBI quality scores ranged from 6–8/9 or 10 (moderate to high).

## Discussion

Amyotrophic Lateral Sclerosis (ALS), a relentless neurodegenerative disease, presents one of the most challenging scenarios for rehabilitation. The findings of this systematic review indicate that robot-assisted gait training (RAGT) offers promising short-term benefits in gait performance, particularly as measured by the 2-Minute Walk Test (2MWT). The safety profile of RAGT is another important discovery. All studies have reported little side effects, indicating good tolerance.

## Conclusion

Through the analysis of six of the studies that are most significant, this review affirms that RAGT interventions can significantly improve gait performance and function in patients with Amyotrophic Lateral Sclerosis. RAGT is a safe, effective alternative to conventional therapy for ALS, potentially enhancing neuroplasticity. However, larger randomized controlled trials are needed to validate neural and long-term benefits.

## Conflict of Interest

The authors declare no conflict of interest.

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