The effectiveness of exoskeletons in improving rehabilitation outcomes following total knee replacement

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Summary

Robotic exoskeletons represent a transformative advancement in post-surgical rehabilitation, offering potential improvements in recovery outcomes for total knee arthroplasty (TKA) patients. This pilot study evaluates the Keeogo exoskeleton's efficacy in enhancing rehabilitation metrics, including gait function, pain levels, knee joint range of motion, and hospital stay duration. Fourteen TKA patients were randomized into intervention and control groups, with the former receiving exoskeleton-assisted rehabilitation and the latter undergoing standard care. Key outcomes, assessed through spatiotemporal gait analysis and patient-reported measures, revealed significant benefits for the intervention group within one week post-surgery. Improvements included higher WOMAC and HSS scores, superior knee range of motion, and reduced hospitalization durations. These findings underscore the potential of exoskeletons to elevate orthopedic rehabilitation standards. Further research is essential to conduct comprehensive cost-benefit analyses, ensuring these technologies' feasibility and broader adoption in clinical practice. This study advances robotic-assisted rehabilitation in orthopedics.

Introduction

Robotic exoskeletons, lightweight devices with integrated sensors and motors, have emerged as transformative tools in rehabilitation sciences. These devices provide external support and mobility, making them particularly valuable in post-surgical recovery settings. Total knee arthroplasty (TKA), a common intervention for knee osteoarthritis, requires effective rehabilitation to restore knee function, gait, and overall mobility. Conventional rehabilitation approaches, while effective, often result in prolonged hospital stays and variable outcomes. Recent research suggests that robotic exoskeletons can improve key recovery metrics such as range of motion, gait function, and pain reduction, making them a promising adjunct to traditional rehabilitation[1]. This pilot study focuses on evaluating the Keeogo exoskeleton's effectiveness in TKA rehabilitation. By assessing functional recovery metrics, the study aims to provide evidence for integrating robotic technologies into standard clinical protocols, potentially setting new benchmarks for orthopedic rehabilitation.

Methods

This study enrolled 14 patients aged 50–80 years undergoing TKA for knee osteoarthritis or rheumatoid arthritis. Participants were randomized into an intervention group (Keeogo-assisted rehabilitation plus standard therapy, n=6) and a control group (standard therapy only, n=8). The intervention involved training and practice sessions with the Keeogo exoskeleton under professional supervision, starting on post-operative day two, continuing for four weeks. Outcomes were assessed at baseline, week 1, and week 4, measuring active range of motion (AROM), visual analog scale (VAS) scores for pain, WOMAC and HSS functional scores, hospital stay duration, and self-selected walking speed.

Results and Discussion

Participants in the intervention group demonstrated significantly better recovery outcomes compared to the control group. At week 1, Keeogo users exhibited superior AROM ($p<0.05$) and higher WOMAC and HSS scores. Hospital stays were also notably shorter for the intervention group. Pain levels, measured via VAS scores, showed no significant differences between groups. By week 4, the Keeogo group continued to outperform the control group in functional measures, particularly in gait speed and mobility. The results underscore the efficacy of robotic exoskeletons like Keeogo in enhancing short-term recovery following TKA. Improvements in functional scores and reduced hospital stays highlight the technology's potential to expedite rehabilitation and optimize healthcare resource utilization.

Conclusions

This pilot study demonstrates the potential of the Keeogo robotic exoskeleton to enhance short-term rehabilitation outcomes following total knee arthroplasty. Significant improvements in functional recovery metrics, including range of motion, mobility, and hospital stay duration, underscore its efficacy as a promising adjunct to conventional therapy. While limitations such as small sample size and lack of blinding warrant further investigation, these findings contribute valuable insights to the emerging field of robotic-assisted rehabilitation. Continued research and development will be pivotal in establishing its cost-effectiveness and integrating such technologies into standardized clinical protocols.

References

[1] Cai, L., et al (2002). Res Nurs Health, **46**: 203-209.