



IEEE Transactions on Medical Robotics and Bionics (IEEE-TMRB)

Special Section on Precision Postoperative Orthopedic Rehabilitation Robots

Summary:

Orthopedic disorders constitute a global public health challenge and a leading contributor to disability, with more than 1.7 billion people afflicted with various musculoskeletal (MSK) conditions around the world. This is reflected by the vast orthopedic market, estimated at USD 39.46 billion in 2022, and projected to reach USD 49.52 Billion by 2028. Post-surgical orthopedic rehabilitation training directly impacts the recovery of mobility, ambulation, and limb function in patients. From a physical therapy perspective, precision postoperative orthopedic rehabilitation training can: (i) stimulate the healing of bone and soft tissue at the injury site; (ii) reduce tissue adhesion and osteoporosis caused by long-term fixation; (iii) enhance the functionality of the bone injury site and improve the strength of surrounding muscles; (iv) leverage the clinical information gathered during the surgical phase towards devising data-driven rehabilitation protocols; and (v) provide objective assessment/measurements on motor recovery to improve post-operative outcomes. Traditional rehabilitation training typically involves physiotherapists performing manual manipulation towards relieving pain, improving movement, and enhancing overall functional capacity. On the other hand, it is labor-intensive, costly, limited to one-on-one treatment and hence has limited access, and lacks quantitative assessment. Robot-assisted systems, on the other hand, provide automated means for supporting medical staff, while allowing for repetitive, accurate and precise, quantitatively driven treatment, as well as the potential for remote rehabilitation solutions. However, up to date, most available rehabilitation robots have been developed for addressing neurological disorders rather than postoperative orthopedic rehabilitation. Compared to neurological disorders, orthopedic rehabilitation is more sensitive to inaccurate or excessive training, which may cause pain, delayed or non-healing scenarios, as well as high risk of patient reinjury due to the compromised bone integrity. Existing rehabilitation robots do not fully meet the needs of postoperative rehabilitation for orthopedic conditions and injuries, and hence, there is an urgent need for the development of novel, specifically designed robots and related technologies for postoperative orthopedic rehabilitation.

The goal of this special issue is to provide readers with the current state of postoperative orthopedic rehabilitation robots and related technologies and to discuss the roadmap for future work, leveraging emerging technologies, including sensors, wearables, smart materials, and AI.

Topics of interest:

- Rehabilitation robotic devices after orthopedic surgery
- Robot-assisted rehabilitation of gait and locomotion following musculoskeletal disorders
- Wearable biofeedback devices
- Intelligent control of robotic devices
- Quantitative evaluation of orthopedic rehabilitation treatments and biomechanical functional assessment
- Human performance measurement and analysis

- ❑ Human robot interface
- ❑ Remote Rehabilitation
- ❑ New smart materials and fabrication schemes

Important Dates:

- Manuscript submission deadline: December 31, 2024
- Revisions back to authors: January 30, 2025
- Submission of the final version: March 30, 2025
- Publication of the Special Section: May 15, 2025

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