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AI-based Skeleton Recognition System for Rehabilitation Exercise in Breast Cancer Survivors: A Randomized Controlled Trial (AiRE-MS)

Abstract

Background: Endocrine therapy remains a cornerstone in hormone receptor-positive breast cancer treatment and lasts many years. Although highly effective, these treatments often cause musculoskeletal symptoms such as joint pain, stiffness, carpal tunnel syndrome, tenosynovitis, myalgia, and muscle weakness, severely compromising quality of life. We designed an AI-driven tele-rehabilitation app using biological image recognition from smartphone cameras to provide real-time exercise guidance.

Methods: We enrolled 82 participants undergoing endocrine therapy in a 16-week, two-arm randomised controlled trial (1:1). Participants received either an AI-driven rehabilitation app or standard home-based exercise program. Assessments occurred at baseline, 4 weeks, 12 weeks, and 4-week postintervention follow-up. Primary outcomes were grip strength, M-SACRAH, and WOMAC. Secondary outcomes included BCTQ and circulating biomarkers.

Results: Participants showed good adherence, with low attrition throughout follow-up. After adjustment for baseline imbalances, the intervention showed greater improvement in functional outcomes than usual care. Grip strength differed significantly between groups over time; by 3 months after the intervention, the intervention group showed a 9.6% increase from baseline (20.34 vs 18.26 kg), whereas the control group declined from 1 to 3 months after intervention. At 1 month after intervention, the intervention group had significantly lower M-SACRAH pain scores than the control group (mean difference, -15.11; $p = 0.013$), as well as lower WOMAC total scores (mean difference, -13.20; $p = 0.046$) and WOMAC pain scores (mean difference, -14.67; $p = 0.029$). At 3 months after intervention, BCTQ outcomes also favored the intervention group, with lower total scores (mean difference, -3.64; $p = 0.026$) and function scores (mean difference, -2.86; 95% CI, 0.89-4.82; $p = 0.004$).

Discussion: AI vision-based remote rehabilitation improved pain and function more than conventional home exercise in breast cancer survivors receiving endocrine therapy, especially grip strength, joint symptoms, and hand function.

Trial registration: ClinicalTrials.gov NCT06642948

Keywords

Breast cancer survivorship; Exercise oncology; Endocrine therapy-related; musculoskeletal symptoms; Artificial intelligence

Conflict of Interest & Ethical Approval

yes

Abstract submitters declaration

yes

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