

Comparison of active-assisted and resistive robotic exercises for upper-limb functional recovery in patients with stroke

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Introduction

Background. Selecting a suitable modality based on the status of upper limb function can maximize the effects of robotic rehabilitation; therefore, it is necessary to identify the optimal training modality.

Objectives. This study aimed to compare robotic rehabilitation approaches incorporating either **resistance training (RET)** or **active-assisted training (AAT)** using the same rehabilitation robot among patients with stroke who have moderate impairment.

Method

In this randomized controlled trial, we randomized 34 patients with stroke who had moderate impairment into the experimental group (n = 18) and control group (n = 16). Robot-assisted therapy was performed in both groups for 30 minutes, 5 days per week, for 4 weeks. The same rehabilitation robot provided resistance to the RET group and assistance to the AAT group. Body function and structure, activity, and participation were evaluated as the study outcomes before, during, and after the intervention.

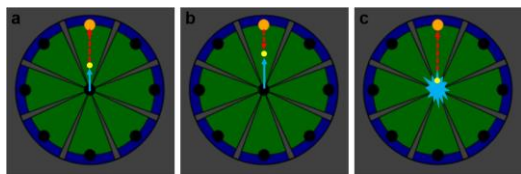


Figure 1. (a) **Active-assisted mode:** when the participant attempts active reaching toward the target, the robot applies assistive force in the direction of the participant's movement toward the target.
(b) **Isotonic resistance exercise:** robot applies resistance force in the opposite direction to the participant's reaching movement toward the target.
(c) **Isometric resistance exercise:** robot exerts force to move the participant's arm away from the center circle, and the participant attempts to stabilize their position against the robotic forces.

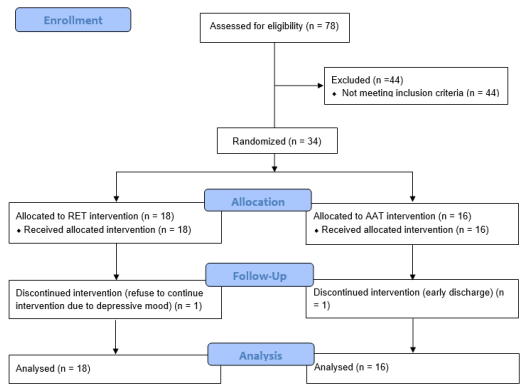


Figure 2. CONSORT flow diagram. Flow chart of patients with stroke included resistance training (RET) or active-assisted training (AAT).

Results

The study demonstrated that RET led to better improvement than AAT in terms of smoothness ($F = 4.008, p = 0.031$), which was the primary outcome, as well as in the Fugl-Meyer Assessment (FMA)-upper extremity ($F = 18.068, p < 0.001$), FMA-proximal ($F = 26.23, p < 0.001$), Action Research Arm Test-gross movement ($F = 6.818, p = 0.014$), and displacement ($F = 3.688, p = 0.045$). In addition, the Stroke Impact scores were improved only in the RET group.

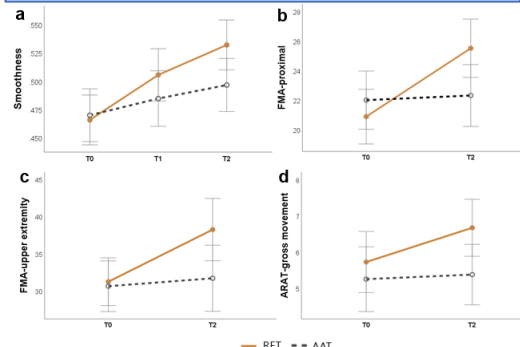


Figure 3. (a) Changes in smoothness over time in RET and AAT groups. (b), (c), (d) Comparisons of clinical outcomes between RET and AAT.

Conclusion

Robotic RET was more effective than AAT in improving upper limb function, structure, activities, and participation among patients with stroke who had moderate impairment.