



# Early rehabilitation after robot-assisted transaxillary thyroidectomy - A Randomized Clinical Trial -

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## Purpose

Robot-assisted thyroidectomy minimizes visible scarring, making it preferable for younger patients. The transaxillary approach involves an axillary incision with prolonged muscle and dermal retraction, leading to potential postoperative pain and reduced ipsilateral shoulder range of motion (ROM). While ice packs and stretching exercises are suggested for recovery, the effectiveness of early rehabilitation remains unclear. This study evaluates whether early education combined with physical therapy enhances functional recovery compared to education alone.

## Material and Methods

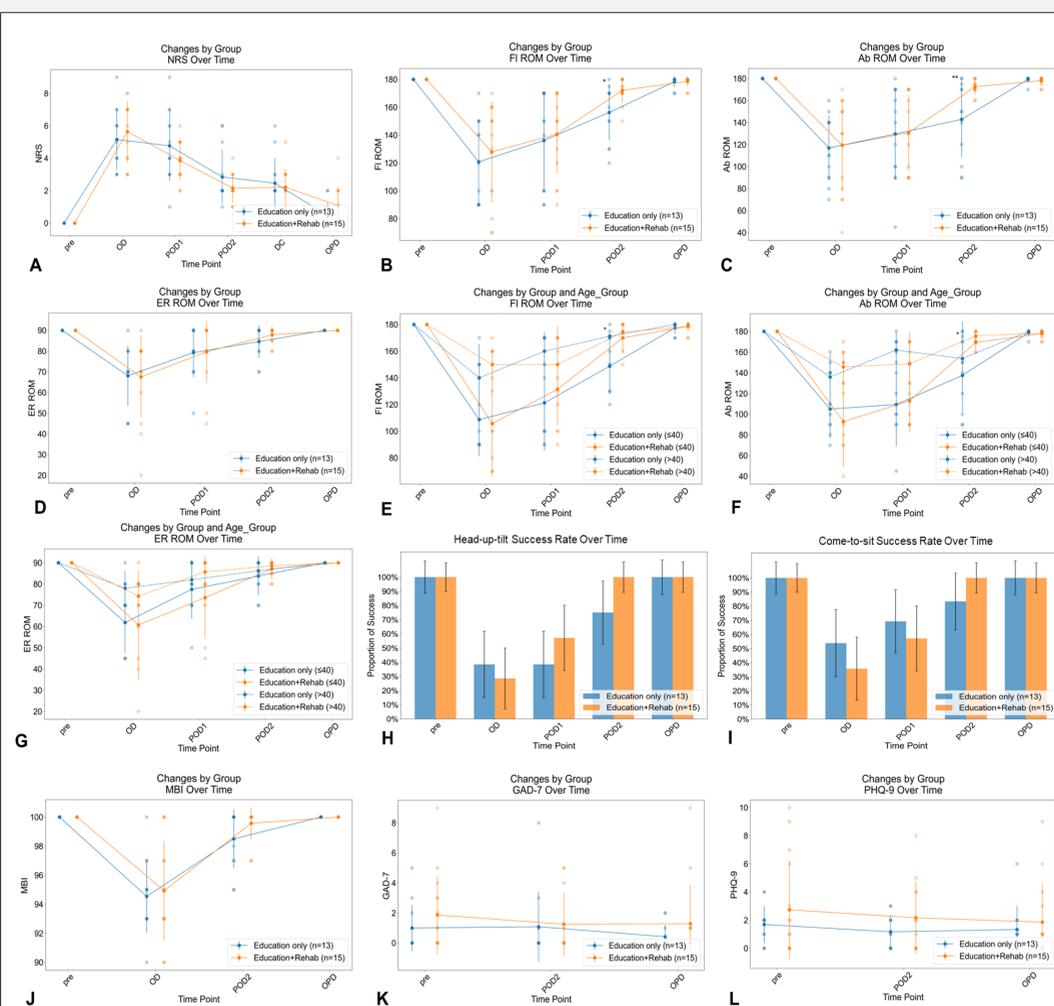
- Twenty-eight thyroid cancer patients undergoing transaxillary robot-assisted thyroidectomy were randomly assigned to either a rehabilitation group (n=15), receiving postoperative rehabilitation and education (Table 1), or a control group (n=13), receiving education only.
- Primary and secondary outcomes included pain scores (NRS), passive shoulder ROM (flexion, abduction, external rotation), and functional performance (head-up-tilt and come-to-sit feasibility), assessed at pre-operation, operation day (OD), postoperative days 1 and 2 (POD1, POD2), discharge (DC), and outpatient visit (OPD). Modified Barthel Index (MBI) was measured at pre-operation, OD, POD2, and OPD. General Anxiety Disorder-7 (GAD-7) and Patient Health Questionnaire-9 (PHQ-9) scores were checked at pre-operation, POD2, and OPD.
- A linear mixed model was used to analyze group × time interactions for pain scores and ROM. T-tests and Chi-square tests were applied to compare baseline characteristics and functional outcomes.

**Table 1. Early rehabilitation program after robot-assisted thyroidectomy**

| Day   | Program  | Service provider   |
|---|--|--------------------|
| OD  | I. Patient and caregiver education   | Physiatrist        |
|   | 1. Body perception: pain and function  |                    |
|   | 2. Importance and method of ice bag apply  |                    |
|   | 3. Desensitization technique applying on the peri-surgical site                      |                    |
|   | 4. Gentle stretching of the ipsilateral shoulder joint                               |                    |
| POD1  | 5. Gentle massage of the bilateral sternocleidomastoid muscle                        | Physical therapist |
|   | II. Physical therapy and education   |                    |
|   | 1. Breathing exercise and core setting   |                    |
|   | 2. Cryotherapy using a vapocoolant spray on the pectoral and anterolateral neck area |                    |
|   | 3. Deep neck muscle activation   |                    |
|   | 4. Passive range of motion exercise of the neck                                      |                    |
|   | 5. Education of neck muscle stretching exercise                                      |                    |
|   | 6. Mobilization of the pectoral muscle layers  |                    |
| 7. Passive range of motion exercise of the shoulder joint |  |                    |
|   | 8. Education of shoulder joint stretching exercise                                   |                    |

## Results

- In short-term analysis, the rehabilitation group showed significantly greater improvements in pain reduction (group × time interaction,  $P < 0.001$ ) (Fig.2A, Table 2) and shoulder abduction ROM (group × time interaction,  $P = 0.044$ ) (Fig. 2C, Table 2) compared to the control group.
- Age subgroup analysis revealed that patients aged  $\leq 40$  years experienced more pronounced benefits in shoulder ROM recovery (Fig.2E-G). However, there was no significant difference in restoring head-up-tilt (Fig. 2H) and come-to-sit (Fig. 2I) between groups.
- Although MBI scores increased over time, no significant group × time interaction was observed (Fig. 2J, Table 2). Psychological outcomes (GAD-7, PHQ-9) also showed no significant differences between groups (Fig. 2J, 2K).
- In long-term follow-up, both groups achieved similar functional outcomes by OPD visit.



**Fig. 1. Intergroup comparison of physical, functional and psychological measurements over time**

**Table 2. Linear mixed model for short-term effect of intervention**

| Parameter                      | Co         | SE    | Lower CI | Upper CI | P     |          |
|--------------------------------|------------|-------|----------|----------|-------|----------|
| Pain score, NRS                | Group      | 1.17  | 0.60     | -0.01    | 2.34  | 0.053    |
|                                | Time       | -0.19 | 0.06     | -0.30    | -0.08 | 0.001*   |
|                                | Group×Time | -1.20 | 0.21     | -1.60    | -0.80 | < 0.001* |
| Shoulder flexion ROM           | Sex        | 0.33  | 0.70     | -1.04    | 1.70  | 0.633    |
|                                | Age Group  | -0.86 | 0.53     | -1.90    | 0.17  | 0.102    |
|                                | Group      | 0.64  | 9.53     | -18.04   | 19.33 | 0.946    |
| Shoulder abduction ROM         | Time       | 18.75 | 3.75     | 11.39    | 26.11 | 0.000*   |
|                                | Group×Time | 3.39  | 5.15     | -6.69    | 13.48 | 0.510    |
|                                | Sex        | -6.45 | 10.31    | -26.67   | 13.76 | 0.532    |
| Shoulder external rotation ROM | Age Group  | 27.06 | 7.85     | 11.68    | 42.45 | 0.001*   |
|                                | Group      | -7.17 | 11.35    | -29.42   | 15.08 | 0.528    |
|                                | Time       | 14.23 | 4.49     | 5.44     | 23.03 | 0.002*   |
| Modified Barthel Index         | Group×Time | 12.37 | 6.15     | 0.31     | 24.43 | 0.044*   |
|                                | Sex        | -5.43 | 12.27    | -29.47   | 18.61 | 0.658    |
|                                | Age Group  | 33.41 | 9.33     | 15.11    | 51.71 | < 0.001* |
| GAD-7                          | Group      | -0.22 | 4.84     | -9.71    | 9.27  | 0.963    |
|                                | Time       | 8.85  | 1.68     | 5.57     | 12.14 | < 0.001* |
|                                | Group×Time | 1.32  | 2.30     | -3.18    | 5.83  | 0.564    |
| PHQ-9                          | Sex        | 6.91  | 5.47     | -3.81    | 17.63 | 0.207    |
|                                | Age Group  | 8.45  | 4.16     | 0.30     | 16.60 | 0.042*   |
|                                | Group      | 0.01  | 0.90     | -1.74    | 1.77  | 0.989    |
| NRS                            | Time       | 2.02  | 0.38     | 1.27     | 2.77  | 0.000*   |
|                                | Group×Time | 0.30  | 0.52     | -0.73    | 1.33  | 0.566    |
|                                | Sex        | -0.71 | 0.93     | -2.55    | 1.12  | 0.445    |
| PHQ-9                          | Age Group  | 1.98  | 0.72     | 0.57     | 3.38  | 0.006*   |

Co, coefficient; CI, confidential interval; NRS, numeric rating scale; ROM, range of motion; SE, standard error; P, P-value (\*, considered significant at < 0.05)

## Conclusion

Early rehabilitation combined with education is more effective than education alone in reducing postoperative pain and improving shoulder abduction ROM during early recovery, particularly in younger patients undergoing robot-assisted transaxillary thyroidectomy. However, long-term functional outcomes were comparable between groups, indicating that the primary benefit of early rehabilitation lies in accelerating initial recovery.