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The Impact of a Stabilization Exercise on Neck Pain: A Systematic Review and Meta-analysis

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Abstract

Introduction The efficacy of a stabilization exercise for the relief of neck pain remains controversial. We conducted a systematic review and meta-analysis to explore the effectiveness of a stabilization exercise on neck pain.

Methods We searched Embase, Web of Science, EBSCO Information Services, and the Cochrane Library databases through May 2019 for randomized controlled trials (RCTs) assessing the impact of a stabilization exercise on neck pain. This meta-analysis was performed using the random effects model.

Results Six RCTs are included in the meta-analysis. Compared with the control group of patients with neck pain, a stabilization exercise can significantly reduce pain scores at 4 to 6 weeks (mean difference [MD]: −2.41; 95% confidence interval [CI], −4.46 to −0.35; $p = 0.02$), Neck Disability Index [NDI] at 10 to 12 weeks (MD:− 6.75; 95% CI, −11.71 to −1.79; $p = 0.008$), and depression scale at 4 to 6 weeks (MD: −4.65; 95% CI, −7.00 to −2.31; $p = 0.02$), but it has no obvious impact on pain scores at 10 to 12 weeks (MD: −1.07; 95% CI, −3.42 to 1.28; $p = 0.37$) or at 6 months (MD: −1.02; 95% CI, −3.43 to 1.39; $p = 0.41$).

Conclusions A stabilization exercise can provide some benefits to control neck pain.

Keywords
- stabilization exercise
- neck pain
- randomized controlled trials

Introduction

Neck pain is reported to rank as the second most prevalent musculoskeletal disorder.[1–3] It is estimated that ∼ 67% of people may experience neck pain during their lifetime.[4,5] Neck pain results in a reduced quality of daily life and has a considerable economic impact on health care systems. Its diagnosis and treatment are still challenging because the anatomical source and cause of neck pain remains elusive in most cases.[6]

Neck pain may be associated with a reduction in the strength and endurance capacity of the cervical muscles.[7,8] For instance, the strength of deep and anterior cervical flexors in the cervical spine is reduced in patients with neck pain.[9] Exercise can possibly alleviate neck pain because of its ability to gain muscle strength, flexibility, and endurance, as well as restore injured tissues.[10] Stabilization exercises serve as an important approach to alleviate back and pelvic pain,[11–13] and they have the ability to achieve a stable injury-free state for the cervical spine.[14,15]

Several studies reported on the treatment efficacy of stabilization exercises on neck pain, but the results are conflicting.[4,16–18] This meta-analysis of randomized controlled trials (RCTs) aimed to investigate the treatment efficacy and function of stabilization exercises versus general exercises for patients with neck pain.

Materials and Methods

This systematic review and meta-analysis were performed based on the guidance of the Preferred Reporting Items for Systematic Reviews and Meta-analysis statement and

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Cochrane Handbook for Systematic Reviews of Interventions.[19,20] No ethical approval and patient consent were required because all analyses were based on previously published studies.

Literature Search and Selection Criteria

We systematically searched several databases including Embase, Web of Science, EBSCO Information Services, and the Cochrane Library from inception to May 2019 with the key words *stabilization exercise* and *neck pain*. The reference lists of retrieved studies and relevant reviews were also hand-searched, and the search process as described was performed repeatedly to include additional eligible studies.

The inclusion criteria are presented as follows: (1) study design is RCT, (2) patients are diagnosed with neck pain, and (3) intervention treatments are stabilization exercises versus general exercise. Patients with cervical radiculopathy were excluded.

Data Extraction and Outcome Measures

Some baseline information was extracted from the original studies including first author, number of patients, age, female, body mass index (BMI), and detailed methods in the two groups. Data were extracted independently by two investigators, and discrepancies were resolved by consensus. We contacted the corresponding author to obtain data when necessary.

The primary outcomes are pain scores at 4 to 6 weeks and 10 to 12 weeks. Secondary outcomes are pain scores at 6 months, Neck Disability Index (NDI) at 10 to 12 weeks, and depression scale at 4 to 6 weeks.

Quality Assessment in Individual Studies

The methodological quality of each RCT was assessed by the Jadad Scale that consists of three evaluation elements: randomization (0–2 points), blinding (0–2 points), and dropouts and withdrawals (0–1 points).[21] One point is allocated to each element if they have been conducted and mentioned appropriately in the original article. The Jadad Scale scores vary from 0 to 5 points. An article with a Jadad score ≤ 2 is considered low quality; it is considered high quality with a Jadad score ≥ 3.[22]

Statistical Analysis

We assessed mean differences (MDs) with 95% confidence intervals (CIs) for continuous outcomes (pain scores at 4–6 weeks, 10–12 weeks, and 6 months; NDI at 10–12 weeks; and depression scale at 4–6 weeks). Heterogeneity was evaluated using the I^2 statistic with $I^2 > 50\%$ indicating significant heterogeneity.[23] The random effects model was used for all meta-analyses. We searched for potential sources of heterogeneity for significant heterogeneity. Sensitivity analysis was performed to detect the influence of a single study on the overall estimate via omitting one study in turn or performing the subgroup analysis. Owing to the limited number (< 10) of the included studies, publication bias was not assessed. Results were considered statistically significant for $p < 0.05$. All statistical analyses were performed using RevMan, v.5.3 (The Cochrane Collaboration, Software Update, Oxford, United Kingdom).

Results

Literature Search, Study Characteristics, and Quality Assessment

A detailed flowchart of the search and selection results is shown in ►**Fig. 1**. A total of 469 potentially relevant articles were identified initially. Six RCTs that ultimately met our inclusion criteria were included in the meta-analysis.[4,16–18,24,25]

►**Table 1** presents the main characteristics of the six included RCTs. The six studies were published between 2003 and 2019, and the total sample size was 395. Five included RCTs involved chronic neck pain,[4,16,18,24,25] and the remaining RCT involved neck pain caused by posttraumatic stress disorder.[17]

Among the six RCTs, four included RCTs that reported pain scores at 4 to 6 weeks,[16–18,25] two included RCTs that reported pain scores at 10 to 12 weeks,[4,25] two included RCTs that reported pain scores at 6 months,[18,25] two included RCTs that reported the NDI at 10 to 12 weeks,[4,25] and two included RCTs that reported the depression scale at 4 to 6 weeks.[17,25] Jadad scores of the six included studies varied from 3 to 5 points, and all six studies were considered high quality, according to the quality assessment.

Primary Outcomes: Pain Scores at 4 to 6 Weeks and 10 to 12 Weeks

The random effects model was used for the analysis of pain scores at 4 to 6 weeks and 10 to 12 weeks. Compared with the control group of patients with neck pain, stabilization exercises were associated with significantly reduced pain scores at 4 to 6 weeks (MD: −2.41; 95% CI, −4.46 to −0.35; $p = 0.02$) with significant heterogeneity among the studies (I^2: 94%; heterogeneity $p < 0.00001$; ►**Fig. 2**) but showed no notable impact on pain scores at 10 to 12 weeks (MD: −1.07; 95% CI, −3.42 to 1.28; $p = 0.37$) with significant heterogeneity among the studies (I^2: 91%; heterogeneity $p = 0.0009$; ►**Fig. 3**).

Sensitivity Analysis

Significant heterogeneity was observed among the included studies for the primary outcomes, and significant heterogeneity remained when performing sensitivity analysis by omitting one study in turn.

Secondary Outcomes

Stabilization exercises were found to have no substantial influence on pain scores at 6 months compared with the control group for neck pain (MD: −1.02; 95% CI, −3.43 to 1.39; $p = 0.41$; ►**Fig. 4**), but did result in a reduction in NDI at 10 to 12 weeks (MD: −6.75; 95% CI, −11.71 to −1.79; $p = 0.008$; ►**Fig. 5**) and depression scale at 4 to 6 weeks (MD: −4.65; 95% CI, −7.00 to −2.31; $p = 0.02$; ►**Fig. 6**).

Discussion

Altered motor control is confirmed in chronic neck pain.[6,26,27] Different aspects are associated with altered motor control and include co-contraction of agonistic muscles, more activity for superficial flexors and extensors,

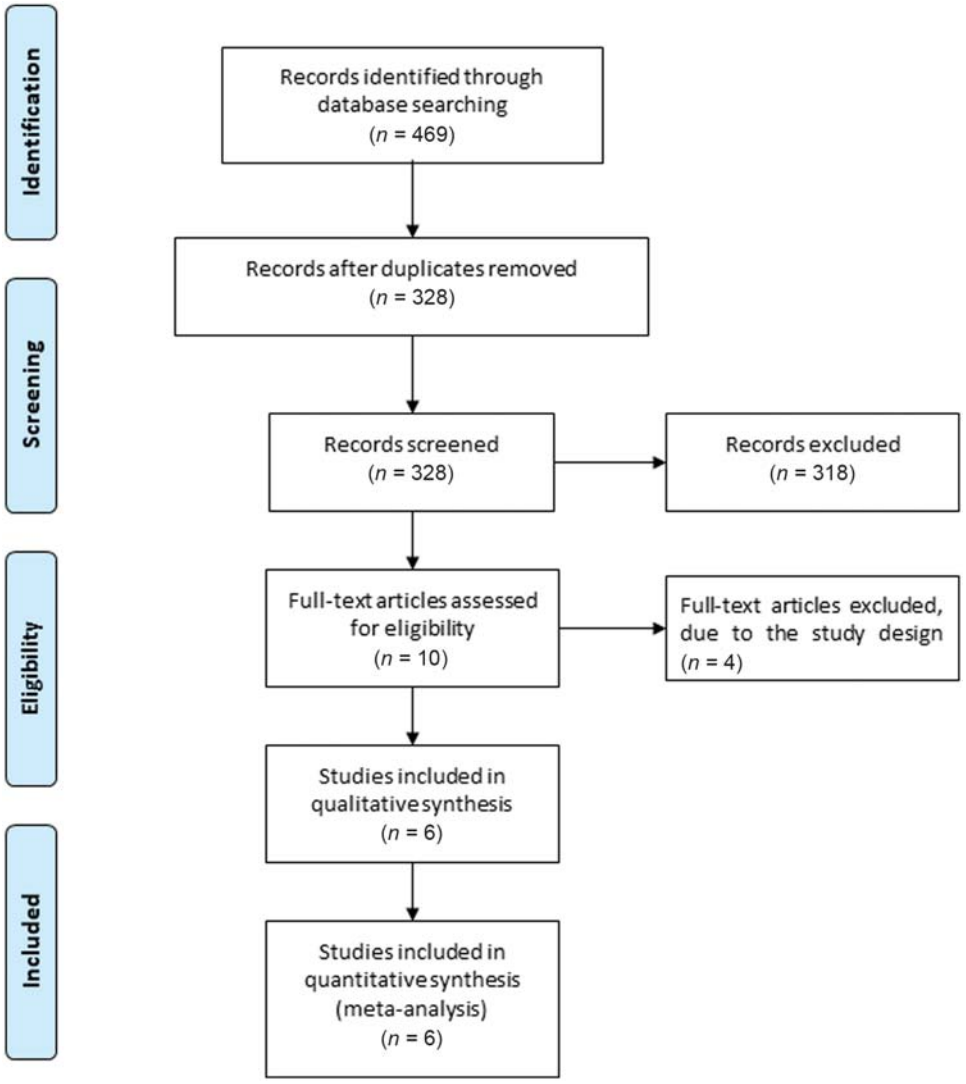

Fig. 1 Flow diagram of study search and selection process.

delayed onset time for neck muscles, and weakness of deep muscles.[6,28–30] The muscles are found to provide ~ 80% of spinal stabilization.[31] Deep and superficial muscles have different roles for cervical stabilization. Deep muscles are segmental stabilizers and provide stabilization between segments that is the basis for participation of the superficial muscles.[6]

Patients with neck pain have weak deep cervical flexors that may result in increased activity level of the superficial flexor muscles.[6] These patients have reduced deep muscle activity and increased superficial muscle activity during cognitive tasks and functional activities. Increased activity of superficial flexors during isometric contraction is also reported to cause neck pain.[28] High co-contraction of a weak sternocleidomastoid and the anterior scalene can lead to neck pain and disability.[32] A specific exercise program should be designed to target the deep flexors first and then the superficial ones.

Cervical stabilization exercises can improve neck pain and cervical muscle performance in patients with cervicogenic headache.[12] When compared with isometric and stretching exercises, stabilization exercises may be more effective in improving disability and pain control for patients with neck pain.[25] Our meta-analysis concluded that stabilization exercises can substantially reduce pain scores at 4 to 6 weeks, NDI at 10 to 12 weeks, and depression scale at 4 to 6 weeks for neck pain patients, but they show no obvious influence on pain scores at 10 to 12 weeks or 6 months. In one included RCT involving the influence of exercise programs on neck pain, the results found significantly increased deep flexor muscle endurance for stabilization exercise and also increased endurance for a group of routine exercises.[4]

Significant heterogeneity is observed when omitting one study in turn for the sensitivity analysis. Several factors may account for this heterogeneity, and they include different causes (e.g., chronic neck pain and posttraumatic stress disorder) of neck pain, various combinations with stabilization exercises (e.g., isometric neck strengthening and physical therapy), and duration of administration (ranging from 6 weeks to 12 months).

This study has several possible limitations. First, only six RCTs were included in this meta-analysis, and five of them

Table 1 Characteristics of included studies

No.	Study	Stabilization exercise group						Control group							Jada score
		N	Age, y	Female, *n*	BMI, kg/m^2	Duration, mo	Methods	*N*	Age, y	Female, *n*	BMI, kg/m^2	Duration, mo	Methods	Follow-up time	
1	Shiravi et al[16]	45	27.6 ± 2.06	–	22.2 ± 1.16	–	Scapular stabilization exercises for neck movement impairment	45	25.11 ± 1.99	–	22.3 ± 1.43	–	Active exercise performed by the patient	6 wk	4
2	Ghaderi et al[4]	20	35.97 ± 2.5	–	–	–	Stabilization exercise and routine electrotherapy for nonspecific chronic neck pain	20	36.346 ± 3.06	–	–	–	Routine exercise and electrotherapy	10 wk	3
3	Park and Kim[17]	15	57.5 ± 6.7	2	23.3 ± 3.5	24.6 ± 12.1	Cervical exercises for 30 min, 3 times/week for 6 wk and physical therapy for posttraumatic stress disorder	16	62.86 ± 7.9	4	23.76 ± 3.3	20.2 ± 10.1	Physical therapy	6 wk	4
4	Griffiths et al[18]	37	51.1 ± 14.00	20	–	30 (median)	Specific neck stabilization exercises with general neck advice and exercise program for chronic neck disorders	37	51.5 ± 13.6	26	–	24 (median)	General neck advice and exercise program	6 mo	5
5	Dusunceli et al[25]	20	50.2 ± 4.8	14	–	45.0 ± 46.8	Physical therapy agents and neck stabilization exercises for nonspecific neck pain	20	53.4 ± 6.8	12	–	43.2 ± 40.6	Physical therapy agents	12 mo	4
6	Ylinen et al[8]	60	45 ± 6	–	25 ± 3	96 ± 72	High-intensity isometric neck strengthening and stabilization exercises for chronic neck pain	60	46 ± 5	–	26 ± 4	96 ± 60	General exercises	12 mo	4

Abbreviation: BMI, body mass index.

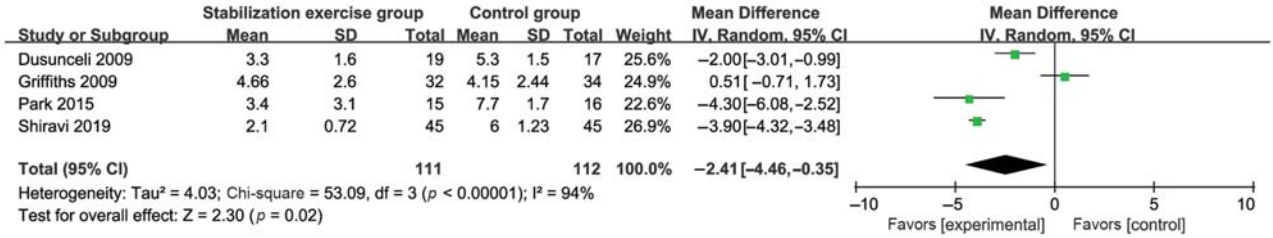

Fig. 2 Forest plot for meta-analysis of pain scores at 4 to 6 weeks. CI, confidence interval; IV, inverse variance; SD, standard deviation.

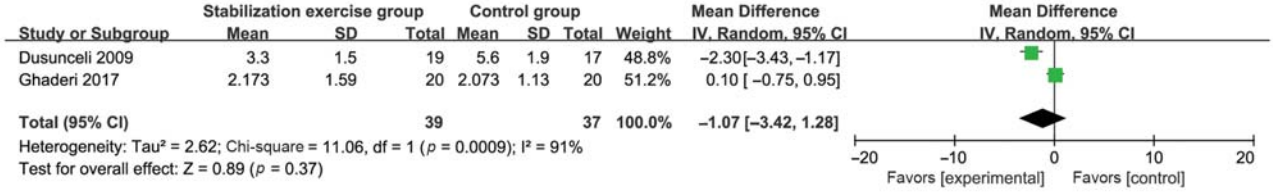

Fig. 3 Forest plot for meta-analysis of pain scores at 10 to 12 weeks. CI, confidence interval; IV, inverse variance; SD, standard deviation.

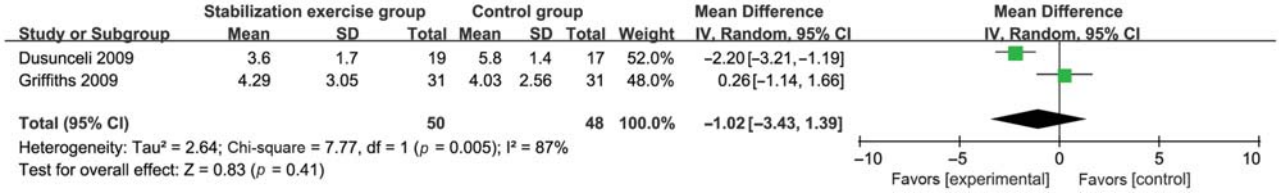

Fig. 4 Forest plot for meta-analysis of pain scores at 6 months. CI, confidence interval; IV, inverse variance; SD, standard deviation.

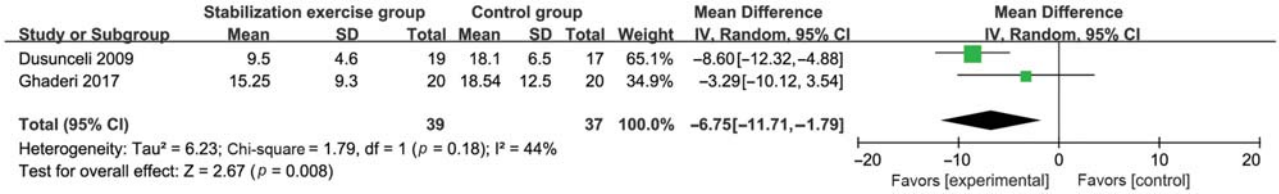

Fig. 5 Forest plot for meta-analysis of Neck Disability Index (NDI) at 10 to 12 weeks. CI, confidence interval; IV, inverse variance; SD, standard deviation.

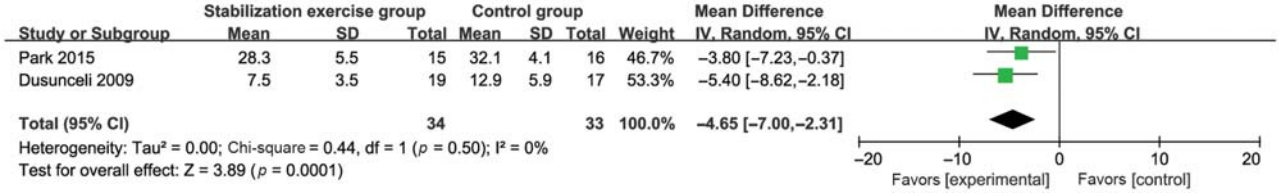

Fig. 6 Forest plot for meta-analysis of depression scale at 4 to 6 weeks. CI, confidence interval; IV, inverse variance; SD, standard deviation.

had a small sample size ($n < 100$). Overestimation of the treatment effect is more likely in smaller trials compared with larger samples. Next, significant heterogeneity was observed in this meta-analysis and may have been caused by different methods and duration of stabilization exercises, as well as sex. Finally, it was not feasible to perform a meta-analysis of some important outcomes such as endurance or the SF-36 Short Form. In conclusion, stabilization exercises can provide some benefit for pain relief and cervical function for patients with neck pain.

Conflicts of Interest
None declared.

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