Efficacy of Stabilization Exercise for Neck Pain: A Narrative Review and Meta-Analysis of Randomized Controlled Studies

Wirkung von Stabilisierungsübungen auf Patienten mit Nackenschmerzen: ein Überblick und Meta-Analyse von randomisierten kontrollierten Studien

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ABSTRACT

Introduction Stabilization exercise may be an important approach to alleviate neck pain. However, its use has not been well established. We conduct a narrative review and meta-analysis to evaluate the efficacy of stabilization exercise to control neck pain.

Methods PubMed, Embase, and the Cochrane Central Register of Controlled Trials are searched. Randomized controlled trials (RCTs) assessing the influence of stabilization exercise on neck pain are included. Two investigators independently have searched articles, extracted data, and assessed the quality of included studies. Meta-analysis is performed using the random-effect model.

Results Five RCTs involving 217 patients are included in the meta-analysis. Compared with control intervention for neck pain, stabilization exercises has no notable impact on pain intensity (Std. MD = −0.55; 95 % CI = −1.24 to 0.14; P = 0.12), neck disability index (Std. MD = −0.44; 95 % CI = −1.01 to 0.13; P = 0.13), SF-36 physical health (Std. MD = −0.18; 95 % CI = −0.61 to 0.26; P = 0.43), SF-36 mental health (Std. MD = −0.03; 95 % CI = −0.47 to 0.41; P = 0.89), but can remarkably decrease depression scale (Std. MD = −1.05; 95 % CI = −1.59 to −0.50; P = 0.0002).

Conclusions Stabilization exercises shows similar impact on pain intensity, neck disability index, SF-36 physical health and SF-36 mental health, but significant reduced depression scale compared with control intervention in patients with neck pain.

ZUSAMMENFASSUNG

Einführung: Stabilisierungsübungen können ein wichtiger Ansatz bei der Therapie von Nackenschmerzen sein. Solche Übungen gehören jedoch nicht zu den gut etablierten Therapien. Wir führten einen systematischen Überblick und Meta-Analyse durch, um die Wirkung von Stabilisierungsübungen auf die Linderung von Nackenschmerzen zu evaluieren.

Methoden: Wir führten eine Recherche in PubMed, Embase und dem Cochrane Central Register of Controlled Trials durch. Eingeschlossen waren randomisierte kontrollierte Studien (RCT), in denen der Einfluss von Stabilisierungsübungen auf Nackenschmerzen bewertet wurde. Zwei Untersucher führten unabhängig voneinander eine Recherche der Artikel durch, extrahierten Daten und bewerteten die Qualität der jeweiligen Studien. Die Metaanalyse wurde anhand des Ramdom-effects Modells durchgeführt.

Ergebnisse: In die Metaanalyse waren fünf randomisierte kontrollierte Studien (RCT) mit insgesamt 217 Patienten eingeschlossen. Im Vergleich zu den Therapien der Kontrollgruppen bei Nackenschmerzen hatten Stabilisierungsübungen keinen nennenswerten Einfluss auf die Schmerzintensität (Std. MD=-0,55; 95% CI=-1,24 bis 0,14; P=0,12), die Funktionseinschränkung der Nackenmuskulatur (NDI) (Std. MD=-0,44; 95% CI=-1,01 bis 0,13; P=0,13), die körperliche Gesundheit gemäß SF-36 (Std. MD=-0,18; 95% CI=-0,61 bis 0,26; P=0,43), die psychische Gesundheit gemäß SF-36 (Std. MD=-0,03; 95% CI=-0,47 bis 0,41; P=0,89), konnte aber den Wert der Depressionsskala

deutlich senken (Std. MD=-1,05; 95% CI=-1,59 bis -0,50; P=0,0002).

Schlussfolgerungen: Bei Patienten mit Nackenschmerzen zeigen Stabilisierungsübungen im Vergleich zu Therapien der Kontrollgruppen eine ähnliche Wirkung auf die Schmerzintensität, die Funktionseinschränkung der Nackenmuskulatur (NDI), die (SF-36) körperliche Gesundheit und die psychische Gesundheit (SF-36); Stabilisierungsübungen zeigten aber eine signifikante Reduktion auf der Depressionsskala.

Introduction

Neck pain is well known as one of the most common pain problems, and the reported prevalence ranges from 22–30 % [1–3]. It can result in significantly reduced quality of daily life and extensive use of healthcare resources [4–6]. Neck pain can be caused by a variety of factors such as the decreased strength and endurance capacity of cervical muscles, cervical disc herniation, cervical instability or trauma. The anatomic source and cause of neck pain is not clear in many patients, and the treatment plan is often designed based on clinical findings [7]. One widely accepted approach is to use "red flags" to identify potentially serious disease or classify non-serious conditions as "simple" or "non-specific" neck pain [8]. Neck pain is found to have important association with reduction in the strength and endurance capacity of cervical muscles [9, 10]. Certain muscles (e. g. deep and anterior cervical flexors) in the cervical spine tend to weaken in patients with neck pain [11]. For example, patients with cervicogenic headache symptoms have decreased maximal isometric strength and isometric endurance of the cervical flexor muscles [12].

Exercise is widely accepted for the rehabilitation of subjects with neck pain, and aims to gain muscle strength, flexibility and endurance, as well as restore injured tissues [1]. Exercise programs for managing neck pain are different with regard to duration, training frequency, intensity, and mode of exercise. Positive effects on neck pain is observed after the use of isometric exercises and strength training [13, 14]. Neck stabilization exercise has gradually emerged as an important rehabilitation programme to limit pain, maximize function, and prevent further injury [15, 16]. It is designed to obtain a stable, injury-free state for cervical spine [17, 18], and has gained great popularity in the treatment of back and pelvic pain [19–21].

However, the use of stabilization exercise for neck pain has not been well established. Recently, several studies on the topic have been published, and the results have been conflicting [8, 22–24]. Considering these inconsistent effects, we therefore conducted a narrative review and meta-analysis of RCTs to evaluate the efficacy of stabilization exercise for the alleviation of neck pain.

Materials and Methods

Ethical approval and patient consent are not required since this is a narrative review and meta-analysis of previously published studies. The narrative review and meta-analysis are conducted and reported in adherence to PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) [25].

Search strategy and study selection

Two investigators have independently searched the following databases (inception to June 2018): PubMed, Embase, and the Cochrane Register of Controlled Trials. The electronic search strategy is performed using with the following key words: stabilization exercise, and neck pain. We also have checked the reference lists of the screened full-text studies to Identify other potentially eligible trials.

The following inclusive selection criteria are applied: (i) population: women with neck pain; (ii) intervention: stabilization exercise in combination with physiotherapy or routine exercise; (iii) comparison: physiotherapy or routine exercise; and (iv) study design: RCT.

Data extraction and outcome measures

We have used a piloted data-extraction sheet, which covers the following information: first author, number of patients, age, female, body mass index (BMI), duration and detail methods in two groups. Data are extracted independently by two investigators, and discrepancies are resolved by consensus. We have contacted the corresponding author to obtain the data when necessary. No simplifications and assumptions are made.

The primary outcome is pain intensity. Secondary outcomes include neck disability index, SF-36 physical health, SF-36 mental health, and depression scale.

Quality assessment in individual studies

The Jadad Scale is used to evaluate the methodological quality of each RCT included in this meta-analysis [26]. This scale consists of three evaluation elements: randomization (0–2 points), blinding (0–2 points), dropouts and withdrawals (0–1 points). One point would be allocated to each element if they have been mentioned in article, and another one point would be given if the methods of randomization and/or blinding had been appropriately described. If the methods of randomization and/or blinding were inappropriate, or dropouts and withdrawals had not been recorded, then one point was deducted. The score of Jadad Scale varies from 0–5 points. An article with Jadad score ≤ 2 is considered to be of low quality. If the Jadad score ≥ 3, the study is thought to be of high quality [27].

Statistical analysis

We have estimated standard mean differences (Std. MDs) with 95 % confidence intervals (CIs) for continuous outcomes (pain intensity, neck disability index, SF-36 physical health, SF-36 mental health, and depression scale). A random-effects model is used regardless of heterogeneity. Heterogeneity is reported using the I^2 statistic, and $I^2 > 50$ % indicates significant heterogeneity [28]. Whenever significant heterogeneity is present, we search for potential sources of heterogeneity. Sensitivity analysis is performed to detect the

influence of a single study on the overall estimate via omitting one study in turn when necessary. Owing to the limited number (< 10) of included studies, publication bias is not assessed. Results are considered as statistically significant for P < 0.05. All statistical analyses are performed using Review Manager Version 5.3 (The Cochrane Collaboration, Software Update, Oxford, UK).

Results

Literature search, study characteristics and quality assessment

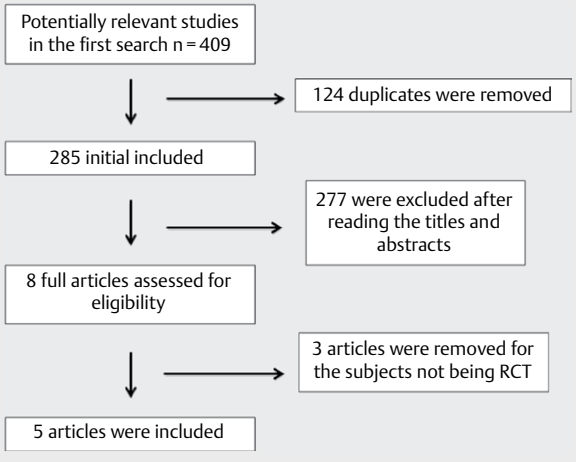
A detailed flowchart of the search and selection results is shown in ▶**Fig. 1**. 409 potentially relevant articles are identified initially. Finally, five RCTs that meet our inclusion criteria are included in the meta-analysis [8, 22–24, 29].

The main characteristics of the five included RCTs are presented in ▶**Table 1**. The five studies are published between 2009 and 2018, and sample sizes range from 31–74 with a total of 217. Four included RCTs report stabilization exercises as an adjunctive therapy to physiotherapy [22–24, 29], and the remaining RCT reports stabilization exercises as an adjunctive therapy to a general neck advice and exercise program [8].

Among the five RCTs, five studies have reported pain intensity, neck disability index [8, 22–24, 29], two studies have reported SF-36 physical health and SF-36 mental health [8, 22], and two studies have reported depression scale [24, 29]. Jadad scores of the five included studies vary from 3–5, and all five studies are considered to be high-quality ones according to quality assessment.

Primary outcome: pain intensity

This outcome data is analyzed with the random-effects model, and the pooled estimate of the five included RCTs suggested that compared to control group for neck pain, stabilization exercises has no significant influence on pain intensity (Std. MD = −0.55; 95 % CI = −1.24 to 0.14; P = 0.12), with significant heterogeneity among the studies (I^2 = 82 %, heterogeneity P = 0.0002, ▶**Fig. 2**).



▶**Fig. 1** Flow diagram of study searching and selection process.

Sensitivity analysis

Significant heterogeneity is observed among the included studies for the primary outcome. After performing sensitivity analysis by omitting one study in each turn, there is still significant heterogeneity.

Secondary outcomes

Compared to control group for neck pain, stabilization exercises shows no obvious impact on neck disability index (Std. MD = −0.44; 95 % CI = −1.01 to 0.13; P = 0.13; ▶**Fig. 3**), SF-36 physical health (Std. MD = −0.18; 95 % CI = −0.61 to 0.26; P = 0.43; ▶**Fig. 4**), SF-36 mental health (Std. MD = −0.03; 95 % CI = −0.47 to 0.41; P = 0.89; ▶**Fig. 5**), but is associated with significantly reduced depression scale (Std. MD = −1.05; 95 % CI = −1.59 to −0.50; P = 0.0002; ▶**Fig. 6**).

Discussion

Specific muscle dysfunction appears to be associated with pain, stabilization exercises have gained popularity in the conservative treatment of patients with spinal pain, but the evidence for the effectiveness of this approach is limited [30, 31]. Previous studies have reported that neck muscle training is effective to reduce the neck pain [32]. Physiotherapy programs are recommended to consist of active muscle training and a multi-modal treatment program including passive modalities for radicular symptoms [33, 34]. One review of exercises regarding mechanical neck problems concludes that exercises can relieve pain in the early stages of radiculopathy [35].

Previous literatures show controversial results on the effects of stabilization exercises on cervical problems. Cervical stabilization exercises with manual therapy demonstrates positive effects on pain level and quality of life [36]. Several studies investigating the effects of exercise on cervical symptoms report that both quality of life and disability scores are improved in the short-term, and symptoms tend to relapse after the treatment discontinuation [37, 38]. In contrast, no significant difference of grip strength is found between standard cervical exercises and other treatment protocol in patients with chronic neck pain [12].

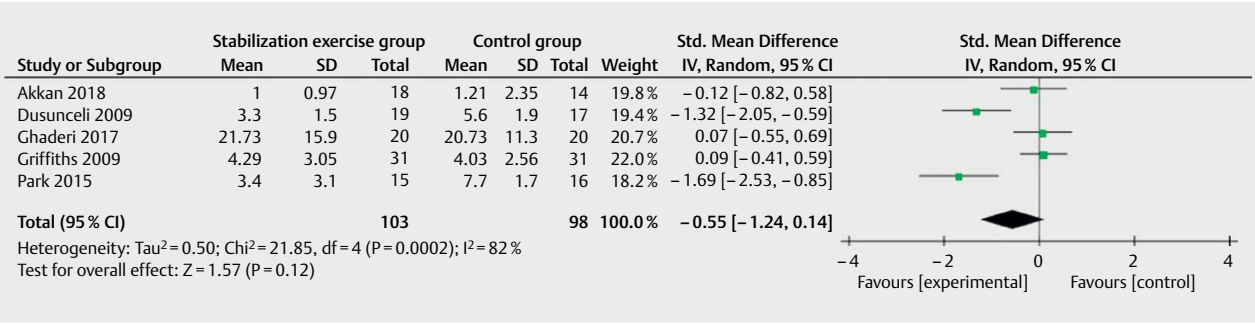
In two randomized trial of patients with cervicogenic headache, cervical stabilization exercises are found to improve neck pain and cervical muscle performance, but the specific effect of low-load endurance exercises is not compared with general exercises. The comparison of stabilization exercises and other exercise regimes remains doubtable in patients with neck pain [20]. In another RCT with regard to neck pain, stabilization exercises may be more effective in improving disability and pain control in relative to isometric and stretching exercises [29].

Our meta-analysis suggests that compared to control intervention for neck pain, stabilization exercises show no remarkable influence on pain intensity, neck disability index, SF-36 physical health and SF-36 mental health. It has been reported that depression is the most common condition among patients with neck and back pain, with the prevalence of 2.5–15.7 % [29]. Depression scale in stretching exercises group is significantly lower than that in control group for neck pain based on our results of this meta-analysis. Regarding the sensitivity analysis, there is still significant heterogeneity when performing the meta-analysis via omitting one study in each turn. There may be several reasons. Firstly, patients with

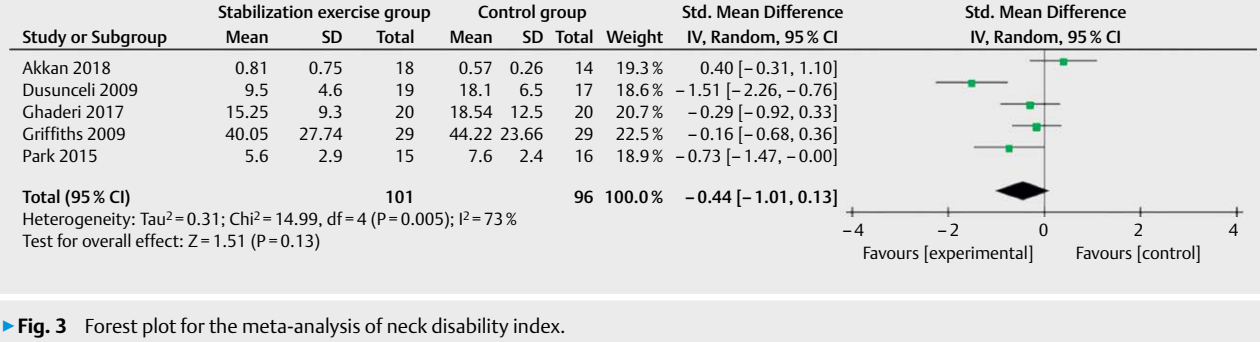
▶ **Table 1** Characteristics of included studies.

NO.	Author and publication year	Stabilization exercise group						Control group						Type of pain	Jada scores
		Number	Age (years)	Female (n)	BMI (kg/m2)	Duration (m)	Methods	Number	Age (years)	Female (n)	BMI (kg/m2)	Duration (m)	Methods		
1	Akkan 2018	18	40.44 ± 7.83	16	26.68 ± 5.21	-	stabilization exercises and standardized physiotherapy protocol	14	37.14 ± 9.81	13	26.22 ± 5.3	-	standardized physiotherapy protocol	cervical radiculopathy	4
2	Ghaderi 2017	20	35.97 ± 2.5	-	-	-	stabilization exercise and routine electrotherapy	20	36.346 ± 3.06	-	-	-	routine exercise and electrotherapy	nonspecific chronic neck pain	3
3	Park 2015	15	57.5 ± 6.7	2	23.3 ± 3.5	24.6 ± 12.1	cervical exercises for 30 min, 3 times/week for 6 weeks and physical therapy	16	62.86 ± 7.9	4	23.76 ± 3.3	20.2 ± 10.1	physical therapy	post-traumatic stress disorder	4
4	Griffiths 2009	37	51.1 ± 14.00	20	-	30 (median)	specific neck stabilization exercises with a general neck advice and exercise program	37	51.5 ± 13.6	26	-	24 (median)	a general neck advice and exercise program	chronic neck disorders	5
5	Dusunceli 2009	20	50.2 ± 4.8	14	-	45.0 ± 46.8	physical therapy agents + neck stabilization exercises	20	53.4 ± 6.8	12	-	43.2 ± 40.6	physical therapy agents	non-specific neck pain	4

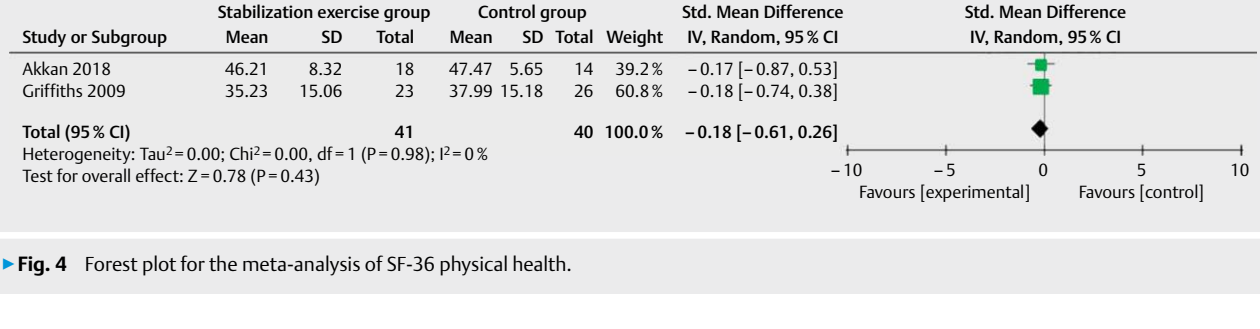
BMI, body mass index.



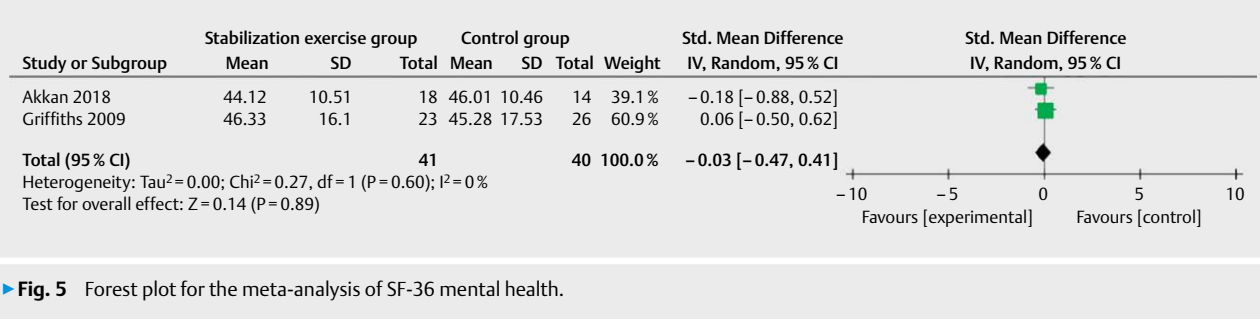
▶ **Fig. 2** Forest plot for the meta-analysis of pain intensity.



▶ **Fig. 3** Forest plot for the meta-analysis of neck disability index.



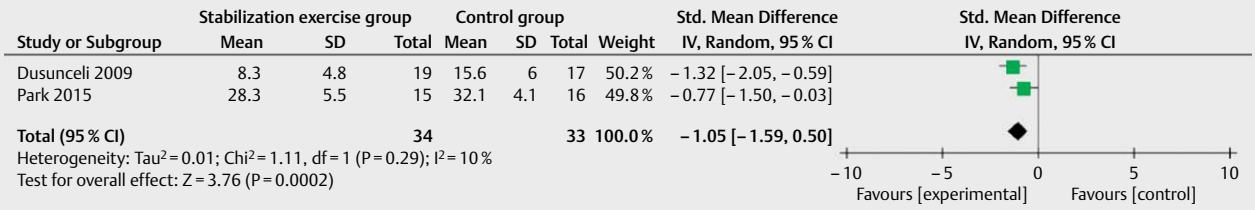
▶ **Fig. 4** Forest plot for the meta-analysis of SF-36 physical health.



▶ **Fig. 5** Forest plot for the meta-analysis of SF-36 mental health.

neck pain are caused by different factors including cervical radiculopathy, nonspecific chronic neck pain and post-traumatic stress disorder. Secondly, the detail methods of stabilization exercise group differ from the combination with physiotherapy or other exercise programs, and the duration time. Thirdly, the stabilization exercise is relatively complex and it may be difficult for patients for performing stabilization exercise. There is lack of strict measurements of administration of stabilization exercise.

This meta-analysis has several potential limitations that should be taken into account. First, our analysis is based on only five RCTs, and all of them have a small sample size (n < 100). Overestimation of the treatment effect is more likely in smaller trials compared with



▶ **Fig. 6** Forest plot for the meta-analysis of depression scale.

larger samples. Next, there is significant heterogeneity among this meta-analysis, possibly due to different methods and duration of stabilization exercises, as well as patients with various causes. Finally, some unpublished and missing data may lead bias to the pooled effect.

Conclusion

Stabilization exercises show no additional benefits for neck pain compared to control intervention.

Research Involving Human Participants and/or Animals

Not applicable.

Conflict of Interest

The authors declare no conflict of interest.

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