Original Article

Effectiveness of exercise therapy versus occlusal splint therapy for the treatment of painful temporomandibular disorders: a systematic review and meta-analysis

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Background: This systematic review of the literature was to compare the effects of exercise therapy and occlusal splint therapy on pain and mobility in individuals with painful temporomandibular disorders (TMD).

Methods: PubMed, Embase and the Cochrane Central Register of Controlled Trials were searched for English publications from database root to March 1, 2020. Search terms were [("temporomandibular joint disorders" or "temporomandibular disorders" or "craniomandibular disorders" or "orofacial pain" or "myofascial pain" or "myofascial pain" or "facial pain") AND (exercise or "physical therapy modalities" or physiotherapy or "exercise therapy") AND ("splints" or "occlusal splints" or "stabilization splint" or "occlusal appliance" or "occlusal splint therapy")]. We included randomized controlled trials that evaluated the effects of therapeutic exercise therapy and occlusal splint therapy, and were published in English. Trial quality was assessed with the Physiotherapy Evidence Database scale.

Results: Six studies were included (498 patients: 251 occlusal splint therapy, 247 therapeutic exercise). The results revealed that exercise therapy was not superior to occlusal splint therapy for pain reduction in patients with painful TMD (P=0.08; weighted standardized mean difference –0.29; 95% CI, –0.62 to 0.04). The effectiveness of occlusal splint therapy and exercise therapy was found to be equivalent in the maximum mouth-opening range (P=0.51; weighted standardized mean difference 0.12; 95% CI, –0.24 to 0.48), right laterotrusion (P=0.99; weighted standardized mean difference –0.00; 95% CI, –0.31 to 0.31), left laterotrusion (P=0.32; weighted standardized mean difference 0.16; 95% CI, –0.16 to 0.48), and protrusion (P=0.77; weighted standardized mean difference 0.06; 95% CI, –0.32 to 0.43) for painful TMD patients.

Conclusions: Given the limitations of the study, the small number of studies included in the sub-analysis for pain relief and the maximum mouth-opening range, and the small overall standardized mean difference for pain relief and mandibular movement observed, no high-quality evidence was found to distinguish the clinical effectiveness between occlusal splint therapy and exercise therapy for painful TMD patients. It appears that more randomized controlled trials comparing the effects of exercise therapy and occlusal splint therapy need to be implemented.

Keywords: Temporomandibular disorders (TMD); physiotherapy; occlusal splint therapy; systematic review; meta-analysis

Introduction

Temporomandibular disorders (TMD) are common chronic musculoskeletal pain conditions among orofacial pain, consisting of a group of conditions associated with pain and dysfunction of the temporomandibular joint (TMJ) and masticatory muscles (1). The main signs and symptoms are deviations or limitations during mouth opening, and pain in the TMJ, the masticatory muscles region (1). Pain is the most common reason patients seek TMD treatment, affecting approximately 10% of adults (2). Mandibular dysfunction such as limited mandibular movement may affect daily activities, resulting in lower quality of life, and therefore, the management of these TMD signs and symptoms is a major public health problem (3). Because the accurate etiology of TMD is unknown, conservative modalities are the preferred first-line treatment, and include counseling, medication, manual therapy, therapeutic exercise, and occlusal splint therapy among others (1). Many studies have identified the effectiveness of exercise therapy and occlusal splint therapy to relieve pain and increase mandibular movement for painful TMD (1,4-6).

Occlusal splint treatment is generally considered to be a basic treatment for TMD (5,7). It could promote correction of the vertical dimension, maxillo-mandibular realignment, TMJ repositioning and cognitive awareness (7-9). Although various different splints are currently available, the most commonly used are stabilization splints (9) and anterior repositioning splints (8). Scientific evidence indicates that stabilization splints reduce pain in patients with TMD in the short term, and the Michigan type can even be used to reduce moderate pain (9). There is less evidence for anterior repositioning splints compared with stabilization splints (8). Anterior repositioning splints are recommended for disc displacements to aid the disc to return to the original position (8). However, the anterior repositioning splint was reported to increase the risk for posterior open bite, and for discs that are unstable or that have not returned to the original position (8). The mechanism of action, indications, or adverse effects for each type are not fully clarified, neither are the best materials and designs (7).

Another conservative treatment option is exercise therapy, which is used to improve strength, mobility, coordination, and to reduce pain in the joints and muscles (10). Previous reviews have already dwelt on the effectiveness of exercise therapy in the treatment of TMD (11-13). In this review, therapeutic exercise modalities are defined as follows: muscle-strengthening exercise, stretching exercise, jaw-opening exercise, postural exercise, and mobilization exercise (10,12). Clinical and study-based outcomes have confirmed the effectiveness of therapeutic exercise modalities for the management of TMD due to improvements in local analgesia, muscle function, and restoration of local blood flow (10,14). As techniques in which patients learn to relieve pain and stress through exercise therapy could help avoid the use of an occlusal splint in the long term, it is necessary to compare the efficacy of therapeutic exercise therapy with occlusal splint therapy (12,13). To our knowledge, few data of reviews comparing the effectiveness of exercise therapy with occlusal splint therapy for the treatment of painful TMD have been reported (12,13). Armijo-Olivo *et al.* (12) conducted a systematic review and found no clear indication of superiority of exercise therapy versus other conservative treatments for TMD. A recent review concluded that the evidence level for prescribing exercises and occlusal splints in the treatment of painful TMD is low (13). Previous studies have provided inconclusive and controversial results; in addition, none of these systematic reviews provided a meta-analysis of the trials to investigate comparative effectiveness of exercise therapy and occlusal splint therapy for the treatment of painful TMD.

The purpose of this study was to compare the effectiveness of exercise therapy with occlusal splint therapy in relieving pain and improving mandibular movement for painful TMD treatment. Because patients are provided additional techniques to relieve pain and increase the mobility of the jaw through exercise therapy, we hypothesized that exercise therapy would be more effective than occlusal splint therapy for the management of those TMD symptoms.

We present the study in accordance with the PRISMA reporting checklist. Available at: http://dx.doi.org/10.21037/apm-21-451.

Methods

Data sources

This meta-analysis was registered in PROSPERO (CRD42019138207), and was performed in accordance with the Preferred Reporting Items for Systematic Review and Meta-analyses (PRISMA) statement. PubMed {database root [1968] – March 1, 2020}, Embase {database root [1988] – March 1, 2020}, and the Cochrane Central Register of Controlled Trials {database root [1991] – March 1, 2020} were independently searched by two of the researchers

(LZ and DDW). Search terms were used according to a combination of medical subject headings (MeSH) terms, text words, and keywords as follows: [("temporomandibular joint disorders" [MeSH] OR "temporomandibular disorders" OR "craniomandibular disorders" [MeSH] OR "orofacial pain" OR "myofascial pain" OR "myofascial pain" OR "facial pain" [MeSH]) AND (exercise [MeSH] OR "physical therapy modalities" [MeSH] OR physiotherapy OR "exercise therapy") AND ("splints" [MeSH] OR "occlusal splints" [MeSH] OR "stabilization splint" OR "occlusal appliance" OR "occlusal splint therapy")], which were chosen based on previous reviews (7,11). Only randomized control trials (RCTs) published in English were included in this meta-analysis. After a primary search, the reference lists of the relevant reviews and retrieved studies were also searched.

Study selection

The inclusion criteria for eligible articles were as follows.

Participants

This review restricted trials with participants meeting the following criteria: (I) diagnosis of TMD according to the RDC/TMD or any clinical diagnosis that involved symptoms and signs of TMD regardless of sex, or race (15); (II) adult (>18 years old); (III) muscle pain, TMJ pain, and/ or pain on movement of the mandible; (IV) musculoskeletal dysfunction; (V) no previous surgery in the TMJ, and (VI) no other serious comorbid conditions (e.g., neurological disease, rheumatologic disease, malignant disease).

Studies and outcomes

This review included RCTs that compared the effects of exercise therapy with occlusal splint therapy for the management of painful TMD. Studies that reported outcome measures of pain intensity and/or range of motion (ROM) were included. To truly investigate the therapeutic effects of exercise therapy and occlusal splint therapy, RCTs that compared occlusal splint therapy alone with therapeutic exercise were included. If there were two or more intervention groups (i.e., control/placebo groups) in a single study, only the occlusal splint therapy and exercise therapy group data were extracted for meta-analysis.

The exclusion criteria were as follows: (I) studies that were non-RCT, and non-peer reviewed articles, opinion articles, and papers not written in English; and (II) studies

that included TMD caused by psychogenic, neurologic, or metabolic disorders.

Data extraction and quality assessment

Two independent reviewers (LZ and DDW) performed the search and evaluated every potentially relevant article according to the criteria listed above after an original screening of titles and abstracts. Original data collected from the full text of the eligible articles were compiled in predesigned forms that included objectives, participants, intervention protocol, outcome measures, and results. Discrepancies were resolved by analyzing the reasons for disagreement to achieve a consensus among reviewers at each stage.

A meta-epidemiological study conducted by Moseley *et al.* (16) concluded that researchers could use either the Cochrane Risk of Bias tool or the Physiotherapy Evidence Database (PEDro) scale to quantify risk of bias, but the instruments cannot be used interchangeably. As this meta-analysis focused on trials evaluating physical therapy interventions, PEDro scale was used to evaluate the blinding of participants and therapists in this review (16). The PEDro scale included 11 items and was applied to evaluate the risk of bias and completeness of statistical reporting (17). Because the first item assesses external validity and is not calculated in the PEDro score, the score ranges from 0 (poor quality) to 10 (high quality).

Statistical analyses

The mean differences and standard deviations of each study were calculated using data extracted from the full text of the included articles. Data in this review were analyzed using RevMan5.3 (Cochrane Collaboration). The standardized mean differences with 95% confidence intervals for continuous data were summarized with a random-effect model. Statistical heterogeneity was assessed using the chi-square based Q test at a significance of 0.1. The I^2 statistic quantified inconsistency across trials as unimportant (0–40%), moderate (30–60%), substantial (50–90%), and considerable (75–100%) (18). A P value of <0.05 was considered to indicate statistical significance.

Patient and public involvement

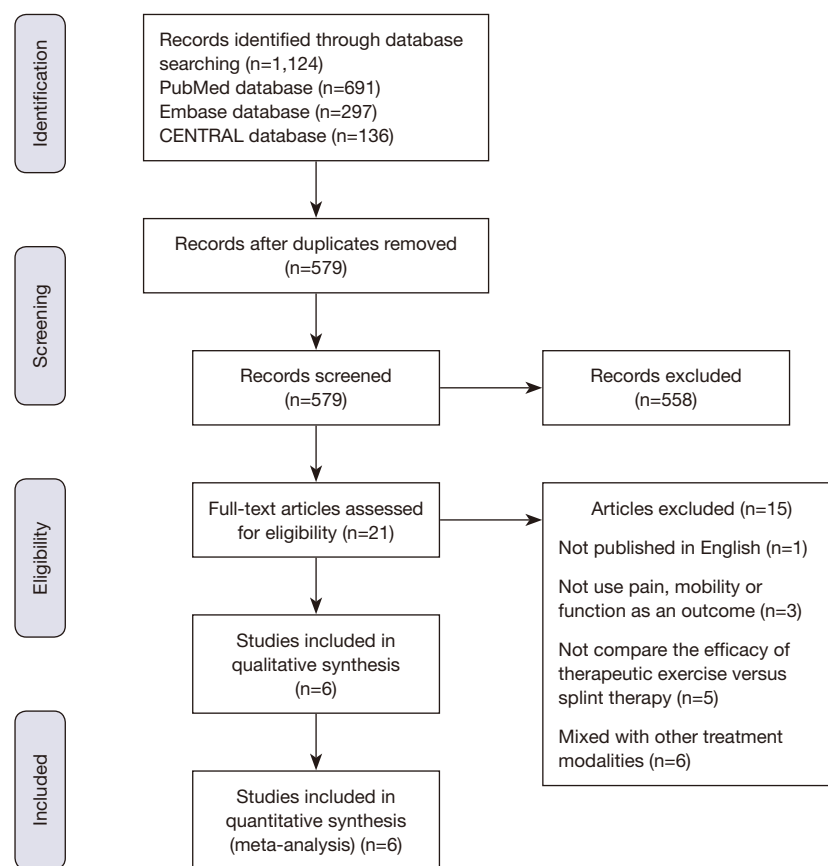This study did not include patient or public involvement.

Figure 1 Flow chart of studies screening process based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guideline.

Results

A total of 1,124 potentially relevant articles were identified. Of these, duplicated articles and articles which did not match the inclusion criteria were excluded after the initial screen of the titles and/or abstracts. Twenty-one articles that met the inclusion criteria were independently evaluated by the two reviewers. After screening the full text, 15 articles were excluded for the following reasons: published in Dutch, did not use pain and mandibular function as an outcome, did not compare the efficacy of therapeutic exercise and splint therapy, or included other treatment modalities. Finally, six RCTs met the inclusion criteria and were included in the meta-analysis (*Figure 1*) (19-24).

Characteristics of the included studies

Table 1 presents the details of the studies included in this review. A total of 498 participants were included, with 247

in the exercise therapy group and 251 in the occlusal splint therapy group. According to RDC/TMD criteria, five studies included patients with the diagnosis of myofascial pain (19,21-24), and the remaining study included patients with the diagnosis of myofascial pain (97–100%) and/or arthralgia (55–61%) (20). Exercise therapy was designed to restore normal musculoskeletal function and to reduce pain. In this review, exercise therapy programs were given by a physiotherapist and were divided into four categories: self-stretching exercise (20,22-24), jaw-opening exercises (19,21), postural exercise (20,22,23), and mobilization exercise (19,21). All patients in the exercise therapy received exercise therapy interventions under the instruction and supervision of the physiotherapist. In five included studies, patients in the splint therapy group received the stabilization splint (19-23), and the remaining study used a resilient bite splint (24). All six studies reported a similar prescription of an occlusal splint given by a dentist in which the splint was used while

Table 1 Data extracted from the included studies

Author/country/year	Objective	Patient group	Interventions	Outcome measures	Result	PEDro
Haketa et al./ Japan/2010	To evaluate the efficacy between two treatment options for TMD: occlusal splint and exercise	The exercise therapy group (n=26); the splint therapy group (n=26)	In the exercise group, participants performed self-mobilization exercise and jaw-opening exercises by 4 sets per day. Participants in the splint group wore a stabilization appliance while sleeping at night	1. Maximum mouth-opening range 2. Maximum daily pain intensity 3. Limitation of daily functions	Therapeutic exercise brings earlier recovery of jaw function compared with splints	8
Alejandro et al./ USA/2012	To evaluate treatment outcome of a jaw exercise regimen in comparison to that of the stabilization splint of TMD	The exercise therapy group (n=28); the splint therapy group (n=64)	Subjects in the jaw exercise group were instructed to open their jaw as far as possible without pain and hold the jaw in that position for five seconds, and then close their jaw and rest 10 seconds. Subjects assigned to the stabilization splint group were instructed to wear their splints every night	1. The Craniomandibular Index (CMI): severity of TMD signs and symptoms 2. Pain: VAS 3. The modified Symptom Severity Index Questionnaire	The jaw exercise was not found to be statistically significantly inferior to the stabilization splint	7
Katyayan et al./ India/2014	Io assess the efficacy of stabilization splint therapy and masticatory muscle exercises on TMD related facial pain and mandibular mobility	The masticatory muscle exercise group (n=40); the splint therapy group (n=40)	Patients were instructed to perform a standardized program for masticatory muscle exercises, including jaw-opening exercise, resistance exercise, and self-mobilization. The patients were instructed to wear the stabilization appliance while sleeping at night for a minimum of 12 h	1. The ranges of movements of the mandible 2. Deviations of movements 3. TMJ sounds 4. Masticatory muscle pain 5. TMJ pain	Stabilization splint treatment has no better results in relieving facial pain and increasing the mobility of the mandible than masticatory muscle exercises alone over a 6-months' time interval	8
Van Grootel et al./ Netherlands/2017	To evaluate treatment outcome of exercise therapy in comparison to that of splint therapy of myogenous TMD	The exercise therapy group (n=37); the splint therapy group (n=35)	Postural exercise and self-stretching of jaw-closing muscles were performed to avoid stress related pain from the masticatory system. The splint was used as much as possible, at least in the evening and overnight for a minimum of 10 to 12 h	1. Treatment duration 2. Success rate 3. Number of visits 4. VAS	Exercise therapy may be preferred as initial therapy over occlusal splint therapy in stepped-care of myogenous TMD	6
Tamer et al./ Egypt/2018	To compare the effects of a short-term exercise treatment versus occlusive splinting on pain and ROM in TMD patients	Exercise group (n=56); occlusive splinting group (n=56)	Exercise treatment included postural exercise and self-stretching for 15 min per session, 2 weekly for 6 weeks. Splinting was used daily for a period of 6 weeks	1. Pain: VAS 2. ROM: TMJ opening index (TOI)	Therapeutic exercise could be a better initial treatment than occlusive splint in relieving pain and improving ROM in cases of myogenic temporomandibular dysfunction	7
Wänman et al./ Sweden/2020	To evaluate the effect of exercise and bite splint therapy, respectively, in patients with TMD	The exercise group (n=60); bite splint group (n=30)	Patients in exercise therapy group were instructed to do two different trainings: jaw closing and opening movement and isometric exercises. Patients in the splint therapy group received a resilient bite splint that should be used during sleeping	1.The frequency of TMJ clicking sounds, TMJ locking 2. Jaw pain 3. Jaw function limitation scale-20 4. The Patient Global Impression of Change (PGIC)	Jaw exercise programmes and bite splint therapy had similar positive effects on perceived severity of TMJ clicking sounds	9

TMD, temporomandibular disorders; TMJ, temporomandibular joint; RCT, randomized controlled trial; ROM, range of motion; VAS, visual analogue scale; PEDro, Physiotherapy Evidence Database.
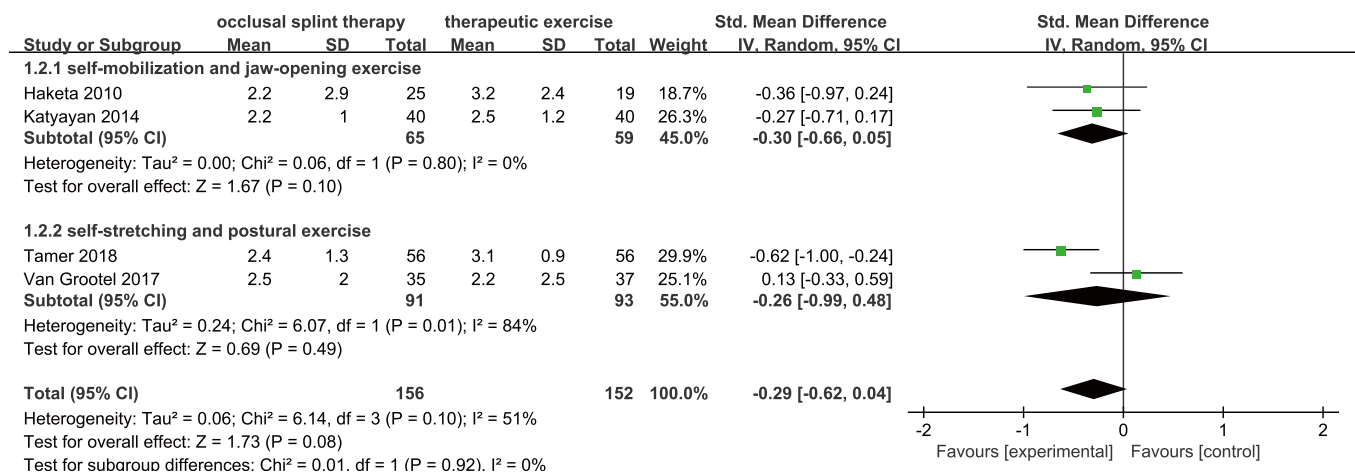
Study or Subgroup	occlusal splint therapy			therapeutic exercise			Weight	Std. Mean Difference IV, Random, 95% CI	Std. Mean Difference IV, Random, 95% CI
	Mean	SD	Total	Mean	SD	Total			
1.2.1 self-mobilization and jaw-opening exercise									
Haketa 2010	2.2	2.9	25	3.2	2.4	19	18.7%	-0.36 [-0.97, 0.24]	
Katyayan 2014	2.2	1	40	2.5	1.2	40	26.3%	-0.27 [-0.71, 0.17]	
Subtotal (95% CI)			65			59	45.0%	**-0.30 [-0.66, 0.05]**	

Heterogeneity: Tau² = 0.00; Chi² = 0.06, df = 1 (P = 0.80); I² = 0%
Test for overall effect: Z = 1.67 (P = 0.10)

1.2.2 self-stretching and postural exercise									
Tamer 2018	2.4	1.3	56	3.1	0.9	56	29.9%	-0.62 [-1.00, -0.24]	
Van Grootel 2017	2.5	2	35	2.2	2.5	37	25.1%	0.13 [-0.33, 0.59]	
Subtotal (95% CI)			91			93	55.0%	**-0.26 [-0.99, 0.48]**	

Heterogeneity: Tau² = 0.24; Chi² = 6.07, df = 1 (P = 0.01); I² = 84%
Test for overall effect: Z = 0.69 (P = 0.49)

Total (95% CI)			156			152	100.0%	**-0.29 [-0.62, 0.04]**	

Heterogeneity: Tau² = 0.06; Chi² = 6.14, df = 3 (P = 0.10); I² = 51%
Test for overall effect: Z = 1.73 (P = 0.08)
Test for subgroup differences: Chi² = 0.01, df = 1 (P = 0.92), I² = 0%

Figure 2 Forest plot of comparison: occlusal splint therapy *vs.* exercise therapy, outcome: pain relief.

sleeping at night. Recommendations for the duration of wearing the splint varied, with four studies that required patients to wear the splint as much as possible (19,21,22,24). and the other two studies required patients to wear the splint for 4–6 weeks (20,23). All included studies reported similarities in the baseline comparisons of TMD symptoms between exercise therapy group and occlusal splint therapy group.

Outcome measures

Five studies reported measurements of pain intensity, and the intensity of the present facial pain was measured with the Visual Analog Scale (VAS) (19-23). Three studies reported the performance of a clinical examination focusing on the ranges of movement of the mandible and deviations of movements (19,21,24). In addition to the measurement of maximum mouth-opening range, Katyayan *et al.* (21) and Wänman *et al.* (24) also reported the measurement of right lateral excursion, left lateral excursion, and protrusion.

Methodologic quality

The methodologic quality of the included RCTs varied. Assessment with the PEDro scale (*Table 1*) revealed that five of the six included studies were shown to have strong methodologic quality (scores higher than 6).

Effects on pain relief

Figure 2 showed the standardized mean differences between

the occlusal splint therapy and exercise therapy groups regarding the effects on pain. Pain intensity was reported in two studies of subgroup 1 using self-mobilization exercise and jaw-opening exercise showing unimportant heterogeneity (I^2=0%; P=0.80), and two other RCTs of subgroup 2 using self-stretching exercise and postural exercise showed substantial heterogeneity (I^2=84%; P=0.01). Additionally, overall heterogeneity for this outcome was moderate (I^2=51%; P=0.10), with unimportant heterogeneity observed among subgroups (I^2=0%; P=0.92). The findings suggested that there were no significant differences in pain relief between occlusal splint therapy and physiotherapy (P=0.08; weighted standardized mean difference –0.29; 95% CI, –0.62 to 0.04).

Effects on maximum mouth-opening range

Figure 3 demonstrated the standardized mean differences between the occlusal splint therapy and exercise therapy groups regarding the effects on maximum mouth-opening range. Subgroup 1 using the stabilization splint showed substantial heterogeneity (I^2=69%; P=0.07), and one RCT of subgroup 2 using the resilient bite splint reported this outcome. Additionally, overall heterogeneity for this outcome was moderate (I^2=40%; P=0.19), with unimportant heterogeneity observed among subgroups (I^2=0%; P=0.72). The findings suggested that there were no significant differences for maximum mouth-opening range between occlusal splint therapy and exercise therapy (P=0.51; weighted standardized mean difference 0.12; 95% CI, –0.24 to 0.48).
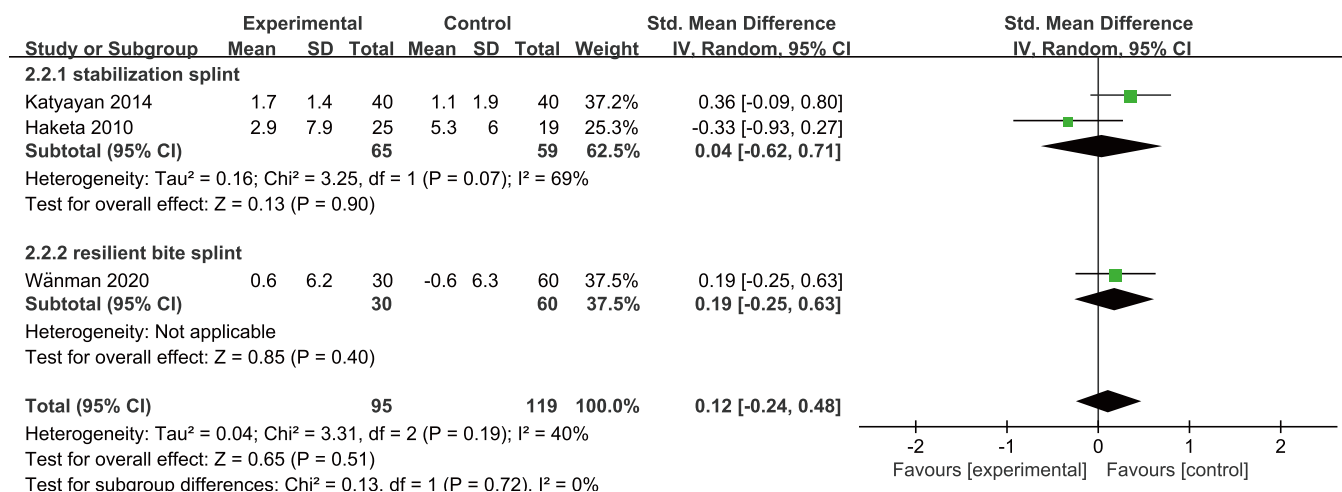
Figure 3 Forest plot of comparison: occlusal splint therapy *vs.* exercise therapy, outcome: maximum mouth-opening range.

Effects on laterotrusion and protrusion

Figure 4 shows the standardized mean differences between the occlusal splint therapy and exercise therapy groups regarding the effects on laterotrusion and protrusion. The findings suggested that there was a non-significant difference for right laterotrusion (P=0.99; weighted standardized mean difference –0.00; 95% CI, –0.31 to 0.31, I^2=0%), left laterotrusion (P=0.32; weighted standardized mean difference 0.16; 95% CI, –0.16 to 0.48; I^2=4%), and protrusion (P=0.77; weighted standardized mean difference 0.06; 95% CI, –0.32 to 0.43; I^2=31%).

Discussion

Conservative measures are recommended as initial therapy for painful TMD. The evaluation of TMD symptoms such as pain and mandibular movement is essential for the management of TMD patients, as pain is one of the clinical symptoms of TMD, and one of main reasons for patients seeking treatment and assistance. In this review, the hypothesis was not met, there was no significant difference in pain relief and mandibular ROM improvement between exercise therapy and occlusal splint therapy for patients with painful TMD.

Treatment strategies for exercise therapy and occlusal splint therapy are founded on non-invasive, reversible interventions (13). List *et al.* (25) concluded that conservative treatment including exercise therapy and occlusal splint therapy could effectively relieve TMD pain and increase jaw opening. Previously, the efficacy of exercise therapy versus occlusal splint therapy for TMD has been controversial (12,13). Some authors suggested that therapeutic exercises under supervision of the physiotherapist had an additional effect on patient's well-being and thus might help to encourage patient's coping strategies, which may be associated with the superiority of exercise therapy over occlusal splint therapy (10,11). Although in this review, patients in the exercise therapy group received exercises under supervision of the physiotherapist, the results of the present review are in accordance with other studies; no significant difference was found for pain relief between exercise therapy and occlusal splint therapy (12,13). One possible explanation for this disconcordance could be the difference of included participants in the studies. The present review included patients with myofascial pain and/ or arthralgia. It has been found that patients with pain in the TMJ, the masticatory muscles region receive less benefit from exercise therapy compared with patients with mandibular dysfunction (19). Differences in the treatment outcome could be due to the heterogeneity of the patient psychological and material factors (26), however, this possible heterogeneity could not be taken account into this review. Sample sizes vary across studies, which may also explain why some studies have shown the superiority of exercise therapy compared with occlusal splint therapy. Due to these diverse opinions, further RCTs to identify comparative effectiveness of exercise therapy and occlusal splint therapy are obviously required. The finding of the present meta-analysis demonstrated that no significant
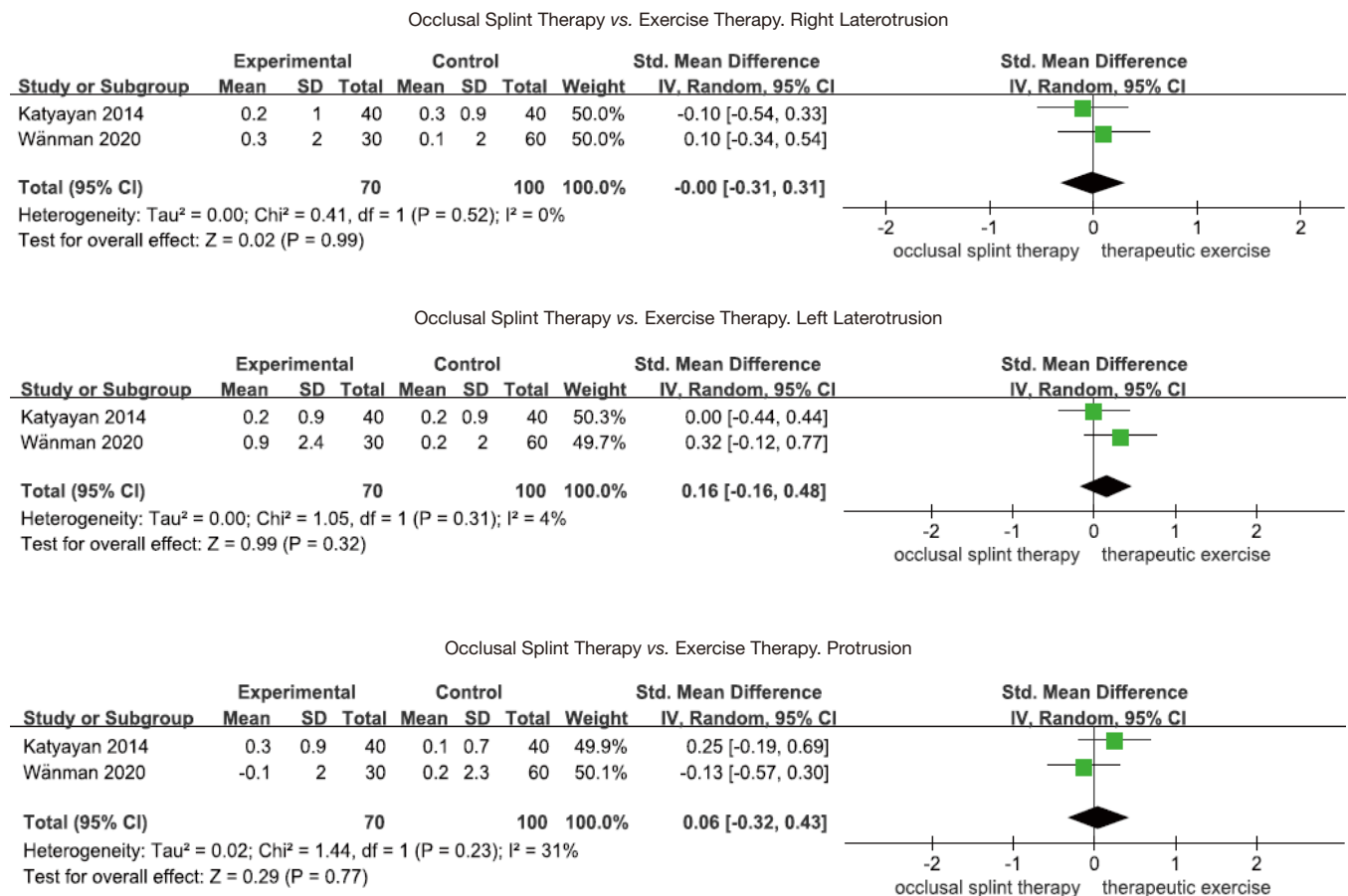
Figure 4 Forest plot of comparison: occlusal splint therapy *vs.* exercise therapy, outcome: laterotrusion and protrusion.

difference was found for mandibular movement between the two treatment modalities. Our results are in line with previous studies on TMD patients that concluded that exercise therapy and occlusal splint therapy had similar positive effects on the improvement of mandibular ROM (4,12). Given the small number of studies included in the sub-analysis for pain relief and mobility improvement, and the small overall standardized mean difference observed, these results have to be interpreted with caution. There was a high risk of bias in 3 of the studies with no blinding of participants (17,19,20). Many patients across the studies were lost to follow-up (19,21,22). Findings of the present study are not generalizable, and further meta-analyses and studies are needed before adopting these findings in clinical practice.

Therapeutic exercise has an activating approach with the aim to reduce sensory features and muscle tension around the jaw, and to mobilize and challenge dysfunction and pain

(12,27). Various mechanisms by which exercise therapy improves TMD symptoms have been explored (28,29). Patients with painful TMD exhibited reduced blood flow to the masseter muscles, mainly caused by vasoconstriction that resulted from hyperactivity of the muscles (28). Consequently, the transport of metabolites and nutrients was impeded, which could cause the accumulation of by-products, thereby triggering pain (29). Mobilization was applied to stimulate parasympathetic activity, which could increase local blood flow, and lead to an analgesic effect based on the activation of a pain-gate mechanism (30). Stretching of the jaw muscles could lead to a reduction in the symptoms of TMD as well as an improvement in mandibular function (13). In addition, the neuromuscular, vascular, and rehabilitationary benefits of jaw exercise and posture correction exercise for TMD patients have been reported in previous studies (31,32). The positive effect of relieving pain and improving mandibular mobility may thus be assigned to the exercise therapy for patients with

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painful TMD.

The use of occlusal splints for patients with TMD is common in dentistry (7,8). The comprehensive treatment effect of occlusal splints on TMD has been reported to be 70–75% (5). The occlusal splint has a fundamental intention to alter the biomechanical loading on the TMJ and to decrease parafunctional activity (7). An occlusal splint could change the position of the TMJ by increasing the vertical dimension of the mouth (8). Furthermore, occlusal splint therapy affected motor control by changing the activity patterns of the jaw-closing muscles (33). The reduction in the electrical activity of the masticatory muscles might explain the mechanism for the therapeutic effects of occlusal splint therapy (34). Some researchers suggested that only immediate reductions in electromyographic activity are achieved after occlusal splint therapy; however, after long-term use of occlusal splints, no reductions occur due to the adaptive mechanisms of the muscles (34,35). Alajbeg *et al.* (36) reported that stabilization splints resulted in a significant decrease in pain intensity compared with other devices. Considering disc displacements, anterior repositioning splints were able to return discs to their original position for those with anterior disc displacement with reduction, but they were not applicable for those with anterior disc displacement without reduction (8). However, there is no high-quality evidence to determine the mechanism of occlusal splints and to make decisions regarding the indications for each type. According to the findings of this review, occlusal splints have been recommended to use during sleep in TMD patients, but there is still controversy about the duration of wearing the splint.

Some limitations of this review should be addressed. First, given the difference in subtype included in the RDC/TMD diagnostic criteria, treating all patients with TMD as if they would respond the same to any intervention is not ideal. Second, only six studies with 498 patients were included in this analysis. Third, other data sources such as SCI-E or Scopus which could have increased the number and quality of the retrieved RCTs were not considered in this review. The findings were not definitive and generalizable due to the small number of included studies, and should be interpreted with caution. Further study is necessary before adopting these findings in clinical practice.

Conclusions

The effectiveness of occlusal splint therapy and exercise therapy was equivalent in pain relief and improvement of mandibular movement for painful TMD patients; exercises did not show clear superiority over occlusal splints for treating painful TMD. Given the limitations of the study, no high-quality evidence was found, indicating that there is great uncertainty about the effectiveness of exercise therapy versus occlusal splint therapy for TMD. It appears that high-quality, large-scale, and well-designed RCTs that determine the diagnostic criteria for TMD and isolate the type of exercise and occlusal splint are needed to compare the effects of exercise therapy and occlusal splint therapy for the management of TMD.

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Footnote

Reporting Checklist: The authors have completed the PRISMA reporting checklist. Available at http://dx.doi.org/10.21037/apm-21-451

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Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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