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Review Article

Effects of Eye Movement Desensitization and Reprocessing (EMDR) Treatment in Chronic Pain Patients: A Systematic Review

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Abstract

Objective. This study systematically reviewed the evidence regarding the effects of eye movement desensitization and reprocessing (EMDR) therapy for treating chronic pain.

Design. Systematic review.

Methods. We screened MEDLINE, EMBASE, the Cochrane Library, CINHAL Plus, Web of Science, PsycINFO, PSYNDEX, the Francine Shapiro Library, and citations of original studies and reviews. All studies using EMDR for treating chronic pain were eligible for inclusion in the present study. The main outcomes were pain intensity, disability, and negative mood (depression and anxiety). The effects were described as standardized mean differences.

Results. Two controlled trials with a total of 80 subjects and 10 observational studies with 116 subjects met the inclusion criteria. All of these studies assessed pain intensity. In addition, five studies measured disability, eight studies depression, and five studies anxiety. Controlled trials demonstrated significant improvements in pain intensity with high effect sizes (Hedges' g: –6.87 [95% confidence interval (CI_{95}): –8.51, –5.23] and –1.12 [CI_{95}: –1.82, –0.42]). The pretreatment/posttreatment effect size calculations of the observational studies revealed that the effect sizes varied considerably, ranging from Hedges' g values of –0.24 (CI_{95}: –0.88, 0.40) to –5.86 (CI_{95}: –10.12, –1.60) for reductions in pain intensity, –0.34 (CI_{95}: –1.27, 0.59) to –3.69 (CI_{95}: –24.66, 17.28) for improvements in disability, –0.57 (CI_{95}: –1.47, 0.32) to –1.47 (CI_{95}: –3.18, 0.25) for improvements in depressive symptoms, and –0.59 (CI_{95}: –1.05, 0.13) to –1.10 (CI_{95}: –2.68, 0.48) for anxiety. Follow-up assessments showed maintained improvements. No adverse events were reported.

Conclusions. Although the results of our study suggest that EMDR may be a safe and promising treatment option in chronic pain conditions, the small number of high-quality studies leads to insufficient evidence for definite treatment recommendations.

Key Words. Eye Movement Desensitization and Reprocessing (EMDR); Chronic Pain; Treatment; Systematic Review

Introduction

Psychosocial treatment is an important pillar in the treatment of chronic pain [1]. Unfortunately, the majority of the psychosocial approaches to the treatment of chronic pain are characterized by insufficient effects on pain intensity and only low to moderate effect sizes for disability and coping [1,2]. Cognitive behavioral therapy (CBT) as the most common and successful psychological approach in treating pain is effective in reducing disability and catastrophizing, whereas the effects on pain intensity are negligible compared with active controls [1]. Given this currently relatively modest level of efficacy, uncertainty regarding the persistence of treatment effects [1] and the

high social and economic costs of this condition [3], exploration of new treatment methods is warranted.

Growing evidence suggests that eye movement desensitization and reprocessing (EMDR) treatment may benefit patients with somatic symptoms. A systematic review on EMDR in the treatment of medical unexplained symptoms concluded that EMDR might be an effective treatment in such patients. However, this review did not specifically focus on pain patients. Moreover, since then, further progress has been made in this area. Accordingly, the current status of EMDR in the treatment of chronic pain is unclear [4].

EMDR initially originated as a treatment for posttraumatic stress disorder (PTSD) [5] and rapidly became an empirically validated treatment for this condition [6–9]. It is a structured psychotherapy and combines the use of well-established psychotherapeutic methods (including imaginal exposure, cognitive, and self-control techniques) with the use of specific EMDR elements like bilateral sensory stimulation (e.g., eye movements or bilateral hand tapping induced by the therapists fingers) and the dual focus of attention principle [10,11]. According to the dual focus of attention principle, focusing on memories actually causing affective distress at the same time as attending to a dual sensory attention stimulus (e.g., eye movements), the EMDR procedure facilitates information processing of emotional distressing material (e.g., trauma and pain).

Although EMDR was originally developed for individuals who had experienced psychological trauma, the neurobiological similarities found in patients who suffered from PTSD and chronic pain disorders [12] encouraged scientists to explore the utilization of EMDR in the treatment of chronic pain, even in the absence of psychological trauma.

In the treatment of chronic pain, EMDR interventions seek especially to alter the patient's cognitive, affective, and somatic symptoms related to pain and to identify internal resources that may provide relief [10,11]. This is done in a standardized eight-step protocol that includes recall of relevant distressing memories while patients are receiving bilateral sensory input (dual focus of attention). After treatment planning and preparation, each session is structured in the way that at first identification of a distressing pain-related memory ("target") is conducted, and secondly desensitization of this target is initiated through focusing synchronously on these distressing memories at the same time as attending to the bilateral sensory attention stimulus (e.g., eye movements). Possible targets for processing may be disturbing pain-related or traumatic memories, current pain perceptions or stressful situations, as well as future painful or stressful situations. Depending on what targets are to be reprocessed, different protocols (standard protocol and pain specific protocols) are available. During the standard EMDR protocol ("standard protocol" [11]), patients are instructed to concentrate on a disturbing pain-related or traumatic memory and the associated thoughts, feelings, and somatic perceptions while focusing on an external bilateral stimulus. For the direct processing of pain conditions, also modified pain-specific EMDR "pain protocols" (e.g., Grant [10]) can be used in which current or antecedent pain sensations itself are targeted.

Typically, the client reports at the end of each set of bilateral stimulation, new or changed emotions, cognitions, physical sensations, imagery, or other experiences. Subsequent sets of bilateral stimulation focus on new targets that have come into the client's awareness at the end of the previous set. This new material is targeted and followed until the client again reports a stable resolution. The desensitization phase continues until the client no longer reports any disturbance associated with the original targeted experience. As a rule, each session closures with a final stabilization techniques (e.g., safe-place imagery).

The concept of EMDR is based on the adaptive information processing model, which posits that past traumatic experiences are involved in triggering the present pathology, which is represented by different psychological symptoms, such as fear and emotional distress, as well as physical sensations, such as pain [13,14]. Those previous traumatic or painful memories may result in an augmented pain response to present stimuli, although these stimuli may not be painful in nature. Repeated exposure to painful stimuli and/or traumatic experiences may induce a complex series of neuroplastic processes at the corticolimbic levels that transduce information coming from either the inside of one's own body or from the environment into cellular memory [15]. It has been hypothesized that a distinct effect of EMDR treatment may be desensitization of the limbically augmented portion of the pain experience [16,17].

There has been an increasing amount of literature regarding the use of EMDR in the treatment of chronic pain in recent years. This review aims to systematically summarize the current evidence regarding the use of EMDR in the treatment of chronic pain and to discuss the implications and conclusions that can be drawn from it.

Methods

Procedures

This review was performed in accordance with the recommendations of the Cochrane Collaboration [18] and is reported in accordance with the preferred reporting items for systematic reviews and meta-analyses statement [19]. All of the steps and methods used in this review were specified in advance in a predetermined review protocol that was developed using RevMan software (Version 5.2, the Cochrane Collaboration Copenhagen, Denmark; the detailed protocol is available upon request from the corresponding author).

We searched MEDLINE (January 1966–April 2013), EMBASE (January 1980–April 2013), the Cochrane

Library, CINHAL Plus (January 1937–April 2013), Web of Science, PsycINFO, PSYNDEX, and the Francine Shapiro Library to find relevant studies. The search strategy was adapted for each database as necessary (see the web appendix for the complete search strategy). Additionally, reviews regarding the use of EMDR in pain patients were screened to identify relevant studies. Complete publications were retrieved for all of the promising abstracts identified. In addition, the references cited by promising articles were scrutinized, and a citation search was performed on the included articles. We also searched the trial registries on ClinicalTrials.gov and the World Health Organization International Clinical Trials Registry Platform to identify ongoing trials, but no ongoing trials were found. Searches were performed independently by two reviewers (J. T. and S. L.) without language restriction.

The two reviewers independently scanned the titles and abstracts of the eligible studies. Both reviewers independently scanned the full-text articles to determine whether the articles met the selection criteria. Disagreements between the two reviewers were resolved by discussion, and if agreements between the two reviewers could not be reached, a third reviewer was consulted.

Eligibility Criteria

As the number of controlled trials examining the use of EMDR in patients suffering from pain was limited, we decided to summarize the best evidence currently available. Accordingly, in addition to controlled trials, we also screened for all published before-after studies examining the use of EMDR in the treatment of chronic pain.

Studies were included in the analysis if they: 1) were available as a full publication or report of a prospective intervention, 2) in which pain reduction was an outcome of the intervention, 3) had a design that used EMDR treatment as an active treatment of primary interest, 4) were conducted with a well-defined cohort of chronic pain patients, and 5) included more than two subjects. Due to the high risk of bias, case reports describing single patients were not included in the analysis. Relevant data from each study were transferred into a data extraction form that was created for this review.

Data Collection and Outcomes

Two reviewers (J. T. and S. L.) independently extracted data using a prespecified data extraction form. All discrepancies were double checked, and if disagreements between the two reviewers arose, a third reviewer was consulted. Data regarding the descriptive characteristics of the participants and characteristics of the treatments, including the treatment setting, EMDR protocol applied, EMDR targets used, mode of delivery, and therapist, were collected. Following the recommendations of initiative on methods, measurement and pain assessment in clinical trails [20], data were collected for this review on outcomes in the domains of: 1) pain experience, 2) disability, and 3) negative mood (including depression and anxiety). Additionally, all publications were screened for adverse events and safety aspects. All outcomes were recorded and, if possible, based on the pretreatment and posttreatment and follow-up means described as standardized effect sizes.

Risk of Bias Assessment

A comprehensive assessment tool referred to as the Platinum Standard [21] identified relevant criteria to guide the evaluation of EMDR studies and was specifically designed to evaluate effectiveness in EMDR research (see also web appendix for the distinct items). It was favored against the risk of bias assessment of the Cochrane Collaboration because it includes more comprehensive quality criteria according to the CONSORT statement for reporting of trials of nonpharmacologic treatments [20,22]. The Platinum Standard includes 13 comprehensive criteria for assessing research designs looking at EMDR efficacy. In addition to the study design, this assessment tool takes treatment-specific aspects of EMDR into consideration. It evaluates different criteria based on signaling questions separately. These criteria included the following: (item #1) clearly defined target symptoms, (item #2) reliable and valid measures, (item #3) use of blind evaluators, (item #4) information regarding an assessor's training, (item #5) manualized, replicable, and specific treatment, (item #6) random assignment, (item #7) treatment adherence, (item #8) nonconfounded conditions, (item #9) use of multimodal measures, (item #10) length of treatment, (item #11) level of therapist training, (item #12) use of a control group, and (item #13) effect size reporting. Criteria were classified as follows: "✓," criteria fully met, "♦," criteria partially met, or "✗," criteria not met (see web appendix for detailed assessment criteria). According to the Cochrane recommendations [18], to guarantee validity and transparency, no sum score was calculated, but the results were reported descriptively for each criterion.

Statistical Analyses

Multiple measurements were typically used in each trial. For the evaluation of relevant treatment effects, three outcomes were identified and labeled as "*pain*," "*disability*," and "*mood*." Although standard trial reporting guidance promotes the definition of primary outcomes [20,22], most trials did not state a single or preferred a priori primary outcome, so a judgment had to be made. From each trial, we selected the measure considered to be most appropriate for each of the three outcomes. When there was more than one measure for an outcome, we gave preference to the measure that had documented frequent usage in the field as opposed to a novel or unvalidated measure.

The primary data type was measurement using continuous scales. Due to the low number of studies and the high heterogeneity regarding patient groups (e.g., headache and fibromyalgia), length of treatment, and other factors (sex, age, and the type of EMDR

protocol used), we abstained from combining different studies in a meta-analysis and reported the results descriptively instead.

We estimated treatment effects using standardized mean differences by extracting the means, standard deviations, and sample sizes. For the controlled trials, the standardized mean differences were calculated as Hedges' g using posttreatment data from the comparison groups (with negative values favoring EMDR intervention). For the observational studies, the effect sizes were calculated based on the means and pooled standard deviations of the pretreatment and posttreatment data [23] to provide estimates of the relative sizes of the treatment effects. Algebraic signs were adapted so that negative values indicated improvement. When the standard deviation was not reported, the standard deviation was estimated based on the average of the remaining study results (Cochrane Handbook, Chapter 16.1.3.1 [18]). In the cases in which different follow-up time points were assessed, the longest follow-up assessment period available was chosen. Cohen's categories were used to evaluate the magnitude of the effect size, with a Hedges' g <0.5 indicating a small effect size, a Hedges' g ranging from 0.5 to 0.8 indicating a moderate effect size, and Hedges' g >0.8 indicating a large effect size [18]. All calculations were performed using RevMan software (Version 5.2).

Results

An initial database search identified 3,631 studies (Figure 1). After adjusting for duplicates, 2,211 studies remained. Of these studies, 2,065 studies were discarded after reviewing the abstracts because both reviewers agreed that these papers did not meet the inclusion criteria. The full text of the remaining 146 citations was examined in more detail (see the web appendix). Of these 146 potentially relevant citations, 118 were excluded because they did not contain original scientific data (e.g., reviews, manuals, narrative reports, and newsletters). Of the remaining 28 citations, 12 referred to single case reports and were therefore not included in the final analysis. In addition, five studies provided insufficient information [17,24–27]. We contacted the corresponding authors or associated institutions (e.g., university departments) of these five potentially relevant studies in an effort to obtain the missing information, of which one author provided sufficient data [27]. The remaining four studies were excluded due to insufficient information.

Characteristics of the Included Studies

In total, two controlled trials [14,28] that consisted of a total of 80 patients (74 women and 6 men), as well as 10 observational studies [16,27,29–36] that treated 116 patients (76 women, 35 men, and 5 patients whose

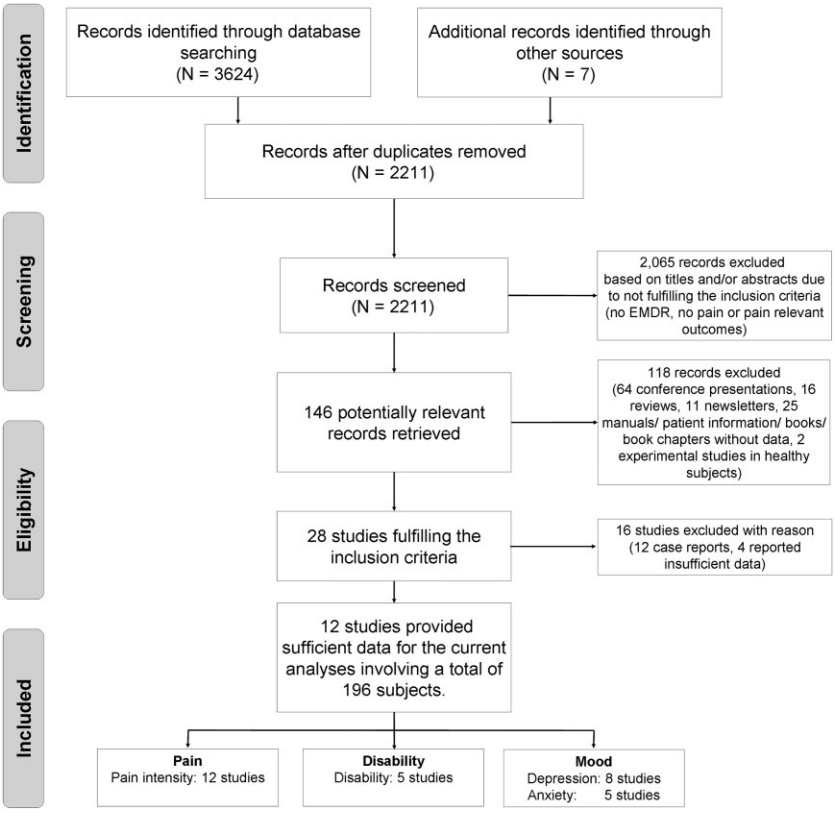

Figure 1 Preferred reporting items for systematic reviews and meta-analyses (PRISMA, [19]) flow diagram for search strategy. Study selection process. EMDR = eye movement desensitization and reprocessing.

gender was not reported), met the inclusion criteria (Figure 1). The included studies differed considerably in lengths of treatment, protocols used, and sample selection criteria (Table 1).

Three studies assessed phantom limb pain (PLP) [33,34,36], two studies assessed headache (including migraine) [28,32], three studies assessed musculoskeletal pain (not further specified) [29,31,35], and two studies examined fibromyalgia [27,30]. A mixed sample of chronic pain patients, consisting of headache, fibromyalgia, and neuropathic pain, was assessed by Mazzola et al. [16], whereas the sample of chronic pain patients in the study performed by Estergard [14] was not described in more detail (Table 1).

Different types of EMDR targets were distinguished after assessing the EMDR protocols used by the authors. The protocols used in seven studies were based on the standard EMDR protocol [14,27,29,33–36], four of which used a combination of the standard protocol and a standardized pain-specific EMDR protocol (developed and published by Grant [10]) [27,29,35,36], and one of which used the standardized pain-specific EMDR protocol only [16]. Four studies used self-developed EMDR treatment protocols [28,30–32]. The protocol used by Marcus [28] did not entail specific targets, but combined slow eye movements in a figure eight pattern with diaphragmatic breathing and compression with the hands to the frontal and occipital cranial areas. Hassard [31] mentioned that he had no direct training in EMDR, but had based the procedure on published EMDR descriptions without providing more detailed information regarding the targets or EMDR procedure.

The number of sessions was predefined in only half of the studies [14,16,28–30,35], whereas the other half were characterized by a variable number of treatment sessions that depended upon treatment success [27,31–34,36]. In the prespecified studies, the number of treatments varied from one session [28] to 12 sessions [16]. Notably, in those studies in which the number of treatment sessions was not preset and was based on treatment success, the mean number of treatment sessions ranged from five [34] to seven [33] sessions per patient for PLP (range 3–15), four sessions for musculoskeletal pain (range 1–11) [31], and eight sessions for headache [32] (range not reported). The Hassard study [31] was originally intended with a higher dose, but the study ended prematurely when the leading study therapist left the program.

Results from the Controlled Trials

The two controlled trials available were characterized by significant effects and high effect sizes compared with the control groups (Table 2). Although both the standard care medication group and the EMDR treatment group displayed reduced pain levels in the study performed by Marcus [28], EMDR intervention reduced or eliminated migraine pain with greater rapidity and showed significant improvement compared with standard care medication, as indicated by a Hedges' g of –6.87 (95% confidence interval [CI_{95}]: –8.51, –5.23). The study performed by Estergard [14] using a matched two-group, wait-control design resulted in a Hedges' g of –1.12 (CI_{95}: –1.82, –0.42).

Results from Pretreament/Posttreatment Observational Studies

The results of all of the observational studies assessing improvements in pain intensity are summarized in Figure 2 and Table 3.

Effects on Pain Intensity

All of the observational studies reported pain intensity outcomes (Figure 2 and Table 3). Pretreatment and posttreatment effect size calculations revealed that the effect sizes for reductions in pain intensity varied considerably, ranging from a Hedges' g of –0.24 (CI_{95}: –0.88, 0.40) to –5.86 (CI_{95}: –10.12, –1.60).

A closer examination revealed that the effects on pain varied with the length of treatment. The three studies showing only small to moderate effects on pain intensity (Hedges' g of –0.24 [31], –0.28 [30], and –0.56 [32]) were characterized by short durations (≤four sessions) [30,31] or premature study termination due to unplanned personnel deficits [32]. When assessing the duration of treatment effects, the results tended to be maintained at the follow-up assessments. Accordingly, the results of pain intensity and frequency in migraine patients assessed by Konuk et al. [32] were maintained at 3-month follow-up and were similar to those reported posttreatment. For PLP, follow-up indicated that long-lasting pain reductions remained after 3 months and 1 year [33,36]. In musculoskeletal pain patients, the treatment effects either remained stable over 2 [35] or 3 months [31], or resulted in further improvements from the posttreatment assessment to the 2-month follow-up [29]. Five out of the 12 studies reported complete pain relief in 15–40% of the patients [33,36]. In most of these patients, this pain relief was sustained also at the follow-up assessments ranging from 2 months up to 40 months, which indicates a timely stable effect. Three studies also reported patients without any improvement in pain, disability, or mood [27,31,36].

High effect sizes were reported for PLP (Hedges' g of –0.95 [36], –2.40 [33], and –3.34 [34]), headache (Hedges' g of –0.56 [32] and –0.95 [16]), and chronic musculoskeletal pain (Hedges' g of –0.99 [29] and –5.86 [35]). The effects in patients suffering from fibromyalgia were more inconsistent and ranged from a Hedges' g of –0.28 [30] to –2.24 [27].

Effects on Disability

Five studies reported disability outcomes [16,27,31,34,36] (Table 3). Three studies [16,31,36] used a general measure of health status (the Short Form-36 Health Survey [16,36] and the Nottingham Health Profile

Table 1 Characteristics of the studies

Study	EMDR Protocol and Targets	Types of Patients (Pain Intensity, Duration)	Number of Subjects (f/m)	Assessed Outcomes	Study Design and Authors' Conclusions
Allen [35]	**Protocol:** Standard EMDR protocol and a specific pain protocol **Targets:** Trauma targets, pain-related disturbing thoughts, and experiences of pain **Number of sessions:** Nine weekly 60-minute sessions **Bilateral stimulation:** Eye movements	Nonmalignant chronic pain (VAS 6.5 ± 1.0, 17.6 ± 16.1 years)	4 (3/1)	**Primary outcomes:** Pain (VAS) Mood (BAI and BDI) **Others:** PTSD (IES) Coping (MBHI) **Follow-up:** 2 months	Uncontrolled observational clinical trial with four adult chronic pain patients (all of whom reported experiencing some psychological trauma before the pain started) using a pretest/posttest design with a 2-month follow-up. This study aimed to replicate the study performed by Grant and Threlfo [29]. Using a standard EMDR protocol, the primary target for EMDR processing was the original incident in which the injury occurred for the first time that the pain was experienced. In addition to targeting the memory of the etiological event, when available, the painful experience was also targeted using a specific pain protocol [10]. EMDR was repeated until a satisfactory degree of pain relief was reported. All clients reported substantially decreased pain levels, decreased negative affect, and increased ability to control their pain following treatment. No adverse events were reported.
de Roos et al. [36]	**Protocol:** Standard EMDR protocol and a pain-specific protocol **Targets:** Trauma targets, pain-related disturbing memories, and actual pain **Number of sessions:** Variable (mean: 5.9, range: 3–10 sessions), weekly 90-minute sessions **Bilateral stimulation:** Eye movements and auditory tones	Phantom limb pain (NRS 5.0 ± 1.7, 13.6 ± 15.1 years)	10 (4/6)	**Primary outcomes:** Pain (NRS) Disability (SF-36) Mood (SCL-90 subscales) **Others:** PTSD (IES, SIL) Fatigue (CIS-20R) **Follow-up:** 3 months	Uncontrolled observational clinical trial using a pretest/posttest design with a 3-month follow-up and an additional long-term follow-up at variable time points (mean: 2.8 years). EMDR treatment consisted of weekly 90-minute sessions using eye movements or auditory tones for bilateral stimulation. Treatment ended when the participant reported no more pain at the end of the session, or reported no further improvements during three successive sessions. The standard EMDR protocol was used for trauma- and pain-related disturbing memories. For in-session PLP processing, a pain-specific EMDR pain protocol was used that focused on the currently experienced PLP and phantom limb sensations instead of the traumatic memory. Targets were processed in a hierarchical procedure (initial trauma in the beginning and actual pain in the end). All but two of the participants improved, and four were considered to be completely pain free at the 3-month follow-up. Of the six participants available at long-term follow-up, three were pain free and two had reduced pain intensity. Interestingly, in the two nonresponders, amputation was not regarded as "traumatic," but rather as being a lifesaving event and was therefore remembered in a positive way.

Estergard [14]	**Protocol:** Standard EMDR protocol **Targets:** Pain-related disturbing memories **Number of sessions:** Six sessions of 90 minutes, 1 week apart **Bilateral stimulation:** Eye movements	Chronic pain (PRI > 10 of 45, range: 1–30 years)	37 (33/4)	**Primary outcomes:** Pain (SFMPQ) Mood (MAACL-R)* **Follow-up:** None	Randomized controlled trial in chronic pain patients comparing the efficacy of six sessions of EMDR with treatment as usual in a matched two-group, wait-control design. Participants were matched on pretest chronic pain scores and randomized to EMDR or a delayed treatment group. The experimental group received six 90-minute EMDR sessions over a 6-week period, and the control group waited. Study samples and EMDR treatment were not described in more detail (type of pain, age, or protocol). EMDR treatment was found to significantly reduce chronic pain in the experimental group when compared with the control group. In addition, the results examining whether a reduction in dysphoria occurred from the use of EMDR verged on significance ($P < 0.06$). Interestingly, the greatest reductions in dysphoria occurred over the first half of the treatment period. No adverse events were reported.
Friedberg [30]	**Protocol:** Self-developed protocol based on a recently (by the author) published self-administered protocol for EMD **Targets:** "Most salient or intense symptom, sensation, or feeling" **Number of sessions:** Two sessions of 60 minutes, 1 week apart **Bilateral stimulation:** Hand taps or audio stimuli (via stereo headphones)	Fibromyalgia (NRS 50.9 ± 20.6, 10.2 years)	6 (6/0)	**Primary outcomes:** Pain (SUD) Disability (FIQ)* Mood (BAI and BDI)* **Others:** Fatigue (FS) Thermal biofeedback monitoring **Follow-up:** 3 months (incompletely reported)	Uncontrolled observational clinical trial of a two-session EMD procedure with biofeedback monitoring for fibromyalgia using a pretest/posttest design with 3-month follow-up. While focusing on the most salient symptom, sensation, or feeling, the therapist stood behind the patient and performed four till eight series of alternating hand taps (approximately four taps per second) on the patient's shoulders. Pain decreased by 18.5% after two EMDR sessions. The 3-month follow-up revealed improvements in measures of anxiety (45.8%), depression (31.6%), fibromyalgia impact (19.2%), and fatigue (26.7%). Reductions in stress, pain, and fatigue were also found on SUD ratings during the treatment sessions. The in-session biofeedback monitoring confirmed that a relaxation effect was associated with the EMDR procedure. Four out of six subjects were considered to be treatment responders (showing at least 25% improvement from baseline to follow-up assessments on at least two of the four outcome measures). No adverse events were reported.
Grant and Threlfo [29]	**Protocol:** Standard EMDR protocol and specific pain protocol **Targets:** Trauma targets, pain-related disturbing thoughts, and experiences of pain **Number of sessions:** Nine weekly 60-minute sessions **Bilateral stimulation:** Eye movements (combined with BS home exercises using auditory tones or tapping)	Chronic musculoskeletal pain (PPI 60.3 ± 15.3, 5.3 ± 4.2 years)	3 (3/0)	**Primary outcomes:** Pain (SFMPQ) **Others:** Coping (CSQ) **Follow-up:** 2 months	Uncontrolled observational clinical trial with three adult chronic pain sufferers using a pretest/posttest design with a 2-month follow-up. Using a standard EMDR protocol, the primary target for EMDR processing was the original incident in which the injury occurred for the first time that the pain was experienced. In addition to targeting the memory of the etiological event, when available, the experience of pain was also targeted using a specific pain protocol [10]. EMDR was repeated until a satisfactory degree of pain relief was reported. All clients reported substantially decreased pain levels, decreased negative affect, and an increased ability to control their pain following treatment. No adverse events were reported.

Table 1 Continued

Study	EMDR Protocol and Targets	Types of Patients (Pain Intensity, Duration)	Number of Subjects (f/m)	Assessed Outcomes	Study Design and Authors' Conclusions
Hassard [31]	**Protocol:** Specified self-developed EMDR pain protocol (the therapist had no direct training in EMD, but based the procedure on the published description) **Targets:** Visual image eliciting stimulus of past traumatic and past pain-related traumatic memory **Number of sessions:** Variable (mean: 4, range: 1–11 sessions) **Bilateral stimulation:** Eye movements	Chronic pain (PPI 25, duration not reported)	27 (12/15)	**Primary outcomes:** Pain (NHP-pain category) Disability (NHP) Mood (HADS) **Follow-up:** 3 months	In this uncontrolled observational clinical trial with a pretest/posttest design and 3-month follow-up, EMDR was investigated in a series of pain clinic patients (in particular cLBP) who were referred for psychological treatment. EMDR was offered to pain patients when they were considered to have either traumatized memories or flashbacks or some other anxiety problems for which there was a visual image eliciting stimulus. Participants received EMDR as a major part of their treatment (combined with medication, cognitive, or behavioral treatment components, if necessary). The majority had PTSD or a similar anxiety problem with an accident history. The EMDR treatment ended when the patient finished reporting images. All of the patients described reductions in anxiety and distress in at least one session. Eight (of the 27 patients) dropped out before the completion of treatment and could not be retrieved. As a within session procedure, EMDR was observed to have a large and fast effect on "emotional reaction" and "energy." A significant, but short-lasting, change occurred with "social isolation." No effects were observed with sleep or pain. Some return of symptoms was observed at the 3-month follow-up. No adverse events were reported.
Kavakci et al. [27]	**Protocol:** Standard EMDR protocol and a specific pain protocol **Targets:** Trauma targets, pain-related disturbing thoughts, and experiences of pain **Number of sessions:** Five to eight weekly sessions (mean: 6.1 ± 1.3) of 60–90 minutes **Bilateral stimulation:** Eye movements	Fibromyalgia (VAS 8.0 ± 1.3, 5.4 years)	7 (6/1)	**Primary outcomes:** Pain (VAS) Disability (FIQ) Mood (BDI) **Others:** Tender points (TPC) Sleep (PSQI) Anger (STAS) PTSD (PDS) **Follow-up:** None	Uncontrolled observational clinical trial with seven adult fibromyalgia patients using a pretest/posttest design without any follow-up assessment. Five of seven cases had traumatic life histories, and three of these patients met the criteria for PTSD. Patients received five to eight sessions of EMDR on a weekly basis. If the patients reported any trauma, trauma was focused on using a standard EMDR protocol. Otherwise, pain was focused on using a specific pain protocol [10]. At the end of the treatment period, both trauma and depressive symptoms showed significant and meaningful improvements. Moreover, patients stated that they experienced significant increases in their sleep and life qualities, and decreases in perceived pain. Their TPC significantly decreased in the physical examination. At the end of the treatment period, only one patient continued to meet the FMS classification criteria. No adverse events were reported.

Konuk et al. [32]	**Protocol:** Self-developed "EMDR Headache Protocol" **Targets:** 1) Traumatic events clearly connected to headaches (e.g., first experienced/remembered headache attack), and 2) recalled traumatic events associated "relatively close in time" to the first headache attack and traumatic headache attacks (first, worst, and last). **Number of sessions:** Variable (mean: 8), weekly 50-minute sessions **Bilateral stimulation:** Eye movements	Migraine (NRS 6.1 ± 5.9, 12 years, range: 2 to 30 years)	11 (9/2)	**Primary outcomes:** Pain (NRS) Mood (SA-45 subscales) **Others:** WHQ (pain frequency, pain duration, use of medication, and doctor visits) **Follow-up:** 3 months	This uncontrolled observational clinical trial using a pretest/posttest design with a 3-month follow-up investigated the effectiveness of EMDR on migraine headache by specifically treating traumas related to headaches. Patients received an average of eight 50-minute sessions on a weekly basis over a 3-month period. Based on a self-developed "EMDR Headache Protocol," therapists provided EMDR by following the steps of the standard EMDR protocol, targeting headache-related traumatic events in hierarchical sequence. Treatment did not specifically address other traumatic experiences that may have been related to the participants' psychological symptoms. A longer study had originally been planned, but the study ended when the neurologist left the program. Significant decreases in headache frequency and duration occurred with no reductions in pain intensity. There were also significant decreases in the use of painkillers and doctor visits. All results were maintained at 3-month follow-up and were similar to those reported posttreatment. No adverse events were reported, but increases in the number of headaches during the treatment interval were reported, followed by decreases in frequency posttreatment.
Marcus [28]	**Protocol:** "Integrated" treatment protocol consisting of diaphragmatic breathing, compression with the hands to the frontal and occipital cranial areas, and application of EMDR in the form of slow eye movements in a figure eight pattern for 30–90 seconds **Targets:** No specific targets (interoception/focus on diaphragmatic breathing) **Number of sessions:** One session (60 minutes) **Bilateral stimulation:** Eye movements combined with bilateral cranial compression	Severe migraine (with a subjective pain level ≥6) (NRS 7.6, 12.5 years)	43 (41/2)	**Primary outcomes:** Pain (NRS, pain diary) Disability (HDI, MIDAS)* **Others:** Time to pain relief, use of medication **Follow-up:** None	Randomized controlled trial in chronic migraine headache sufferers comparing an "integrated EMDR" treatment intervention with a standard care medication. The comparison standard care medication group received various medications. Only one EMDR treatment session was provided to each participant for relief of the current migraine episode. Participants were treated during the mid to late stages of a migraine attack and migraine pain levels were assessed by an independent evaluator pretreatment, posttreatment, 24 hours, 48 hours, and 7 days posttreatment. Both the standard care medication and integrated EMDR treatment groups demonstrated reduced migraine pain levels immediately posttreatment, as well as 7 days later. However, integrated EMDR treatment reduced or eliminated migraine pain with greater rapidity and showed significantly greater improvements compared with standard care medication immediately posttreatment. No adverse events were reported.
Mazzola et al. [16]	**Protocol:** Specific pain protocol **Targets:** Pain sensations, original cause of pain, worst pain crises, and any additional traumatic information (e.g., special situations that surrounded the pain, medical interventions, and losses) **Number of sessions:** 12 weekly 90-minute sessions **Bilateral stimulation:** Eye movements	Chronic pain (headaches: N = 30, fibromyalgia: N = 4, and neuropathic pain: N = 4) (VAS 8, 12 years)	38 (32/6)	**Primary outcomes:** Pain (VAS) Disability (SF-36) Mood (STAI and BDI) **Follow-up:** None	Uncontrolled observational clinical trial in chronic pain sufferers using a pretest/posttest design. Treatment focused on desensitizing the emotional and somatic aspects of the pain experience using a specified EMDR treatment manual for pain control [10]. Additionally, psychoeducation, visualization, and relaxation techniques were offered. Accordingly, reprocessing started by focusing either on the present pain (if the patient was feeling pain at the beginning of the session) or by focusing on painful memories, such as the onset of the illness or strong pain episodes in the past. In addition to EMDR, pharmacological treatment was prescribed to address the specific needs of each individual. Patients showed statistically significant symptom improvements (reduced pain severity, quality of life, depression, and anxiety scores), as well as reductions in medication relative to baseline, after 12 weeks of EMDR treatment. A decrease in the consumption of medication was observed in 79% of patients, while 21% of patients showed no change. No adverse events were reported.

Table 1 Continued

Study	EMDR Protocol and Targets	Types of Patients (Pain Intensity, Duration)	Number of Subjects (f/m)	Assessed Outcomes	Study Design and Authors' Conclusions
Schneider et al. [33]	**Protocol:** Standard EMDR protocol **Targets:** Events associated with the amputation, as well as a variety of targets related to issues of self-esteem, pain sensations, present triggers, and thoughts of the future **Number of sessions:** Variable (mean: 7, range: 3–15 sessions) **Bilateral stimulation:** Eye movements	Phantom limb pain (NRS 9.1 ± 1.0, 7.6 ± 5.4 years)	5 (gender not reported)	**Primary outcomes:** Pain (VAS) Mood (BDI) **Others:** PTSD (IES) continued use of medication **Follow-up:** 1–2 years (variable)	Uncontrolled observational clinical trial with a pretreatment/posttreatment assessment and variable long-term follow-up of EMDR treatment of phantom limb pain following a traumatic leg amputation. The number of EMDR treatments varied from 3 to 15 sessions. As "real world exigencies" prevented the complete treatment of two of the cases, one patient was discharged from the hospital and one patient declined further treatment because his insurance company refused further reimbursement. All patients were on extensive medication regimens prior to EMDR. EMDR resulted in significant decreases or the elimination of phantom pain, reductions in depression and PTSD symptoms to subclinical levels, and significant reductions or elimination of medications related to the phantom pain and nociceptive pain at long-term follow-up. No adverse events were reported.
Wilensky [34]	**Protocol:** Standard EMDR protocol **Targets:** Events associated with the amputation, other related events (seeing the "stump" for the first time, the idea of being a "cripple," as well as various physical sensations), as well as memories of earlier accidents (e.g., deaths of family members, father's pain, targets related to brother's death or wife's leukemia diagnosis) **Number of sessions:** Variable (mean: 5.6, range: 3–9 sessions) **Bilateral stimulation:** Eye movements or other forms of dual attention stimulation (e.g., bilateral hand taps or auditory tones)	Phantom limb pain (NRS 7.7 ± 1.9, 9.3 ± 15.1 years)	5 (1/4)	**Primary outcomes:** Pain (NRS) Disability (PDI) Mood (BDI) **Others:** PTSD (IES-R) **Follow-up:** None	Uncontrolled observational clinical trial with a pretreatment/posttreatment assessment (without standardized follow-up, course only narratively reported) of EMDR treatment of phantom limb pain following amputation. The standard EMDR treatment protocol was used to target the accident that caused the amputation and other related events. Not only the accident was targeted, but a number of times it was also necessary to process earlier memories that appeared to be related. In one case, the pain did not remit until earlier memories of accidents involving the affected foot were targeted. The number of sessions varied within a range from three to nine and was correlated with the amount of time since the initial accident. The author therefore suggests that this may indicate that the sooner the pain client is treated after the amputation, the quicker remission can be achieved. Four of the five clients completed the prescribed treatment and reported that pain was either completely eliminated or reduced to a negligible level (less than or equal to 1 out of 10). The one client who stopped treatment chose to do so after reducing his pain by one half, which was tolerable to him. No adverse events were reported.

* As data were reported incompletely, no precalculations/postcalculations were possible.

BAI = Beck Anxiety Inventory; BDI = Beck Depression Inventory; BS = bilateral stimulation; cLBP = chronic low back pain; CIS-20R = Checklist Individual Strength-Revised; CSQ = Coping Skills Questionnaire; EMDR = eye movement desensitization and reprocessing; FIQ = Fibromyalgia Impact Scale; FMS = fibromyalgia syndrome; FS = Fatigue Scale; HADS = Hospital Anxiety and Depression Scale; HDI = Headache Disability Inventory; IES = Impact of Event Scale; IES-R = Impact of Event Scale–Revised; MAACL-R = Multiple Affect Adjective Checklist-Revised; MBHI = Millon Behavioral Health Inventory; MIDAS = Migraine Disability Assessment Scale; NHP = Nottingham Health Profile; NRS = Numeric Rating Scale; PDI = Pain Disability Index; PDS = Posttraumatic Diagnostic Scale; PLP = phantom limb pain; PPI = present pain intensity; PRI = Pain Rating Index; PSQI = Pittsburgh Sleep Quality Index; PTSD = posttraumatic Stress Disorder; SA-45 = Symptom Assessment-45 Questionnaire (derived from the SCL-90) SCL-90 = symptom checklist; SF-36 = Short-Form Health Survey; C SFMPQ = Short-Form McGill Melzack Pain Questionnaire; SIL = Self-Inventory List; STAI = State-Trait Anxiety Inventory; STAS = State-Trait Anger Scale; SUD = subjective units of discomfort; TPC = tender point count; VAS = visual analogue scale; WHQ = Weekly Headache Questionnaire.

Table 2 Effect size calculations of the controlled trails for pain reduction

	EMDR			Controls			Effect Size
Study-ID	Mean	SD	Total	Mean	SD	Total	Hedges' g (95% CI)
Effects on pain							
Estergard [14]	10.0	8.9	20	20.9	10.2	17	–1.12 (–1.82, –0.42)
Marcus [28]	0.1	0.4	26	2.9	0.4	21	–6.87 (–8.51, –5.23)
Effects on disability							
Marcus [28]	53.75	27.0	26	—	—	—	—
Effects on mood*							
Estergard [14]	60.9	21.3	20	75.4	19.3	17	–0.70 [–1.40, –0.01]

The standard mean differences were calculated as the Hedges' g, with 95% confidence intervals (CI), with negative values favoring the EMDR treatment group.
* Mood assessed by the Multiple Affect Adjective Checklist-Revised (MAACL-R, a combined score of anxiety, depression and hostility).
EMDR = eye movement desensitization and reprocessing; SD = standard deviation.

[31]), whereas two studies used more pain-specific disability assessment tools (the Pain Disability Index [34] and the Fibromyalgia Impact Questionnaire [27]). The pretreatment/posttreatment effect size calculations from these studies revealed that the effect sizes for improvements in disability ranged from a Hedges' g of –0.34 (CI_{95}: –1.27, 0.59) to –3.69 (CI_{95}: –24.66, 17.28). Interestingly, the study with short duration (four sessions) was characterized by a small effect on disability whereas studies with longer duration (≥six sessions) indicated more pronounced improvements in disability. The improvements in disability were most powerful in those studies, in which the reduction in pain intensity was most pronounced.

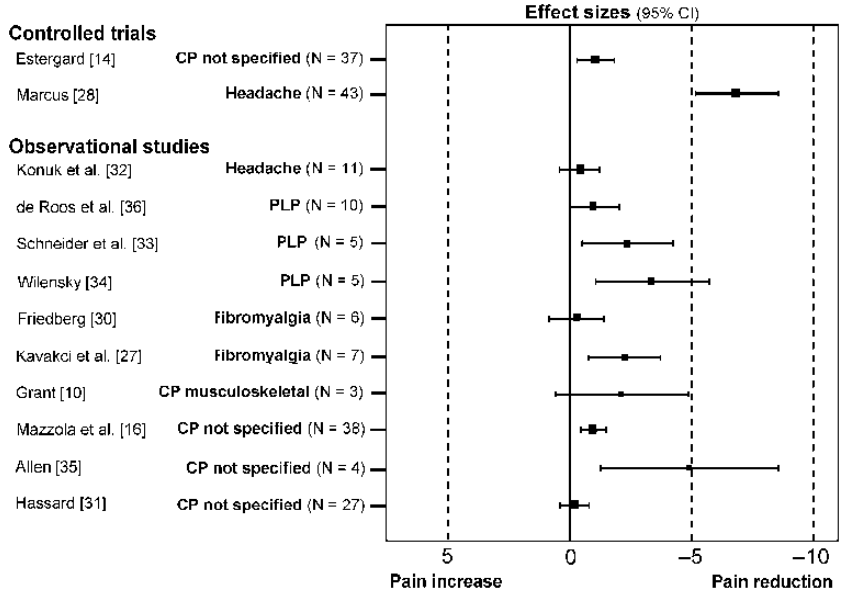

Figure 2 Effects of eye movement desensitization and reprocessing (EMDR) on pain intensity. Calculation of the standardized mean differences revealed that the effect sizes varied considerably. For the controlled trials, the standardized mean differences were calculated as the Hedges' g with 95% confidence intervals for improvements in pain intensity. For the observational studies, the effect sizes were calculated based on the pooled standard deviations of the pretreatment and posttreatment data (negative values favor EMDR intervention). CI = confidence interval; N = sample size; PLP = phantom limb pain; CP = chronic pain.

Table 3 Effect size calculations of the observational studies

	Before Intervention			After Intervention			Effect Size	Follow-up			Effect Size
Study ID	Mean	SD	Total	Mean	SD	Total	Hedges' g (95% CI)	Mean	SD	Total	Hedges' g (95% CI)
Effects on pain											
Allen [35]	6.5	1.0	4	0.4	0.8	4	–5.86 (–10.12, –1.60)	0.8	1.0	4	–4.96 (–8.64, –1.28)
de Roos et al. [36]	5.0	1.7	9	2.8	2.6	9	–0.95 (–1.94, 0.04)	2.5	2.9	9	–1.00 (–2.00, –0.01)
Friedberg [30]	50.8	20.6	6	44.2	22.2	6	–0.28 (–1.42, 0.86)	—	—	—	—
Grant and Threlfo [29]	60.3	15.3	3	41.3	15.3	3	–0.99 (–2.86, 0.87)	30.0	3.5	3	–2.18 (–4.83, 0.46)
Hassard [31]	74.1	29.5	19	66.2	35.1	19	–0.24 (–0.88, 0.40)	65.5	36.5	19	–0.25 (–0.89, 0.39)
Kavakci et al. [27]	8.0	1.3	7	4.1	1.9	7	–2.24 (–3.68, –0.81)	—	—	—	—
Konuk et al. [32]	6.1	1.7*	11	4.9	2.4*	11	–0.56 (–1.41, 0.30)	5.2	2.4*	11	–0.42 (–1.26, 0.43)
Mazzola et al. [16]	8.0	1.7*	38	6.0	2.4*	38	–0.95 (–1.43, –0.48)	—	—	—	—
Schneider et al. [33]	9.1	1.0	5	2.8	3.2	5	–2.40 (–4.23, –0.57)	2.8	3.2	5	–2.40 (–4.23, –0.57)
Wilensky [34]	7.7	1.9	5	1.2	1.6	5	–3.34 (–5.60, –1.09)	—	—	—	—
Effects on disability											
de Roos et al. [36]	62.3	22.4	9	70.8	25.8	9	–0.34 (–1.27, 0.59)	70.8	26.8	9	–0.33 (–1.26, 0.60)
Hassard [31]	57.1	26.6	19	41.6	32.2	19	–0.50 (–1.15, 0.14)	47.4	33.4	19	–0.31 (–0.95, 0.33)
Kavakci et al. [27]	64.0	14.9	7	23.6	9.5	7	–3.10 (–4.81, –1.39)	—	—	—	—
Mazzola et al. [16]	39.7	11.7*	38	69.4	32.4*	38	–1.21 (–1.70, –0.72)	—	—	—	—
Wilensky [34]	47.0	2.8	2	18.0	5.7	2	–3.69 (–24.66, 17.28)	—	—	—	—
Effects on depression											
Allen [35]	11.0	7.4	4	2.0	1.4	4	–1.47 (–3.18, 0.25)	0.8	1.0	4	–0.93 (–3.48, –0.12)
de Roos et al. [36]	23.4	7.2	9	18.4	2.4	9	–0.89 (–1.87, 0.09)	19.4	3.9	9	–0.66 (–1.61, 0.30)
Hassard [31]	11.3	3.7	19	8.9	4.1	19	–0.60 (–1.25, 0.05)	10.5	4.8	19	–0.18 (–0.82, 0.45)
Kavakci et al. [27]	20.3	15.0	7	6.9	6.8	7	–1.07 (–2.23, 0.07)	—	—	—	—
Konuk et al. [32]	13.6	4.9	10	11.0	3.7	10	–0.57 (–1.47, 0.32)	—	—	—	—
Mazzola et al. [16]	17.0	7.8*	38	9.0	3.0*	38	–1.34 (–1.84, –0.84)	—	—	—	—
Schneider et al. [33]	21.2	8.7	4	11.5	2.4	4	–1.34 (–3.00, 0.33)	—	—	—	—
Wilensky [34]	34.0	15.2*	1	11.0	3.7*	1	Not estimable	—	—	—	—
Effects on anxiety											
Allen [35]	9.3	5.7	4	3.5	3.1	4	–1.10 (–2.68, 0.48)	1.0	1.4	4	–1.74 (–3.57, 0.09)
de Roos et al. [36]	12.9	3.0	9	11.3	1.2	9	–0.67 (–1.62, 0.29)	11.4	1.9	9	–0.57 (–1.52, 0.38)
Hassard [31]	12.7	3.1	19	9.4	4.8	19	–0.80 (–1.46, –0.14)	11.1	5.2	19	–0.37 (–1.01, 0.28)
Konuk et al. [32]	11.5	4.4	10	8.5	3.2	10	–0.75 (–1.66, 0.17)	—	—	—	—
Mazzola et al. [16]	65.0	20.5*	50	51.5	24.3*	38	–0.59 (–1.05, 0.13)	—	—	—	—

The effect sizes were calculated as the Hedges' g with 95% confidence intervals (CI) based on the pooled standard deviations (SDs) of the pretreatment and posttreatment scores (algebraic signs were adapted, and negative values indicate improvement after eye movement desensitization and reprocessing [EMDR] intervention). In the case of missing SD, the SD were estimated based on the averages of the remaining study results (*).

Effects on Mood

Eight studies evaluated depressive symptoms [16,27,31–36], and five studies assessed anxiety [16,31,32,35,36] (Table 3). Pretreatment/posttreatment effect size calculations for improvements in depressive symptoms ranged from a Hedges' g of –0.57 (CI_{95}: –1.47, 0.32) to –1.47 (CI_{95}: –3.18, 0.25), for improvements in anxiety ranged from a Hedges' g of –0.59 (CI_{95}: –1.05, 0.13) to –1.10 (CI_{95}: –2.68, 0.48).

Safety Aspects

Most studies [14,16,27–31,33,34] reported no relevant adverse events. In the study conducted by de Roos et al. [36], three participants complained of increases in PLP either during or immediately following the EMDR sessions, especially after sessions in which actual pain and/or pain-related memories were targeted. The pain continued for several hours after the session, but in all cases, disappeared after one night of sleep. A similar phenomenon was described by Konuk et al. [32], who also observed transient increases in the number of headaches during the treatment interval, followed by decreases in the frequency posttreatment, and by Allen [35], who reported a transient increase in pain intensity in one patient after the sixth session, which was also followed by a continuous decrease in pain intensity after the following sessions. Only de Roos et al. [36] reported that pain had slightly increased 30 months after EMDR treatment in one PLP patient who had suffered from complex regional pain syndrome (CRPS) before treatment and that CRPS also affected the formerly healthy foot. Apart from this single case, no other severe complications were reported.

Risk of Bias Assessment

The scores for each risk of bias item are shown for all studies in the web appendix. The major drawbacks of most of the studies were the lack of adequate control groups (item #12) and the lack of randomization (item #6). Only two randomized controlled trials were available [14,28], neither of which described the method of allocation. The mean dropout rate for the studies outlined above was low (approximately 5%), and there were no differences in the dropout rates between the EMDR groups and the control groups [14,28]. Further shortcomings were identified, especially regarding study conduct, including biased assignment to treatment due to the lack of blinding and independent assessors (item #3) and the lack of training in the administration of the instruments used in the study (item #4). Biases associated with the implementation of EMDR therapy were found less frequently. With the exception of Hassard [31], all of the investigators used manualized, replicable, and specific treatment programs (item #5), but only two of the studies demonstrated treatment adherence using independent monitoring (item #7) [28,32].

Discussion

The present study systematically summarized the current evidence for the use of EMDR in the treatment of chronic pain. Because only two controlled trials were identified, we extended our analysis to observational studies to obtain the best evidence currently available.

The two eligible controlled trials were characterized by significant reductions in pain intensity that had high effect sizes: Marcus [28] demonstrated greater rapidity and significantly greater improvements in migraine compared with standard care medication, while Estergard [14] demonstrated that EMDR treatment significantly reduced pain in chronic pain patients when compared with a delayed treatment group, without further specifying the underlying pain conditions.

In contrast to the controlled trials, several observational studies explored the effects of EMDR in the treatment of chronic pain. However, even though all of the results pointed in the same direction, the pretreatment/posttreatment effect size calculations of these studies revealed that the effect sizes varied considerably depending on the underlying pain condition and the length of treatment.

Given the marked diversity in the study results, a closer look at these studies was required. Based on the results of the present studies, promising results were reported for PLP [33,34,36], headache [16,28,32], and chronic musculoskeletal pain [29,35]. Interestingly, five studies reported complete pain relief in 15–40% of their patients despite preceding, long-standing histories of treatment-refractory pain in these subjects. This contributed to the astonishingly high effect sizes reported by some of the studies [28,34,35]. Moreover, when evaluating the stability of treatment effects, most of the results were either maintained or showed even further improvements at the follow-up assessments, thus providing some preliminary evidence that EMDR may be effective over the long term.

Notably, most current psychological approaches like CBT lead to improvements in disability and psychological distress, whereas direct effects on pain intensity are predominantly low so far [1,38]. Accordingly, the current consensus is to direct chronic pain care toward pain management rather than pain cure [39]. In contrast, the effects of EMDR seen in our review are mainly associated with some direct improvement in the pain intensity and only to a lesser extent with reductions in anxiety or depression. This may indicate that EMDR has some direct impact on the underlying pain processing corticolimbic levels that finally results in an altered perception of the nociceptive information rather than being restricted merely to secondary "pain management effects" mediated by alterations of higher brain functions like cognition or coping behavior.

Furthermore, EMDR might be effective in treating pain because it focuses specifically on the affective aspects of pain. Chronic pain is often characterized by high affective

distress, and there is an important interaction between affective distress and the patients' pain experience. For example, affective distress can be an emotional component of pain, pain can be a consequence of affective distress, and affective distress can be a comorbid disorder of pain. Originally developed to eliminate the affective distress resulting from traumatic memories, EMDR is suitable to focus specifically on these aspects of pain. Thus, targeting the affective distress and associated distressing events that are coupled with pain itself will ameliorate pain.

Noteworthy, the effect sizes varied considerably across studies, and it would be worthwhile to examine the possible reasons for this variability.

One interesting finding was that treatment success varied with the length of treatment. In particular, studies characterized by treatment duration of fewer than five sessions showed only small improvements in pain intensity and disability. Notably, in those studies in which the number of treatment sessions was not preset, but was instead based on treatment success, the mean number of treatment sessions varied between six and eight sessions. Such data suggest that a treatment duration of six sessions or more may be favorable for the use of EMDR in the treatment of chronic pain conditions. Interestingly, Wilensky [34] observed that the number of sessions necessary for treatment success was correlated with the amount of time since the initial accident. He suggested that the sooner the pain is treated, the more quickly remission can be achieved [34]. Although it would be valuable to further investigate these observations systematically, this observation indicates that more than a few sessions of EMDR may be required to alleviate pain.

An important therapeutic step required for desensitization and reprocessing in EMDR therapy is causing the patients to focus on disturbing memories while focusing on an external bilateral stimulus. Accordingly, an interesting question challenges the primary target of this desensitization and reprocessing procedure. Most of the studies focused on traumatic memories, pain-related disturbing memories, and present pain triggers using the standard EMDR protocol [14,27,29,32–36]. Notably, some of the studies focused additionally on the actual pain itself using modified "pain-specific" protocols [16,27,29,30,33–36]. Special emphasis was placed on facilitating changes in pain sensations and developing new coping strategies based on these experiences. Accordingly, the authors demonstrated a significant increase in the perceived ability to cope with pain following their EMDR pain protocol [29]. Such great variety in possible desensitization targets raises the question of whether the primary focus should be the traumatic experiences or the chronic pain. Notably, Wilensky [34] observed in patients suffering from PLP that it was necessary to process—in addition to the initial pain-related accident—memories that appeared to be related indirectly with the pain (memories associated with seeing the "stump" for the first time, as well as the idea of being a "cripple" and various physical sensations) a number of times. Moreover, during the subsequent course of treatment earlier material often also began to emerge, which involved memories of earlier accidents, deaths of family members, father's pain, as well as targets related to a brother's death or a wife's leukemia diagnosis [34]. Interestingly, in these cases, the PLP pain was most often not alleviated until these early memories were also reprocessed. Nevertheless, based on the current evidence, the question as to whether the traumatic experiences or the chronic pain should serve as the primary focus remains to be determined. Taken together, clear statements regarding favorable protocols or targets cannot be made. The narratives and experiences of the authors suggest that EMDR in the treatment of chronic pain requires a greater variety of targets and more flexibility in the protocol application compared with the treatment of PTSD. Further, the explorative description of the course of most studies suggests that targets for desensitization and reprocessing should neither be restricted to the pain nor to traumatic life events in advance, but should be adapted to the individual, as required. Notably, the fact that the weakest effects on pain intensity were observed in the only study in which the therapist had no direct training in EMDR, but initiated the procedure based on the published description [31], may support the recommendation that EMDR treatment requires special training [37].

In sum, the variability of effect sizes across studies may be explained by several factors, and particularly the length of treatment, the protocols used, as well as possible differences in the therapist's training level may influence the final treatment success.

It is important to note that no severe safety concerns were reported with the use of EMDR in the treatment of chronic pain. As EMDR is a "disclosing" and "stirring up" technique, unanticipated emotional or physiological reactions in the patients may be induced by EMDR. Accordingly, there is the potential risk of retraumatization and deterioration of symptoms in traumatized chronic pain patients in which trauma and pain are associated. Moreover, processing may continue after the patient leaves the therapist setting, potentially representing an increased risk to the patients. An interesting finding was the "breakthrough" phenomenon of a transient increase during the initial treatment interval followed by long-lasting pain relief, as described by de Roos et al. [36], Konuk et al. [32], and Allen [35]. Such observations may indicate that initial pain aggravation is not necessarily a negative sign and should not automatically lead to an immediate discontinuation of therapy. However, reported cases of pain worsening and extensions of CRPS should be viewed as reasons to be extraordinarily reluctant to apply EMDR to patients suffering from CRPS [36]. Nevertheless, the current data suggest that EMDR is a rather safe treatment option.

Finally, a number of limitations need to be considered. The most important limitation is that the overall number of studies was limited. So far, only two controlled trials were available, which were characterized both by small sample sizes, lack of adequate follow-up assessments, and

monocentric design. Thus, based primarily on observational studies, the overall evidence for the use of EMDR in the treatment of chronic pain is currently not clearly determinable. Considering that the majority of included studies was small and monocentric, there is a relevant risk of an overestimation of true treatment effects. Accordingly, all conclusions drawn from this review are exploratory in nature and should be interpreted with caution. In contrast, there is sufficient evidence from systematic reviews and meta-analyses that CBT leads to at least modest improvements in quality of life indexed by positive changes in disability, psychological distress (principally depression), and, to a lesser extent, pain intensity. Accordingly, with only two controlled trials the total evidence for the use of EMDR in the treatment of chronic pain has to be classified as currently insufficient, and additional high-quality studies are needed before recommendations for EMDR can be made.

However, due to the promising findings, there is an urgent need for well-designed studies with adequate control groups to assess specific pain conditions using standardized EMDR interventions of sufficient treatment length.

Furthermore, the studies included showed considerable variability in sample characteristics, treatment procedures, and assessment tools. This heterogeneity prompted us to present the results in a narrative manner.

Nevertheless, our review outlines some essential requirements for further research. The possibility that relatively short treatment can result in the permanent cessation of long-lasting and tedious pain has major implications for the personal recovery of those debilitated by this condition. Although definite recommendations are beyond the scope of this review, scientists should pay particular attention to adequate length of treatment and a comprehensive assessment of potential targets for desensitization and reprocessing when planning future studies. Although dramatic effects were reported, not all patients seemed to respond to EMDR treatment. Three out of 12 studies reported a relevant number on nonresponders without any improvement in pain, disability, or mood [31,36,37]. Therefore, identification of subgroups that are likely to benefit from treatment with EMDR is warranted. Notably, most nonresponders (7 out of 19) were reported in the Hassard study [31], which may indicate the importance of the appropriate education of the therapist as well as the use of manualized and established EMDR protocols.

In conclusion, our review suggests that EMDR may be a safe and promising treatment option for chronic pain conditions. However, the small and methodologically limited existing body of evidence with a high risk of bias provides insufficient evidence for definite treatment recommendations, and further studies are warranted. Thus far, uncontrolled studies have been carried out for a multitude of different pain syndromes, and further research questions such as adequate length of treatment, established protocols, and potential EMDR targets can be derived on the basis of these studies. However, because the number of randomized controlled trials with adequate lengths of treatment is minimal, we recommend further exploration of the efficacy of EMDR in treating chronic pain patients by means of well-designed studies using standardized EMDR interventions of sufficient treatment length with adequate control groups.

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Supporting Information

Additional Supporting Information may be found in the online version of this article at the publisher's web-site:

Appendix SA List of databases searched and search strategies used.
Appendix SB List of potentially relevant studies.
Appendix SC Risk of bias assessment.