# Clinical Question:

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| In patients suffering from headaches secondary to post-concussion syndrome (PCS) or associated disorders, what are the best interventions to improve symptom management based on improvement in headache intensity, frequency, or severity in studies published in 2019 or later.  |

*Terms utilized in Search*

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| **P**atient/Client Group | **I**ntervention (or Assessment) | **O**utcome(s) |
| Post-concussion syndromeMild TBImTBI concussion mild traumatic brain injury acute cervical injurywhiplashmild closed head injury  | Rehabilitation Physical therapy Physiotherapy Intervention Rehab\*  | Headache\* (decrease intensity, frequency, duration) Cervicogenic headache\* Migraine Post-traumatic headachesPost-traumatic cephalalgia |

* Inclusion Criteria
	+ Jan 1 2019- Present
	+ Recommendations based on RCTs, systematic reviews, and appraisal of the literature
	+ Included recommendations that pertained to movement-related impairments
* Exclusion Criteria
	+ Not available in English
	+ Inclusion of only healthy participants (no participants with history of concussive event)
	+ No clear delineation of outcomes specific to individuals with concussion/mild traumatic brain injury when the study also included participants with more severe brain injury
	+ Participant or target population mean age was younger than 8 years
	+ Case study/series
	+ Commentary that was not evidence based
	+ Critical appraisal that resulted in a rating of unacceptable quality

*Databases Searched*

Key: Randomized Control Trail (RCT), Systematic Review (SR), Meta-analysis (MA)

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| **PubMed** Search Terms | Filters | # of hits  |
| ((concussion) AND (mTBI)) AND (headache) | >2019 | 81 |
| ((concussion) AND (mTBI)) AND (headache) | 2019>,RCT, SR, MA | 9 |
| ((concussion) OR (mTBI) OR (mild traumatic brain injury) OR (whiplash)) AND ((headache) OR (cervicogenic headache) OR (Migraine) OR (post traumatic headache)) | 2019>,RCT, SR, MA | 35 |
| ((concussion) OR (mTBI) OR (mild traumatic brain injury) OR (whiplash)) AND ((headache) OR (cervicogenic headache) OR (Migraine) OR (post traumatic headache)) AND ((rehabilitation) OR (rehab) OR (intervention\*)) | 2019>,RCT, SR, MA | 19 |
| ( **Post-concussion syndrome OR mTBI OR mild traumatic brain injury OR whiplash OR concussion OR acute cervical injury or mild closed head injury ) AND ( headache\* OR migraine OR tension headache OR post traumatic headache\* OR cervicogenic headache OR migraine OR Post-traumatic cephalalgia) AND ((rehabilitation) OR (rehab\*) OR (intervention\*) OR (Physical therapy) OR (physiotherapy))** | >2019, RCT, SR, MA | 22 |

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| **SPORTDiscus with Full Text** Search Terms | Filters | # of articles  |
| ( Post-concussion syndrome OR mTBI ) OR ( headaches or migraine or tension headache ) OR ( whiplash or whip lash ) OR cervicogenic headache OR concussion AND intervention OR mild traumatic brain injury | >2019, full text | 189 |
| ( Post-concussion syndrome OR mTBI OR mild traumatic brain injury OR whiplash OR concussion ) AND ( headaches OR migraine OR tension headache OR post traumatic headache OR cervicogenic headache OR migraine ) AND intervention  | >2019, full text | 0 |
| ( Post-concussion syndrome OR mTBI OR mild traumatic brain injury OR whiplash OR concussion ) AND ( headaches OR migraine OR tension headache OR post traumatic headache OR cervicogenic headache OR migraine ) | >2019, full text | 6 |
| ( Post-concussion syndrome OR mTBI OR mild traumatic brain injury OR whiplash OR concussion ) AND ( headaches OR migraine OR tension headache OR post traumatic headache OR cervicogenic headache OR migraine ) AND rehab | >2019 | 2 |
| ( Post-concussion syndrome OR mTBI OR mild traumatic brain injury OR whiplash OR concussion ) AND ( headaches OR migraine OR tension headache OR post traumatic headache OR cervicogenic headache OR migraine ) AND rehab | >2019, full text | 1 |
| ( ( Post-concussion syndrome OR mTBI OR mild traumatic brain injury OR whiplash OR concussion ) AND ( headaches OR migraine OR tension headache OR post traumatic headache OR cervicogenic headache OR migraine ) ) AND ( rehab or rehabilitation ) | >2019 | 6 |
| ( ( Post-concussion syndrome OR mTBI OR mild traumatic brain injury OR whiplash OR concussion ) AND ( headaches OR migraine OR tension headache OR post traumatic headache OR cervicogenic headache OR migraine ) ) AND ( physical therapy OR physiotherapy ) | >2019, full text  | 3 |
| **((concussion) OR (mTBI) OR (mild traumatic brain injury) OR (whiplash)) AND ((headache) OR (cervicogenic headache) OR (Migraine) OR (post traumatic headache)) AND ((rehabilitation) OR (rehab) OR (intervention\*))** | >2019, full text | 12 |
| **( Post-concussion syndrome OR mTBI OR mild traumatic brain injury OR whiplash OR concussion OR acute cervical injury or mild closed head injury ) AND ( headache\* OR migraine OR tension headache OR post traumatic headache\* OR cervicogenic headache OR migraine OR Post-traumatic cephalalgia) AND ((rehabilitation) OR (rehab\*) OR (intervention\*) OR (Physical therapy) OR (physiotherapy))** | >2019, full text | 16 |

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| **CINAHL** Search Terms | Filters | # of articles  |
| ((concussion) OR (mTBI) OR (mild traumatic brain injury) OR (whiplash)) AND ((headache) OR (cervicogenic headache) OR (Migraine) OR (post traumatic headache)) AND ((rehabilitation) OR (rehab) OR (intervention\*))  | >2019, full text | 4 |
| ( Post-concussion syndrome OR mTBI OR mild traumatic brain injury OR whiplash OR concussion ) AND ( headaches OR migraine OR tension headache OR post traumatic headache OR cervicogenic headache OR migraine ) AND intervention\*  | >2019, full text | 1 |
| ( Post-concussion syndrome OR mTBI OR mild traumatic brain injury OR whiplash OR concussion ) AND ( headaches OR migraine OR tension headache OR post traumatic headache OR cervicogenic headache OR migraine ) AND rehab\* | >2019, full text | 2 |
| ( Post-concussion syndrome OR mTBI OR mild traumatic brain injury OR whiplash OR concussion ) AND ( headaches OR migraine OR tension headache OR post traumatic headache OR cervicogenic headache OR migraine ) | >2019, full text | 5 |
| ( Post-concussion syndrome OR mTBI OR mild traumatic brain injury OR whiplash OR concussion OR acute cervical injury ) AND ( headaches OR migraine OR tension headache OR post traumatic headache\* OR cervicogenic headache OR migraine ) | >2019, full text | 5 |
| ( Post-concussion syndrome OR mTBI OR mild traumatic brain injury OR whiplash OR concussion OR acute cervical injury ) AND ( headache\* OR migraine OR tension headache OR post traumatic headache\* OR cervicogenic headache OR migraine) | >2019, full text | 10 |
| ( Post-concussion syndrome OR mTBI OR mild traumatic brain injury OR whiplash OR concussion OR acute cervical injury ) AND ( headache\* OR migraine OR tension headache OR post traumatic headache\* OR cervicogenic headache OR migraine OR Post-traumatic cephalalgia) | >2019, full text | 10 |
| ( Post-concussion syndrome OR mTBI OR mild traumatic brain injury OR whiplash OR concussion OR acute cervical injury or mild closed head injury ) AND ( headache\* OR migraine OR tension headache OR post traumatic headache\* OR cervicogenic headache OR migraine OR Post-traumatic cephalalgia) | >2019, full text | 10 |
| **( Post-concussion syndrome OR mTBI OR mild traumatic brain injury OR whiplash OR concussion OR acute cervical injury or mild closed head injury ) AND ( headache\* OR migraine OR tension headache OR post traumatic headache\* OR cervicogenic headache OR migraine OR Post-traumatic cephalalgia) AND ((rehabilitation) OR (rehab\*) OR (intervention\*) OR (Physical therapy) OR (physiotherapy))** | >2019, full text | 6 |

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| **PsycINFO** Search Terms | Filters | # of articles  |
| ((concussion) OR (mTBI) OR (mild traumatic brain injury) OR (whiplash)) AND ((headache) OR (cervicogenic headache) OR (Migraine) OR (post traumatic headache)) AND ((rehabilitation) OR (rehab) OR (intervention\*))  | >2019, full text | 6 |
| ( ( Post-concussion syndrome OR mTBI OR mild traumatic brain injury OR whiplash OR concussion ) AND ( headaches OR migraine OR tension headache OR post traumatic headache OR cervicogenic headache OR migraine ) ) AND ( physical therapy OR physiotherapy ) | >2019, full text | 0 |
| ( Post-concussion syndrome OR mTBI OR mild traumatic brain injury OR whiplash OR concussion ) AND ( headaches OR migraine OR tension headache OR post traumatic headache OR cervicogenic headache OR migraine ) AND rehab | >2019, full text | 0 |
| ( Post-concussion syndrome OR mTBI OR mild traumatic brain injury OR whiplash OR concussion ) AND ( headaches OR migraine OR tension headache OR post traumatic headache OR cervicogenic headache OR migraine ) AND intervention  | >2019, full text | 2 |
| **( Post-concussion syndrome OR mTBI OR mild traumatic brain injury OR whiplash OR concussion OR acute cervical injury or mild closed head injury ) AND ( headache\* OR migraine OR tension headache OR post traumatic headache\* OR cervicogenic headache OR migraine OR Post-traumatic cephalalgia) AND ((rehabilitation) OR (rehab\*) OR (intervention\*) OR (Physical therapy) OR (physiotherapy))** | >2019, full text | 58 |

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| **MedLine** Search Terms | # of articles  |
| **Available, Completed Studies | Interventional Studies | "Brain Concussion"****\*\*I was sent to** [https://clinicaltrials.gov/search/open/condition=%22Brain+Concussion%22](https://clinicaltrials.gov/search/open/condition%3D%22Brain%2BConcussion%22) **which I was not able to refine the search.\*\*** | 121 |

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| **Embase** Search Terms | Filters  | # of articles  |
| ((concussion) OR (mTBI) OR (mild traumatic brain injury) OR (whiplash)) AND ((headache) OR (cervicogenic headache) OR (Migraine) OR (post traumatic headache)) AND ((rehabilitation) OR (rehab) OR (intervention\*)) AND ([systematic review]/lim OR [meta analysis]/lim OR [randomized controlled trial]/lim) AND [2019-2022]/py | >2019, MA, RCT, SR | 67 |
| ( Post-concussion syndrome OR mTBI OR mild traumatic brain injury OR whiplash OR concussion ) AND ( headaches OR migraine OR tension headache OR post traumatic headache OR cervicogenic headache OR migraine ) AND ( intervention\* or rehab\* ) AND ([systematic review]/lim OR [meta analysis]/lim OR [randomized controlled trial]/lim) AND [2019-2022]/py | >2019, MA, RCT, SR | 33 |
| ( Post-concussion syndrome OR mTBI OR mild traumatic brain injury OR whiplash OR concussion ) AND ( headaches OR migraine OR tension headache OR post traumatic headache OR cervicogenic headache OR migraine ) AND intervention\* AND ([systematic review]/lim OR [meta analysis]/lim OR [randomized controlled trial]/lim) AND [2019-2022]/py | >2019, MA, RCT, SR | 17 |
| (('post concussion' AND syndrome OR mtbi OR mild) AND traumatic AND brain AND injury OR whiplash OR concussion) AND ((((headaches OR migraine OR tension) AND headache OR post) AND traumatic AND headache OR cervicogenic) AND headache OR migraine) AND physiotherapy AND ([systematic review]/lim OR [meta analysis]/lim OR [randomized controlled trial]/lim) AND [2019-2022]/py | >2019, MA, RCT, SR | 8 |
| **('concussion'/exp OR concussion OR mtbi OR 'mild traumatic brain injury'/exp OR 'mild traumatic brain injury' OR (mild AND traumatic AND ('brain'/exp OR brain) AND ('injury'/exp OR injury)) OR 'whiplash'/exp OR whiplash) AND ('headache'/exp OR headache OR 'cervicogenic headache'/exp OR 'cervicogenic headache' OR (cervicogenic AND ('headache'/exp OR headache)) OR 'migraine'/exp OR migraine OR 'post traumatic headache'/exp OR 'post traumatic headache' OR (post AND traumatic AND ('headache'/exp OR headache))) AND ('rehabilitation'/exp OR rehabilitation OR rehab OR intervention\*) AND ([systematic review]/lim OR [meta analysis]/lim OR [randomized controlled trial]/lim) AND [2019-2022]/py** | >2019, MA, RCT, SR | 8 |
| ('postconcussion syndrome'/exp OR 'postconcussion syndrome' OR mtbi OR 'mild traumatic brain injury'/exp OR 'mild traumatic brain injury' OR (mild AND traumatic AND ('brain'/exp OR brain) AND ('injury'/exp OR injury)) OR 'whiplash'/exp OR whiplash OR 'concussion'/exp OR concussion OR 'acute cervical injury' OR (acute AND cervical AND ('injury'/exp OR injury)) OR 'mild closed head injury' OR (mild AND closed AND ('head'/exp OR head) AND ('injury'/exp OR injury))) AND ([cochrane review]/lim OR [systematic review]/lim OR [meta analysis]/lim OR [controlled clinical trial]/lim OR [randomized controlled trial]/lim) AND [2018-2022]/py AND ('headache'/exp OR headache OR 'migraine'/exp OR migraine OR 'tension headache'/exp OR 'tension headache' OR 'post traumatic headache'/exp OR 'post traumatic headache' OR (post AND traumatic AND ('headache'/exp OR headache)) OR 'cervicogenic headache'/exp OR 'cervicogenic headache' OR (cervicogenic AND ('headache'/exp OR headache)) OR 'post-traumatic cephalalgia' OR ('post traumatic' AND ('cephalalgia'/exp OR cephalalgia))) AND ('rehabilitation'/exp OR rehabilitation OR rehab OR 'intervention'/exp OR intervention OR 'physical therapy'/exp OR 'physical therapy' OR (physical AND ('therapy'/exp OR therapy)) OR 'physiotherapy'/exp OR physiotherapy) AND ([systematic review]/lim OR [meta analysis]/lim OR [randomized controlled trial]/lim) AND [2019-2022]/py | >2019, MA, RCT, SR | 73 |

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*Evidence Table*

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| **Author (Year)** | **Risk of bias (quality score)\*** | **Level of Evidence\*\*** | **Relevance** | **Study design** | **Main Study Objective** |
| Patterson Gentile et al, 2021[1](https://sciwheel.com/work/citation?ids=12413758&pre=&suf=&sa=0&dbf=0) | AMSTAR-- Moderate - More than one non-critical weakness\*: The systematic review has more than one weakness, but no critical flaws. It may provide an accurate summary of the results of the available studies that were included in the review. The main flaw being no assessment of risk of bias in articles used.  | 2A- downgrade because article did utilize quality RCT, but not applicable to physical therapy interventions | Moderate | Systematic Review  | Provide a compilation of the evidence for the treatment of posttraumatic headache (PTH) in the pediatric population. Headache features and timing of therapy were considered. The main outcome measure was improvement of headache. |
| Esterov et al, 2021[2](https://sciwheel.com/work/citation?ids=12413473&pre=&suf=&sa=0&dbf=0) | PEDro: 5/11 Eligibility criteria: Yes; Random allocation: No; Concealed allocation: No; Baseline comparability: Yes; Blind subjects: No; Blind therapists: No; Blind assessors: No; Key outcome obtained from more than 85% obtained subjects: Yes ;Intention-to-treat analysis: No; Between-group comparisons: Yes; Point estimates and variability: Yes. | 2B | Moderate—these authors were not physical therapists and only used Muscle energy, myofascial release, counterstain, and suboccipital release. These were most commonly used techniques with least risk of adverse effects that were able to be performed with the most consistency (according to mutual consensus of the providers) between all treating providers in this study independent of level of experience. | RCT—Prospective Pilot Study  | To evaluate osteopathic manipulative treatment (OMT) for headaches in patients with PCS.  |
| Landén Ludvigsson et al, 2019[3](https://sciwheel.com/work/citation?ids=9942989&pre=&suf=&sa=0&dbf=0) | PEDro: 9/11 Eligibility criteria: Yes; Random allocation: Yes; Concealed allocation: Yes; Baseline comparability: No; Blind subjects: Yes; Blind therapists: No; Blind assessors: Yes; Key outcome obtained from more than 85% obtained subjects: Yes ;Intention-to-treat analysis: Yes; Between-group comparisons: Yes; Point estimates and variability: Yes. | 1B | High—Physical therapists helping specific population manage their headache symptoms. Strong, quality RCT.  | RCT | Evaluate the effect of 3 different exercise approaches on headache in chronic WAD grades 2 and 3, and to identify potential factors associated with such headache, and whether they differ depending on 3 different aspects of such headache (current headache, maximum headache, or headache bothersomeness). |
| Minen et al, 2019[4](https://sciwheel.com/work/citation?ids=6650648&pre=&suf=&sa=0&dbf=0) | AMSTAR 2 Low- One critical flaw with or without non-critical weaknesses: The review has a critical flaw and may not provide an accurate and comprehensive summary of the available studies that address the question of interest. Did not do a risk of bias assessment nor individual studies. Authors did not indicate any conflict of interest or funding included in the review.  | 1A | Moderate—Physical therapy interventions implemented, but due the large heterogeneity of the RCTs utilized there was no conclusive data besides early intervention.  | Systematic Review  | Behavioral interventions such as cognitive behavioral therapy, biofeedback, and relaxation are Level-A evidence- based treatments for headache prevention. To understand how to develop and study further mind-body interventions (MBIs) and behavioral therapies for PTH and PCS, we developed the following question using the PICO framework: Are behavioral therapies and MBIs effective for treating PTH and PCS? |
| Argyriou et al, 2021[5](https://sciwheel.com/work/citation?ids=11127715&pre=&suf=&sa=0&dbf=0) | AMSTAR 2 Low- One critical flaw with or without non-critical weaknesses: The review has a critical flaw and may not provide an accurate and comprehensive summary of the available studies that address the question of interest. Did not do a risk of bias assessment nor for individual studies. Do not clearly indicate methods established prior to initiating the study.  | 2A—downgraded from 1A due to utilizing more than just RCT | High—indicates many non-pharmacological interventions worth considering.  | Systematic Review  | A systematic review was conducted, according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) recommendations on recently published (2015–2020) papers on non-pharmacological interventions for PTH. |
| Betthauser et al, 2021[6](https://sciwheel.com/work/citation?ids=11929561&pre=&suf=&sa=0&dbf=0) | PEDro: 6/11 Eligibility criteria: Yes; Random allocation: Yes; Concealed allocation: Yes; Baseline comparability: Yes; Blind subjects: Yes; Blind therapists: No; Blind assessors: No; Key outcome obtained from more than 85% obtained subjects: No ;Intention-to-treat analysis: No; Between-group comparisons: Yes; Point estimates and variability: No. | 1B |  Moderate—large drop-out rate and poor statistical evaluation on the benefits of the treatment. However, did qualitatively discuss changes in patients’ headache symptoms in the specific population, mTBI.  | RCT | Assessed the feasibility of design elements of a yoga-based interventional trial for PCH among Veterans, as well as the acceptability of the intervention. A descriptive analysis was conducted on candidate outcomes including PCH, post-concussive symptoms, pain, and daily functioning. |
| Simpson-Jones and Hunt, 2019[7](https://sciwheel.com/work/citation?ids=6522824&pre=&suf=&sa=0&dbf=0) | AMSTAR 2 Low- One critical flaw with or without non-critical weaknesses: The review has a critical flaw and may not provide an accurate and comprehensive summary of the available studies that address the question of interest. | 3A (specific to the Vision Therapy component) |  Low  | System Review of Case-control studies  | To broadly examine the literature to identify vision interventions following mild traumatic brain injury. Objectives are to identify: (1) evidence-informed interventions for individuals with visual dysfunction after mild traumatic brain injury; (2) professions providing these interventions; (3) gaps in the literature and areas for further research.  |

*Keywords Articles Utilized:*

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| Postconcussion syndrome, postural instability, gaze stability, benign paroxysmal positional vertigo, cervicogenic dizziness, graduated exertion[8](https://sciwheel.com/work/citation?ids=6246389&pre=&suf=&sa=0&dbf=0) |
| Concussion; neurorehabilitation; physical medicine and rehabilitation; postconcussion syndrome; posttraumatic headache; osteopathic manipulative treatment; rehabilitation; traumatic brain injury[2](https://sciwheel.com/work/citation?ids=12413473&pre=&suf=&sa=0&dbf=0) |
| chronic, exercise, headache, rehabilitation, whiplash[3](https://sciwheel.com/work/citation?ids=9942989&pre=&suf=&sa=0&dbf=0) |
| **PsycInfo**: Concussion, mild traumatic brain injury, posttraumatic headache, concussive, stress management, Cognitive Behavior Therapy/ or exp Coping Behavior/ or coping skills, biofeedback, relaxation therapy/ or progressive relaxation therapy/ or autogenic training/ or behavior modification/ or guided imagery/ or hypnotherapy/ or meditation/ or muscle relaxation, yoga, tai chi, qi gong, deep breathing, Mind Body Therapy/ or mind body therapy. **Embase**: concussion, concussive, mild traumatic brain injury, posttraumatic headache, concussive, stress management, Cognitive Behavior Therapy/ or exp Coping Behavior/ or coping skills, biofeedback, relaxation therapy, meditation or hypnosis, guided imagery, tai chi, qi gong, deep breathing, Mind Body Therapy/ or mind body therapy, cognitive behavioral therapy.[4](https://sciwheel.com/work/citation?ids=6650648&pre=&suf=&sa=0&dbf=0) |
| Yoga, Post-concussive headaches, mTBI, Veterans[6](https://sciwheel.com/work/citation?ids=11929561&pre=&suf=&sa=0&dbf=0) |
| Mild traumatic brain injury, oculomotor control, optical devices, vision deficits, vision intervention, vision therapy[7](https://sciwheel.com/work/citation?ids=6522824&pre=&suf=&sa=0&dbf=0) |
| Concussion, pediatric, posttraumatic headache, treatment[1](https://sciwheel.com/work/citation?ids=12413758&pre=&suf=&sa=0&dbf=0) |
| Post-traumatic headache, acupuncture, biofeedback, cognitive-behavioral therapy, non-pharmacological interventions, noninvasive brain stimulation, post-concussion syndrome, therapeutic exercise, traumatic brain injury[5](https://sciwheel.com/work/citation?ids=11127715&pre=&suf=&sa=0&dbf=0) |

*Other Articles to Consider in the Future Since They Haven’t been Published as of 3/2/2022*

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| Exercise in Patients With Post-Concussion Symptoms-- <https://clinicaltrials.gov/ct2/show/NCT04001192> |
| Cervico-vestibular Rehabilitation for Mild Traumatic Brain Injury-- <https://www.clinicaltrials.gov/ct2/show/NCT03677661>  |
| Treating Persistent Post-Concussion Symptoms With Exercise-- <https://clinicaltrials.gov/ct2/show/NCT03895450?cond=Mild+Traumatic+Brain+Injury&cntry=CA&city=Calgary&draw=2>  |

*Exclude:*

* Cervicovestibular rehabilitation following sport-related concussion[9](https://sciwheel.com/work/citation?ids=6613098&pre=&suf=&sa=0&dbf=0)
	+ Based on publication date, but may have applicability.
	+ Sadly, this is just a research article, but it has an interesting take on vestibular and cervical rehab to improve patients having persistent concussion symptoms that did not have an improvement from the initial treatment (exertional based). However, this research article does not give much information on the RCT implemented.
* Physical Therapy Management of Adults with Mild Traumatic Brain Injury[8](https://sciwheel.com/work/citation?ids=6246389&pre=&suf=&sa=0&dbf=0)
	+ Does not have interventions focused on headaches
* fMRI findings in MTBI patients with headaches following rTMS[10](https://sciwheel.com/work/citation?ids=12413424&pre=&suf=&sa=0&dbf=0)
	+ Does not utilize Physical Therapy interventions
* How similar are whiplash and mild traumatic brain injury? A systematic review[11](https://sciwheel.com/work/citation?ids=11784489&pre=&suf=&sa=0&dbf=0)
	+ Does not utilize interventions, but does begin to describe similarities and differences between the two injuries
* Recovery Trajectory of Headaches Attributed to Concussion in an Adults at the Hull-Ellis Concussion Clinic[12](https://sciwheel.com/work/citation?ids=12414361&pre=&suf=&sa=0&dbf=0)
	+ Does not include interventions for headaches
	+ A naturalistic observational cohort study with clinic visits at Weeks 1, 2, 4, 6, 8, 12, and 16 after a concussion. N=303, Adults 17-85yo with diagnosis of concussion
* Specialized interdisciplinary rehabilitation reduces persistent post-concussive symptoms: a randomized clinical trial[13](https://sciwheel.com/work/citation?ids=6651846&pre=&suf=&sa=0&dbf=0)
	+ This article was published in Nov 2018. On the border but doesn’t fit inclusion criteria.
	+ 22-week program combining individual and group-based neuropsychological treatment with exercise therapy and physiotherapeutic coaching (S-REHAB), and the usual treatment offered by the public municipality services (STAND).
	+ The PT component of this interdisciplinary approach was individualized to each patient and no standardization on treatment style. However, with this:
	+ Immediately after treatment, the HIT-6 showed a significant reduction in the headache symptoms in the S-REHAB group compared to the STAND group (F(1, 86) = 4.40, p = 0.039) (ES = 0.38).
	+ ****At 6-month follow-up, the HIT-6 showed a significant reduction in the headache symptoms in the S-REHAB group compared to the STAND group (F(1, 86) = 8.94, p = 0.004)
* Semi-Automated Neurofeedback Therapy for Persistent Postconcussive Symptoms in a Military Clinical Setting: A Feasibility Study[14](https://sciwheel.com/work/citation?ids=8176764&pre=&suf=&sa=0&dbf=0)
	+ Included all traumatic brain injuries which excluded this article, but ~82% were mild TBI
	+ Single-group, pre-post intervention design to evaluate the feasibility of live z-score training (LZT) as a rehabilitation treatment for persistent post-concussion symptoms (PPCS) and characterize changes in self-report symptoms following treatment, as this may inform future clinical effectiveness trials. Baseline (T1) evaluations were completed > 4 weeks before start of LZT; posttreatment (T2) evaluations were completed 1-4 weeks after the final treatment; and a follow-up (T3) evaluation was completed 11-15 weeks after the final treatment.
	+ It works by training patients to self-regulate their abnormal neural activity, as that underlies impaired cognition and behavior. In addition to directly targeting underlying neural dysfunction, it has been suggested that neurofeedback therapy (NFT) also improves self-efficacy, which may also underlie clinical improvement. Generally, NFT uses behavioral principles to train patients in the form of positive reinforcement (eg, advancement in a video game, positive auditory or visual cues) for desirable neural modulation or negative punishment (eg, setbacks in a video game, negative auditory or visual cues) for undesirable neural modulation. Studies have demonstrated that NFT improves somatic complaints (headache, fatigue, sleep disturbance) and cognitive functioning (reduced attention, executive dysfunction)
		- * Did access headache symptoms among many other outcome measures.
* Post-traumatic cephalalgia[(Dwyer and Zasler 2020)](https://sciwheel.com/work/citation?ids=10918766&pre=&suf=&sa=0&dbf=0)
	+ A recent systematic review sought to identify applicable evidence relating specifically to the abortive and preventative treatment of PTC as defined by ICHD criteria; however, such treatment paradigms may inaccurately imply that all PTC are migrainous in all cases which is clearly not the reality of the situation. Unfortunately, no strong evidence from clinical trials is available to direct the treatment of PTC. Some guidelines have been offered for management based on primary headache categories and treatments.
	+ Focuses on pharmacological interventions mainly, did not include any interventions about physical therapy related strategies.
* Symptom Provocation During Aerobic and Dynamic Supervised Exercise Challenges in Adolescents With Sport-Related Concussion[15](https://sciwheel.com/work/citation?ids=11918845&pre=&suf=&sa=0&dbf=0)
	+ Did not access interventions to improve headache symptom
	+ Utilized a dynamic supervised exercise challenge (DSEC)program vs aerobic supervised exercise challenges program (ASEC) to provoke symptoms to determine appropriateness to return to sport and enhance the detection of concussion symptoms to guide in-clinic management decisions.

*Citation List:*

[1.    Patterson Gentile C, Shah R, Irwin SL, Greene K, Szperka CL. Acute and chronic management of posttraumatic headache in children: A systematic review. *Headache*. 2021;61(10):1475-1492. doi:10.1111/head.14236](https://sciwheel.com/work/bibliography/12413758)

[2.    Esterov D, Thomas A, Weiss K. Osteopathic manipulative medicine in the management of headaches associated with postconcussion syndrome. *Journal of Osteopathic Medicine*. 2021;121(7):651-656. doi:10.1515/jom-2020-0035](https://sciwheel.com/work/bibliography/12413473)

[3.    Landén Ludvigsson M, Peterson G, Widh S, Peolsson A. Exercise, headache, and factors associated with headache in chronic whiplash: Analysis of a randomized clinical trial. *Medicine (Baltimore)*. 2019;98(48):e18130. doi:10.1097/MD.0000000000018130](https://sciwheel.com/work/bibliography/9942989)

[4.    Minen M, Jinich S, Vallespir Ellett G. Behavioral Therapies and Mind-Body Interventions for Posttraumatic Headache and Post-Concussive Symptoms: A Systematic Review. *Headache*. 2019;59(2):151-163. doi:10.1111/head.13455](https://sciwheel.com/work/bibliography/6650648)

[5.    Argyriou AA, Mitsikostas D-D, Mantovani E, Litsardopoulos P, Panagiotopoulos V, Tamburin S. An updated brief overview on post-traumatic headache and a systematic review of the non-pharmacological interventions for its management. *Expert Rev Neurother*. 2021;21(4):475-490. doi:10.1080/14737175.2021.1900734](https://sciwheel.com/work/bibliography/11127715)

[6.    Betthauser LM, Forster JE, Bortz A, et al. Strength and awareness in action: Feasibility of a yoga-based intervention for post-acute mild TBI headaches among veterans. *Contemp Clin Trials Commun*. 2021;22:100762. doi:10.1016/j.conctc.2021.100762](https://sciwheel.com/work/bibliography/11929561)

[7.    Simpson-Jones ME, Hunt AW. Vision rehabilitation interventions following mild traumatic brain injury: a scoping review. *Disabil Rehabil*. 2019;41(18):2206-2222. doi:10.1080/09638288.2018.1460407](https://sciwheel.com/work/bibliography/6522824)

[8.    Kane AW, Diaz DS, Moore C. Physical Therapy Management of Adults with Mild Traumatic Brain Injury. *Semin Speech Lang*. 2019;40(1):36-47. doi:10.1055/s-0038-1676652](https://sciwheel.com/work/bibliography/6246389)

[9.    Schneider KJ, Meeuwisse WH, Barlow KM, Emery CA. Cervicovestibular rehabilitation following sport-related concussion. *Br J Sports Med*. 2018;52(2):100-101. doi:10.1136/bjsports-2017-098667](https://sciwheel.com/work/bibliography/6613098)

[10.   Vaninetti M, Lim M, Khalaf A, et al. fMRI findings in MTBI patients with headaches following rTMS. *Sci Rep*. 2021;11(1):9573. doi:10.1038/s41598-021-89118-2](https://sciwheel.com/work/bibliography/12413424)

[11.   Gil C, Decq P. How similar are whiplash and mild traumatic brain injury? A systematic review. *Neurochirurgie*. 2021;67(3):238-243. doi:10.1016/j.neuchi.2021.01.016](https://sciwheel.com/work/bibliography/11784489)

[12.   Langer L, Gladstone J, Comper P, et al. Recovery Trajectory of Headaches Attributed to Concussion in an Adults at the Hull-Ellis Concussion Clinic. *Arch Phys Med Rehabil*. 2019;100(10):e113. doi:10.1016/j.apmr.2019.08.334](https://sciwheel.com/work/bibliography/12414361)

[13.   Rytter HM, Westenbaek K, Henriksen H, Christiansen P, Humle F. Specialized interdisciplinary rehabilitation reduces persistent post-concussive symptoms: a randomized clinical trial. *Brain Inj*. 2019;33(3):266-281. doi:10.1080/02699052.2018.1552022](https://sciwheel.com/work/bibliography/6651846)

[14.   Hershaw JN, Hill-Pearson CA, Arango JI, Souvignier AR, Pazdan RM. Semi-Automated Neurofeedback Therapy for Persistent Postconcussive Symptoms in a Military Clinical Setting: A Feasibility Study. *Mil Med*. 2020;185(3-4):e457-e465. doi:10.1093/milmed/usz335](https://sciwheel.com/work/bibliography/8176764)

[15.   Popovich M, Sas A, Almeida AA, et al. Symptom Provocation During Aerobic and Dynamic Supervised Exercise Challenges in Adolescents With Sport-Related Concussion. *J Athl Train*. Published online January 11, 2021. doi:10.4085/1062-6050-0072.20](https://sciwheel.com/work/bibliography/11918845)

[16.   Dwyer B, Zasler N. Post-traumatic cephalalgia. *NeuroRehabilitation*. 2020;47(3):327-342. doi:10.3233/NRE-208006](https://sciwheel.com/work/bibliography/10918766)

*Having reviewed the studies that meet the inclusion and exclusion criteria, summarize the overall quality of the evidence for your clinical question.*

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| Based on the articles found and evaluated, the quality of evidence ranges from high quality being the systematic reviews[4](https://sciwheel.com/work/citation?ids=6650648&pre=&suf=&sa=0&dbf=0) and RCT[3,6](https://sciwheel.com/work/citation?ids=9942989,11929561&pre=&pre=&suf=&suf=&sa=0,0&dbf=0&dbf=0) to low quality being the case-control systematic review focused on vision interventions[7](https://sciwheel.com/work/citation?ids=6522824&pre=&suf=&sa=0&dbf=0). Many articles were exclude for various reasons, which one can see the individual reasons why stated above.[8–16](https://sciwheel.com/work/citation?ids=6613098,6246389,12413424,11784489,12414361,6651846,8176764,10918766,11918845&pre=&pre=&pre=&pre=&pre=&pre=&pre=&pre=&pre=&suf=&suf=&suf=&suf=&suf=&suf=&suf=&suf=&suf=&sa=0,0,0,0,0,0,0,0,0&dbf=0&dbf=0&dbf=0&dbf=0&dbf=0&dbf=0&dbf=0&dbf=0&dbf=0) There was only 1 specific article[5](https://sciwheel.com/work/citation?ids=11127715&pre=&suf=&sa=0&dbf=0) that directly answered my research question, but a lot of other articles had overlapping concepts and interventions that were applicable. There was a good variety of RCT and systematic reviews to give insight about how to best manage PCS symptoms, but generally not focusing on headaches in this population. The positive component of my research is that all articles included are up-to-date and published since 2019, which makes the evidence extremely valuable for updating best practices and providing ideas on future research topics. What makes this topic particularly difficult is the multifactorial issues that can cause headaches in patients who have suffered a concussion or mTBI. Through the process of researching multiple databases and finding articles about the research question, it’s becoming evident that physical therapy and non-pharmacological interventions are becoming more prominent in the treatment of persistent post-concussion symptoms. Due to the large heterogenous in research articles from mechanism of injury, time since injury, outcome measures, dosage of intervention, and interventions utilized to manage care, it’s challenging to make conclusive decisions about the best treatment to reduce secondary headache symptoms in patients who have PCS. |

*Best Evidence Summary*

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| * Argyriou et al[5](https://sciwheel.com/work/citation?ids=11127715&pre=&suf=&sa=0&dbf=0) provided the best evidence to support the research question because this systematic review focused non-pharmacological interventions for post-traumatic headache (PTH) and their primary outcome measure was changes in headache frequency and severity. Overall they determined that combined pharmacological and non-pharmacological interventions (i.e. noninvasive neuromodulation, physical therapy, cognitive-behavioral treatment, and education) is most likely the best approach for PTH. A note worth comments these authors conclude were that a neck-specific exercise with/without behavior interventions reduce whiplash-related headache in comparison to physical activity prescription, which these changes persisted up to 12 months. Another interesting conclusion they found is that high and low frequency translingual neurostimulation and physical therapy reduced headache frequency and improved sleepy. Lastly, these authors noted that neck manipulation should be avoided in patients with neck pain and therapeutic exercise is a viable, effective intervention to PTH.
* Minen et al[4](https://sciwheel.com/work/citation?ids=6650648&pre=&suf=&sa=0&dbf=0) performed a systematic review on behavioral therapies and mind-body interventions for PTH and post-concussive symptoms. Many of the interventions they included in their analysis had “vastly different methods of delivery of interventions and doses of intervention” and the mass heterogeneity between studies led to inconclusive findings. However, results did suggest that early intervention may be more beneficial to the patients.
* Landen Ludvigsson et al[3](https://sciwheel.com/work/citation?ids=9942989&pre=&suf=&sa=0&dbf=0) analyzed a RCT that introduced 3 different exercise approaches on headache in chronic whiplash disorder (WAD) grade 2 and 3. This was not my primary focus population, but WAD has many overlapping persistent symptoms when compared to PCS. Participants were randomized into either a 12 week of neck-specific exercise without (NSE) or with a behavioral approach (NSEB) or physical prescription (PPA). NSE and NSEB groups reported reduced headache both over time and compared to PPA, which 51% (NSE) and 61%(NSEB) reported at least 50% reduction in their headache at 12 months. There was a statistical significant (P<0.05) in the NSE/NSEB participants who reported at least 50% reduction in headache bothersomeness compared to PPA at 12 months. Ultimately, we should be included neck-specific exercises at the minimum into our interventions when working with patients who have WAD.
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*Student Notes from Articles:*

* Vision Rehabilitation Interventions following mild traumatic brain Injury: A scoping Review[7](https://sciwheel.com/work/citation?ids=6522824&pre=&suf=&sa=0&dbf=0)
	+ Scoping review was conducted of 4 electronic databases of peer-reviewed literature from the databases earliest records to June 2017. Articles were included if the study population was mild traumatic brain injury/concussion and a vision rehabilitation intervention was tested. Two independent reviewers screened articles for inclusion, extracted data, and identified themes.
		- Searched MEDLINE, PsycINFO, Embase, and EBSCO CINAHL Plus with Full Text
	+ 22 articles were included in the final review. Nine studies evaluated optical devices, such as corrective spectacles, contact lenses, prisms, or binasal occlusion. Two studies assessed vision therapy. Ten studies examined vision therapy using optical devices. One study investigated hyperbaric oxygen therapy. Optometrists performed these interventions in most of the studies.
	+ **Most relevant to PT:** Vision therapy. Two studies used vision therapy, also referred to as oculomotor training or rehabilitation in the literature. In one study, vision therapy involved computer-based versional (fixation, saccades, and pursuit) oculomotor training in a research lab. There was no home exercise component. In another study, office-based vision therapy was used along with a home-based therapy program. The vision therapy described, used office based vision exercises and computer-based activities using the Home Therapy System (HTS) to train vergence and versional eye movements. Vision therapy addressed several visual dysfunctions including versional and vergence oculomotor deficits (e.g., convergence insufficiency) and reading ability. The duration/dosage of vision therapy differed in the studies. For example, Kapoor et al. used twice weekly 60-min oculomotor training sessions, with each session consisting of 36 min of actual training with rest breaks, over an 8-week period. In Scheiman et al., the treatment sessions were administered for 60-min weekly with each session consisting of 45 min of therapy time for 12–20 office visits and this was combined with home-based therapy (15 min, 5 times per week). Pre- and post-testing involved both subjective and objective measures that assessed improvements in symptoms after participants completed the vision therapy.
		- * + Could be useful for other components of concussion, but don’t address the headache specific component.
* Acute and chronic management of posttraumatic headache in children: A systematic review[1](https://sciwheel.com/work/citation?ids=12413758&pre=&suf=&sa=0&dbf=0)
	+ SR on PubMed, Embase, Scopus, and Cochrane review search engines were conducted on July 16, 2020 and May 3, 2021. The main outcome measure was improvement of headache.
	+ ICHD-3 criteria define persistent PTH as >3 months. Expert opinion has suggested that early treatment with preventative medications may be able to prevent the development of persistent PTH. However, there is no clear evidence- based determination of when it is most appropriate to switch focus from abortive to preventative pharmacologic therapies based on the results of this current review.
	+ There is a paucity of evidence to guide clinicians on the timing and types of therapies that are effective for treating PTH.
	+ The greatest number of prospective studies with comparator groups focused on nonpharmacologic strategies used to treat postconcus- sive symptoms including PT, exercise therapy, and collaborative care models. However, in most cases, headache was not the primary out- come, but rather one of multiple postconcussion symptoms being measured on an inventory. Further research is needed to assess the specific impact of these therapies on PTH.
	+ We identified six studies (three prospective and 3 retrospective) that evaluated PT and timing of increased activity on PTH in youth. Some reported headache improvement, whereas others found modest or no effect.
* Osteopathic manipulative medicine in the management of headaches associated with postconcussion syndrome[2](https://sciwheel.com/work/citation?ids=12413473&pre=&suf=&sa=0&dbf=0)
	+ A controlled pilot study was conducted of patients with PCS who presented to an outpatient interdisciplinary rehabilitation clinic; patients with symptoms lasting longer than 3 months were enrolled and randomly assigned to an OMT treatment group or a control group.
	+ Primary outcome measures were immediate change in headache scores according to a Visual Analog Scale (VAS) and change in the six item Headache Impact Test (HIT-6) between baseline and follow up visits. The participants in the control group completed the HIT-6 between baseline and follow up visits but did not receive OMT and did not complete the VAS.
	+ No adverse effects or worsening of symptoms were found after OMT, and a significant improvement in headache severity immediately after OMT was found. While there was a difference in mean HIT-6 scores during 4 to 6 week follow up visits showing greater improvement in the treatment group, no statistically significant benefit was found. These overall findings are suggestive that immediate improvement in headache pain can occur in patients with PCS after OMT; however, results are inconclusive to demonstrate a sustained effect on follow up.
	+ The sample size in this study limited the power to assess for statistical significance of HIT-6 scores between the treatment and control groups. Sample sizes of 35 in the treatment group and 35 in the control group would have achieved 80.8% power to reject the null hypothesis with a population mean difference detected in the change in HIT-6 scores between treatment and control groups on follow up. Accounting for 20% dropout rate, sample sizes would include approximately 44 patients in treatment and 44 patients in the control group. (there were only 10 in each group)
* Exercise, headache, and factors associated with headache in chronic whiplash: Analysis of a randomized clinical trial[3](https://sciwheel.com/work/citation?ids=9942989&pre=&suf=&sa=0&dbf=0)
	+ Evaluate the effect of 3 different exercise approaches on headache in chronic WAD grades 2 and 3, and to identify potential factors associated with such headache, and whether they differ depending on 3 different aspects of such headache (current headache, maximum headache, or headache bothersomeness).
	+ Analysis of a randomized clinical trial of people with chronic WAD and headache (n = 188), who were randomized to either 12 weeks of neck-specific exercise without (NSE) or with a behavioral approach (NSEB) or physical activity prescription (PPA). Data were collected at baseline and at 3, 6, and 12 months. Physical and psychosocial factors were tested for association with headache.
	+ NSE/NSEB groups reported reduced headache both over time and compared to PPA. Up to 51% (NSE) and 61% (NSEB) reported at least 50% reduction in their headache at 12 months. The PPA group was not improved over time. Neck pain and dizziness were associated with headache regardless of aspect of headache. The only associated psychosocial factor was anxiety, which was associated with headache bothersomeness.
	+ The primary outcome was headache as reported on 3 different VAS scales (0–100 mm): current headache, maximum headache in the preceding week, and headache bothersomeness in the preceding 24 hours. Exercise diaries were also collected to monitor adherence.
	+ There was a significant mean group difference in change scores between groups in current headache (*P* < .001) while the other 2 outcomes did not quite reach significance (*P* = .06, and .07). A post-hoc difference was reported favoring the NSEB group over the PPA group (*P* < .01), but the difference between the NSE and PPA group did not quite reach significance (*P* = .06). Regarding time, there was no significant difference in change scores from 3 to 12 months. All group-by-time interactions were insignificant. However, when comparing within-group median changes from baseline, the NSEB group was improved over time at all time points and VAS measurements and the NSE group was improved in headache bothersomeness and maximum headache. The PPA group reported no improvement over time. There were no differences between the NSE/NSEB groups in any of the outcomes.
	+ Significantly higher proportion of participants who reported at least 50% reduction in headache bothersomeness in the NSE/NSEB groups versus PPA at 12 months (50% vs 27%, P < 0.05)
	+ Taking all these significant factors into account in the multivariate regression models, higher neck pain and more dizziness were the only factors associated with all 3 headache outcomes, whereas for instance higher anxiety was only associated with bothersomeness.
* fMRI findings in MTBI patients with headaches following rTMS[10](https://sciwheel.com/work/citation?ids=12413424&pre=&suf=&sa=0&dbf=0)
	+ Repetitive transcranial magnetic stimulation (rTMS) is able to alleviate MTBI-related headache (MTBI-HA). This functional magnetic resonance imaging (fMRI) study assessed supraspinal correlates associated with the headache analgesic effect of rTMS at left prefrontal cortex (LPFC), hypothesizing real rTMS would significantly increase modulatory functions at LPFC in comparison to sham treatment.
	+ Real rTMS consisted of 2000 pulses delivered at 10 Hz and 80% of the resting motor threshold at left dorsolateral prefrontal cortex, whereas sham treatment was delivered with same figure-of-eight coil turned 180 degrees.
	+ Two headache characteristics, persistent headache and debilitating headache exacerbation, were assessed during the study. Persistent Headache refers to a chronic daily headache that never goes away. Debilitating Headache refers to the intensity of headache being so severe that it completely debilitates a person’s daily normal functions to a level at which he or she may need to resort to bedrest
	+ Conclusion: 14 subjects receiving real and 12 subjects receiving sham treatments completed the study. The REAL group demonstrated significant (P < 0.02) decreases in headache frequency and intensity at one week following treatment. fMRI scans in the REAL group showed increased evoked heat pain activity (P < 0.002) and resting functional connectivity (P < 0.0001) at the LPFC after rTMS. Neither this significant analgesic effect nor these fMRI findings were seen in the sham group. Sham treatment was, however, associated with a decrease in resting state activity at the LPFC (P < 0.0001).
* How similar are whiplash and mild traumatic brain injury? A systematic review[11](https://sciwheel.com/work/citation?ids=11784489&pre=&suf=&sa=0&dbf=0)
	+ Whiplash and mTBI have many similarities (symptoms, biomechanics, cognitive disorders, presence of diffuse axonal lesions on functional imaging) and some differences (in posture, more vestibular and balance disorders in whiplash). mTBIs result from linear accelerations between 60- 160 g (gravity), studies on whiplash have shown that they can appear from 4.5 g, which could explain biomechanically the frequent concomitant appearance. Cervical joint dysfunction can appear in persistent concussive syndrome, with upper cervical pain, less endurance of the cervical flexor muscles, and an increase in cervical stiffness leading to tension headache. This could explain neck pain in mTBI and headache in whiplash. An explanation to vestibular and cochlear disorders is given, and the two pathologies concomitantly could increase the symptoms.
* Behavioral Therapies and Mind-Body Interventions for Posttraumatic Headache and Post-Concussive Symptoms: A Systematic Review[4](https://sciwheel.com/work/citation?ids=6650648&pre=&suf=&sa=0&dbf=0)
	+ 3 databases (Medline, PsycINFO, and EMBASE) for behavioral interven- tions and MBIs with the subject headings and keywords for PTH, concussion, and traumatic brain injury (TBI). Inclusion criteria were (1) randomized controlled trials, (2) the majority of the intervention had to be behavioral or mind-body therapy focused, (3) the majority of the participants (>50%) had to have had a mild TBI (not a moderate or severe TBI), (4) published in a peer-reviewed publication, and (5) meeting pre-specified primary and/or secondary outcomes. Primary outcome(s): whether there was a significant change in concussion symptom severity (yes/no) based on the symptom severity checklist/scale used, whether there was a 50% reduction in headache days and/or disability; secondary outcome(s): sleep variables, cognitive complaints, depression, and anxiety.
	+ Behavioral interventions such as cognitive behavioral therapy, biofeedback, and relaxation are Level-A evidence-based treatments for headache prevention.
	+ Seven articles met the final inclusion criteria.
	+ Many of the interventions offered vastly different methods of delivery of intervention and doses of intervention. The mass heterogeneity found between the studies led to inconclusive findings.
	+ Results suggest that early intervention may be more beneficial to the patients. Therefore, if “high risk” patients for developing PTH and PCS can be identified shortly after the mTBI, then early identification and intervention may be justified in improving the outcomes for individuals with mild to moderate TBI.
	+ Given that the studies reviewed did not typically account for bias regarding between subject variability, it is hard to make more definitive conclusions.
* An updated brief overview on post-traumatic headache and a systematic review of the non-pharmacological interventions for its management[5](https://sciwheel.com/work/citation?ids=11127715&pre=&suf=&sa=0&dbf=0)
	+ Primary outcomes of interest were changes in headache frequency and severity, quality of life, and associated symp- toms (e.g. depression, anxiety, sleep difficulties). The PubMed/ MEDLINE, Web of Science, CINAHL and PsycINFO databases were searched for peer-reviewed papers
	+ Growing evidence suggests that combined pharmacological and non-pharmacological interventions, encompassing noninvasive neuromodulation, physical therapy, cognitive-behavioral treatment, and education, may be the best approaches for PTH and related comorbidities. Acute/preemptive pharmacological treatments for PTH include drugs used for migraine and TTH.
	+ Cognitive-behavioral therapy (CBT) and repetitive transcranial magnetic stimulation (rTMS) appear to be the most promising approaches for PCS
	+ Non-invasive brain stimulation and cognitive-behavioral therapy are the non-pharmacological strategies with more robust evidence
	+ In a randomized controlled exploratory trial, Jonas et al. compared two acupuncture (i.e. auricular and traditional Chinese) protocols to usual care for chronic mild-tomoderate headache after TBI in 43 veterans and found significant decrease in headache severity and improvement of headache-related quality of life that persisted at 6-week follow-up for both acupuncture protocols compared to usual care.
	+ In a randomized controlled trial, Ludvigsson et al. tested the efficacy of three different exercise protocols (i.e. neck specific exercise with/without a behavioral approach and physical activity prescription) during a 12-week period on headache following chronic whiplash in a sample of 188 patients. Behavioral interventions consisted of psychoeducation and relaxation/breathing exercise sessions for chronic pain. The authors found that neck-specific exercise with/without behavioral interventions reduced current whiplash-related headache in comparison to physical activity prescription, and these changes persisted up to 12 months, while the other outcomes did not reach significance.
	+ In a multicenter prospective randomized controlled study, Ptito et al. assessed the safety and efficacy of a 5-week high – versus low-frequency translingual neurostimulation (TLNS) targeting cranial nerves of the anterior third of the tongue combined with physical therapy for chronic balance deficits following mild-to-moderate TBI in 122 patients with PTH as a secondary endpoint. The authors found reduced headache frequency and improved sleep quality after both high – and low-frequency TLNS.
	+ Patients with PCS and PTH should be offered a multidisciplinary approach including physical therapy, CBT, education on and management of coexisting psychological/ psychiatric symptoms together with pharmacological treatment of headache and neck pain, noninvasive brain stimulation, or other neurostimulation approaches depending on patients’ personal preferences and device accessibility.
	+ We suggest neck manipulation should be avoided, specifically for patients with neck pain. Therapeutic exercise may be effective on many coexisting symptoms coexisting, is cheap, and is efficient to treat PTH along with drugs targeting headache.
* Strength and awareness in action: Feasibility of a yoga-based intervention for post-acute mild TBI headaches among veterans[6](https://sciwheel.com/work/citation?ids=11929561&pre=&suf=&sa=0&dbf=0)
	+ Mild traumatic brain injury (mTBI) is a signature injury sustained by Veterans during recent conflicts. For some, mTBI/concussion is associated with disabling symptoms, including post-concussive headaches (PCH).
	+ Randomized controlled acceptability and feasibility trial was implemented using a waitlist-control design. Design elements of interest included: an exercise run-in class; recruitment and retention strategies; and ecological momentary assessment (EMA) modalities to track headaches and yoga practice. Veteran satisfaction regarding the intervention was also evaluated. A descriptive analysis was conducted on candidate outcomes including PCH, post-concussive symptoms, pain, and daily functioning. N=27, out of 70 consented and eligible
	+ The 1:1 block randomized waitlist control experimental design was used to determine if those initially allocated to the delayed-start group would remain in the study long enough to be provided the opportunity to participate in the yoga intervention.
	+ Six waves of participants were randomized. Those allocated to the 8-weekStrength and Awareness in Action: an Intervention for Post-Acute TBI Headaches(SAA-TBI) began yoga intervention immediately, and the ETU delayed-start group started approximately 8 weeks post
	+ participants randomized to the ETU group received enhanced treatment which consisted of completing surveys over the duration of the entire study period and additional contact/study visits with the study team. ETU did not include additional treatments or interventions specific to headaches
	+ A manualized yoga protocol based on mindful, trauma-informed yoga with an emphasis on poses designed to release head, neck, and shoulder tension was used, with a total of 16 yoga sessions building upon one another over the 8 weeks.
	+ 89% of these Veterans reporting moderate to high levels of satisfaction with the intervention at study completion. Qualitatively, participants endorsed improvements in headaches, chronic pain, and mood. Feasibility results were mixed. Initial feasibility criterion regarding yoga attendance was not met; however, modifications, such as expansion to an additional clinic site and reduction of in-person yoga sessions with increased encouragement to use study-created online yoga videos improved feasibility of the study design. Participants most frequently used mobile and web-based EMA modalities to track yoga practice.
	+ Many participants described benefits obtained from participating in the intervention such as improvements with headaches, mood, and pain.
	+ Many Veterans qualitatively expressed benefits of their participation in the SAA-TBI intervention, primarily noting decreased headache frequency and intensity and improvements in pain and overall mood. Results also suggest that the impact of daily headaches, as assessed by the HIT-6, reduced from Study Visit 3 to Study Visit 4.