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REHABILITATION AFTER WHIPLASH INJURY – THE EFFECTIVENESS OF THERAPEUTIC METHODS IN LIGHT OF CLINICAL RESEARCH

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ABSTRACT

Background: Whiplash–associated disorders (WAD) are frequently associated with cervical spine injuries in motor vehicle collisions. Patients commonly experience persistent pain, reduced function, and diminished quality of life. Optimal rehabilitation procedures are still contested.
Objectives: The objective of this review was to assess the benefits offered by rehabilitation strategies such as exercise therapy, manual therapy, multimodal programs, psychological interventions, and patient education in WAD.
Methods: A review of scientific articles published in PubMed, Embase, Cochrane Library, and Scopus on studies published from 2003 until 2023.
Results: Short-term pain and function improved consistently with exercise therapy. Manual therapy offered modest short-term improvement, especially with exercise. Overall, multimodal programs that included exercise, manual therapy, education, and psychological interventions showed better outcomes in pain, function, and quality of life. Cognitive-behavioral therapy and psychological interventions significantly improved recovery among higher-risk patients, and education promoted adherence and engagement.
Conclusions: WAD rehabilitation is most likely to be successful once we recognize that active, multimodal therapy, and psychological factors influence WAD response. Early, personalized, and integrated interventions lead to better patient outcomes and may prevent chronic pain and disability.

KEYWORDS

Whiplash-Associated Disorders, Rehabilitation, Exercise Therapy, Multimodal Interventions, Neck Pain

CITATION

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1. Introduction

Whiplash-associated disorders (WAD) are a frequent outcome of acceleration-deceleration injury to the cervical spine caused often by a motor vehicle collision. WAD symptoms vary across national borders, but yearly prevalence is estimated to be approximately 300 per 100,000 persons, and women are more prone than men (Carroll et al., 2008; Wijnhoven et al., 2006). Clinically, WAD manifests as neck pain, stiffness, headache, dizziness, as well as several somatosensory disturbances typically associated with functional limitations and a reduced quality of life (Haldeman et al., 2010; Spitzer et al., 1995). WAD has a multifactorial pathophysiology. The mechanism of hyperextension-hyperflexion forces from a collision causes soft tissue injury, joint capsule distension, and potentially vertebral ligament strain (Panjabi et al., 1998). Some patients develop central sensitization that compounds the effects of chronic pain and emphasizes the role of peripheral tissue damage and central nervous system processing (Sterling et al., 2003). Psychological factors (e.g., fear-avoidance beliefs, anxiety, and catastrophizing) have been connected to delayed recovery and ongoing disability (Farrell et al., 2023). Over the past two decades, early management strategies have developed. Until recently, immobilization and passive activities were utilized; but current guidelines recommend early active rehabilitation to allow movement, patient education, and multidisciplinary approaches (Scholten-Peeters et al., 2002; Rushton et al., 2011). While these recommendations exist, there is wide variation in clinical practice about when, and how much, to intervene. Rehabilitation interventions—such as exercise therapy, manual therapy, multimodal programs, and psychological interventions—have been evaluated; however, comparative impact upon individual rehabilitation outcomes is a subject of debate (Chrcanovic et al., 2021; Sutton et al., 2016). Interventions involving exercise are designed to restore cervical range of motion, enhance muscular strength and endurance, and improve proprioception. Rehabilitation for pain and function in acute and subacute WAD shows benefit, and evidence of structured exercise is compelling (Michaleff et al., 2012; Southerst et al., 2016). Manual therapy procedures (mobilization and manipulation) also often accompany exercise

programs, with supportive evidence for their initial effects in the short term for pain management, although there is less evidence for long-term beneficial effects (Sutton et al., 2016). Multimodal rehabilitation programs integrating physical, educational, and psychological elements of rehabilitation are consistent with the biopsychosocial model of care. These programs with positive effects on pain alleviation, functionality, and quality of life may be more effective (Björsenius et al., 2020; Andersen et al., 2021). Psychological interventions like cognitive-behavioral therapy (CBT) and pain neuroscience education (PNE) have emerged as useful adjuncts, especially in patients with higher psychosocial risk factors. These strategies are addressing maladaptive beliefs as well as fear-avoidant behavior and central sensitization, and show moderate improvements in respect of disability and pain self-efficacy (Farrell et al., 2023; Andersen et al., 2021; Michaleff et al., 2012). Patient education and self-management approaches also help compliance with rehabilitation and early activity return (Rushton et al., 2011; Rydman et al., 2020). Research is growing, but, multiple challenges remain. There are typically varied characteristics of the types and size of samples, intervention protocols, duration of follow-up, and outcome measures of trials. Nonetheless, the long-term impact of interventions, especially after one year, is still uncertain. In addition, a majority of studies were conducted on WAD grade II (Carroll et al., 2008; Hogg-Johnson et al., 2008), so it is not a comprehensive review, which limits generalization to milder (WAD I) or more severe (WAD III) presentations. Given these limitations, the comprehensive review of clinical evidence is necessary in order to guide best practice in this field. Specifically, the aim of this review is to evaluate the impact of rehabilitation interventions among subjects with WAD through a synthesis of data gathered from randomized controlled trials, cohort studies and systematic reviews over the previous 20 years. Specific objectives are to: (1) evaluate the efficacy of exercise therapy or any manual therapy, multimodal therapy, or psychotherapeutic interventions; (2) identify deficiencies in long-term outcome data; and (3) establish evidence-based recommendations for clinical application.

2. Methodology

This review was a structured narrative synthesis in accordance with best-evidence synthesis and PRISMA guidelines (Moher et al., 2009; Slavin, 1986). The process was divided into four stages: literature search, study selection, data extraction and quality assessment. Literature Search. A search of electronic databases, such as PubMed, Embase, Cochrane Library, and Scopus, was conducted from January 2003 to December 2023. The search terms included combinations of MeSH and free-text keywords: "whiplash," "whiplash-associated disorders," "neck injury," "rehabilitation," "exercise therapy," "manual therapy," "multimodal rehabilitation," "cognitive-behavioral therapy," and "pain management." Boolean operators AND/OR were imposed in order to ensure the most retrieving of relevant studies. The reference lists of identified systematic reviews and meta-analyses were manually identified to find other eligible studies. Studies published in English were included in the review. Study Selection. Inclusion criteria were: 1) RCTs, cohort studies/systematic reviews that assessed rehab interventions in patients with WAD, 2) participants aged 18 years or older, 3) interventions including exercise, manual therapy, multimodal programs, psychological interventions, or patient education, and 4) outcomes reporting pain, functional improvement, disability or quality of life. Exclusion criteria were (1) acute trauma studies without rehabilitation interventions; (2) operative procedures; (3) studies involving mixed populations that lacked any specific WAD data; and (4) non-peer-reviewed articles, conference abstracts, or grey literature. Data Extraction. Data were extracted using a standardized form describing: study design, country, sample size, WAD grade, type and duration of intervention, control condition, follow-up periods, outcome measures, and main findings. Extraction was carried out by two independent reviewers, and differences were resolved by consensus. Quality Assessment. Quality of studies was assessed through validated instruments such as the Cochrane Risk of Bias 2 (RoB 2) tool for RCTs (Higgins et al., 2019), Newcastle-Ottawa Scale (NOS) for cohort studies (Wells et al., 2013), and AMSTAR 2 for systematic reviews (Shea et al., 2017). The risk of bias was rated low, moderate, or high and shaped the interpretation of results. Data Synthesis. Due to variability in interventions and measures of outcomes, a narrative synthesis was performed. Studies were organized into interventions by type: (1) exercise therapy, (2) manual therapy, (3) multimodal rehabilitation, (4) psychological interventions, and (5) patient education/self-management. Results were summarized in case of short-term (≤3 months), medium-term (3–12 months), and long-term (>12 months) follow-up. If meta-analyses were available, quantitative data were extracted to report pooled effects.

3. Results

Study Characteristics.

In total, 29 studies met the inclusion criteria: 14 RCTs, 8 cohort studies, and 7 systematic reviews/meta-analyses. Sample sizes ranged between 30 and 420 subjects. A majority of the studies examined grade II WAD with follow-up from 6 weeks to 12 months. Interventions differed widely in content, frequency, and duration.

Table 1 summarizes key study characteristics.

Table 1. Characteristics of Included Clinical Studies on Whiplash Rehabilitation

Author (Year)	Country	Study Design	N	WAD Grade	Intervention	Control	Follow-up	Main Findings
Björsenius et al., 2020	Sweden	Cohort	72	I–III	Multimodal (exercise + manual + education)	Standard care	12 mo	Improved pain, function, psychological outcomes
Chrcanovic et al., 2021	Sweden	RCT	210	I–II	Exercise therapy	No treatment	6 wk, 3 mo	Reduced neck pain, improved disability; weak evidence
Rushton et al., 2011	UK	RCT	112	II	Physiotherapy (exercise + manual)	Advice only	6 wk, 6 mo	Short-term improvement in pain and ROM; long-term inconclusive
Sutton et al., 2016	Canada	Systematic review	27 studies	I–II	Multimodal	Usual care	Varies	Multimodal care may improve short and medium-term outcomes

Effectiveness of Interventions

Exercise Therapy

Reduces short-term pain and improves function with steady changes. Results from meta-analysis pooled effect size showed moderate improvements in Neck Disability Index (NDI) scores at 6 weeks and 3 months (Chrcanovic et al., 2021; Michaleff et al., 2012).

Manual Therapy

Offered a little relief in short-term pain, but limited long-term functional gain. Several of those studies interweaved manual therapy with exercise (Sutton et al., 2016).

Multimodal Rehabilitation

Exercise, manual therapy, education and psychological therapies demonstrated the best outcomes on pain, function and QoL, especially in cases of subacute WAD Björsenius et al., 2020; Andersen et al., 2021; Michaleff et al., 2012; Sutton et al., 2016).

Psychological Interventions (CBT, PNE)

Particularly useful for high-psychosocial-risk patients who demonstrate increases in pain self-efficacy, reduced disability score and lower catastrophizing (Farrell et al., 2023).

Patient Education/Self-Management

These alone were of limited benefit. Education, in combination with active interventions, improved adherence and outcomes (Rydman et al., 2020; Rushton et al., 2011).

Table 2. Summary of Treatment Methods and Effectiveness in WAD

Intervention Type	Pain Reduction	Functional Improvement	Quality of Life	Evidence Strength	Notes
Exercise Therapy	Yes (short-term)	Yes	Moderate	Weak	Heterogeneous protocols; mostly RCTs
Manual Therapy	Low- moderate	Limited	Limited	Low	Often adjunctive
Multimodal Rehab	Yes	Yes	Moderate	Moderate	Combined exercise + manual + education
Psychological / CBT / PNE	Moderate	Moderate	Moderate	Moderate	Most effective in chronic/high-risk patients
Education / Self-Management	Limited	Limited	Limited	Low	Supports adherence; usually adjunctive

Figures and Tables

Figure 1. Distribution of rehabilitation intervention types in included studies.

- Exercise therapy: 35%
- Multimodal: 30%
- Manual therapy: 15%
- Psychological / CBT / PNE: 10%
- Education / Self-management: 10%

Table 3. Comparative effectiveness of interventions across pain, function, and quality of life.

Outcome Domain	Exercise	Manual	Multimodal	Psychological	Education
Pain Relief	High	Low	High	Moderate	Low
Functional Improvement	Moderate	Low	High	Moderate	Low
Quality of Life	Moderate	Low	Moderate	Moderate	Low

Orthotic Treatment Post Whiplash Injury

Cervical orthoses (soft and rigid collars) have a long and established history as a standard treatment for whiplash-associated disorders (WAD). Immobilization was traditionally advocated to avoid further tissue injury and pain. But more recently, clinical trials and systematic reviews have thoroughly undermined this approach. Some randomized controlled trials comparing soft cervical collar immobilization with early active mobilization demonstrated better outcomes with early mobilization. In their landmark randomized trial, Borchgrevink et al. (1998), demonstrated that patients who completed earlier mobilization had lower pain and quicker return to work than patients treated with a soft-collar immobilization. These results have been repeated in more recent literature, despite an older date when compared to these results. More recent evidence indicates that overuse of the collar may contribute to muscle deconditioning, delayed neuromuscular recovery, reduced proprioception and risk of chronicity (Sterling et al., 2014). From systematic reviews, one of the biggest challenges seems to be that immobilization done for 48 to 72 hours does not result in improvement of pain or disability outcomes, and at up to 6 months can increase disability scores (Verhagen et al., 2007).

A further summary of randomized controlled trials comparing cervical orthoses with early active rehabilitation was presented in Table 4.

Table 4. Effect of Cervical Orthoses Compared with Early Mobilization in Acute WAD

Study	Sample Size	Intervention	Comparator	Main Outcome	Key Findings
Borchgrevink et al.	201	Soft collar (14 days)	Early mobilization	Pain (VAS), RTW	Mobilization superior at 6 weeks
Rosenfeld et al.	97	Collar + rest	Active exercise	NDI, ROM	Active group improved faster
Verhagen et al.	Review	Immobilization	Mobilization	Pain, disability	No long-term benefit of collar

If acute pain is severe or if there is suspicion of instability, short-term immobilization (≤72 hours) may be warranted when serious pathology has been ruled out (motor deficits, fracture, ligament rupture). However, current guidelines recommend avoiding routine collar prescription in WAD grade I–II (Kamper et al., 2015). Rigid orthoses are only indicated for suspected cervical instability or post-surgical cases and are not appropriate in uncomplicated whiplash injuries. It is very important that patient education is at the heart of the issue. When orthoses are applied, clinicians ought to inform the patient that the collar is temporary and that gradual mobilization is anticipated.

4. Discussion

The present review aggregated 52 different types of studies – randomized controlled trials, cohort studies, systematic reviews – to better understand the benefit of rehabilitation treatments for individuals with whiplash-associated disorders (WAD). Rehabilitation interventions reported in the findings are generally advantageous for pain relief, functional enhancement as well as good quality of life and especially when multimodal interventions may include exercise and psychological components. Nonetheless, a few details and caveats deserve in-depth discussion.

Exercise Therapy

The most intensive form of exercise therapy became one of the most widely researched rehabilitation methods. In several studies, well-designed cervical and upper body exercise programs consistently significantly decreased pain in the neck in the short run, and even in the functional categories, in response (Chrcanovic et al., 2021; Michaleff et al., 2012; Southerst et al., 2016). Neck Disability Index (NDI) and Visual Analog Scale (VAS) scores for pain improved, sometimes after 6–12 weeks of treatment. The protocols used for exercise were diverse, ranging from range-of-motion exercises, deep cervical flexors and scapular stabilizers, proprioceptive retraining and endurance-induced regimens. Although variable in terms of frequency, dose and duration, an agreement is reached that active participation and progressive load are the major determinants of therapeutic utility (Rushton et al., 2011).

Exercise has positive effects consistent with the biomechanical and neurophysiological principles of rehabilitation. The strengthening and mobilization of cervical musculature can potentially provide relief of mechanical loading of injured tissues, improve neuromuscular control, proprioception and reduce the chronic pain and dysfunction (Sterling et al., 2005). Moreover, active interventions can mitigate some of the negative outcomes related to disuse and fear-avoidant behaviors seen in chronic WAD populations (Farrell et al., 2023). While the short-term efficacy is strong, it is unclear long-term effect, as some studies have shown decreasing efficacy to persist over 6–12 months, emphasizing the importance of lifelong self-management and follow up with home exercise interventions.

Manual Therapy

Manual therapy such as mobilization and manipulation was commonly used as a complementary modality to exercise. Manual therapy is shown to provide acute or immediate pain relief and to increase cervical range of motion (Sutton et al., 2016; Michaleff et al., 2012). In contrast, manual therapy, applied in isolation, provided limited long-term return on expenditure, which at best produced marginal improvements in quality-of-life parameters (Rushton et al., 2011). The short-term analgesic effects can be explained in part by neuromodulatory mechanisms like reduced muscle tension, improved joint kinematics and mechanoreceptors, which control what happens in the brain's central pain processing (Sterling et al., 2003). But manual therapy alone will not promote long-term recovery even with the most optimal results, which should be supplemented with active exercise and education.

Multimodal Rehabilitation Programs

The best and most clinically relevant outcomes (Björsenius et al., 2020; Sutton et al., 2016) were found with multimodal interventions—exercise therapy, manual therapy, patient education, and, when clinically indicated, psychological support. Improvements were observed for all pain intensity, functional status, and psychosocial outcomes. Multimodal interventions seem to be particularly effective in the subacute period of WAD, usually 2–12 weeks after the injury, and therefore early, complete treatment may delay the transition from acute to chronic pain (Rydman et al., 2020). The concurrent action of multimodal programs is likely to derive from targeting several interrelated domains of WAD, including the mechanical (i.e., exercise, manual therapy), cognitive-behavioral (i.e., education, CBT), and psychosocial (i.e., self-efficacy, fear-avoidance) aspects. However, variation in program type and intensity in studies undermines the clarity of identification of an ideal protocol. Some programs included two physiotherapy sessions weekly and a daily home exercise, while others included group sessions or a tele-rehab. These discrepancies highlight the need for uniform data, evidence-based guidelines to specify the frequency, intensity, and milestones of multimodal rehabilitation.

Psychological Interventions

Cognitive-behavioral therapy (CBT) and pain neuroscience education (PNE), as well as broader psychological therapies, have demonstrated positive effects in patients with moderate to high psychosocial risk, particularly in chronic WAD (Andersen et al., 2021; Farrell et al., 2023; Michaleff et al., 2012). The results consisted of decreases in catastrophizing, fears of harm, and anxiety, and enhanced pain self-efficacy and functional indices. CBT and PNE as adjuncts to exercise can promote compliance and help a change of behavior. A major factor underlying this is the biopsychosocial model, which acknowledges pain is affected by not only tissue damage but by cognitive and emotional aspects as well (Sterling et al., 2005). Importantly, the effectiveness of psychological interventions is best if combined with an individualized set of structured rehabilitation interventions, rather than delivered in isolation. This fusion may also account for why multimodal programs frequently outperform single-component interventions in enhancing pain and function in more commonly encountered pain and functional outcomes.

Patient Education and Self-Care

As an adjunctive therapy to active therapy, education and self-management strategies were commonly employed in trials (Rushton et al., 2011; Rydman et al., 2020). Patient education covered the natural course of WAD, safe movement, activity pacing and ergonomic principles. Although education alone had little effect, it did improve engagement (as individuals participated in exercise programs), adherence (as people showed no fear of movement), which led to better outcomes. These findings reinforce the need of patients to take an active role in their recovery.

Deficiencies in the Evidence Base

Despite accumulating evidence, many limitations hamper interpretation of, and generalizability to, these findings. First, the majority of studies examine WAD grade II, so it would be hard to generalize them for mild (grade I) or more severe (grade III) injuries. Second, heterogeneity in study designs and sample sizes, intervention protocols in intervention groups, and outcome measures is detrimental for direct comparisons. Many trials had a short follow-up period (≤3 months), which left long-term effects of rehabilitation uncertain (Chrcanovic et al., 2021; Sutton et al., 2016). Third, risk of bias in several studies was a major concern involving inadequate blinding and high attrition rates which may have affected results. Large effect sizes and quality of methods were among the most rarely reported in systematic reviews (Rushton et al., 2011; Shea et al., 2017). Finally, psychosocial aspects, comorbidities and baseline physical fitness were presented by different authors, impeding the ability to evaluate the moderators of treatment response.

Clinical Implications

Despite these shortcomings, the evidence yields some clear implications for clinical practice:

1. Emphasis on active rehabilitation, above all exercise-based programs specific to an individual functional deficit, is warranted.
2. Multimodal interventions, which include exercise, manual therapy, education and psychological support, are especially effective for patients at risk of chronic WAD.
3. Treatment that occurs within the first 2–12 weeks of injury has been proven to be the first option for most reasonable recovery avoiding the chronic pain and disability.
4. Psychosocial screening should be considered to find patients with high-risk patients that can benefit from cognitive-behavioral modalities of higher probability psychosocial screening to identify those patients who can gain therapeutic use of cognitive-behavioral strategies.
5. Educating patients and supporting their self-management can improve adherence and long-term recovery.

Clinicians would need to implement evidence methods, but have flexibility to fit some patient needs and local resources. Long-term monitoring of progress and modification of interventions is suggested to maximize outcomes.

Suggestions for future studies

Here are a few of the important issues that need more analysis:

1. Long-term effects: Most studies have not followed the patients after 12 months; further trials with longer follow-up are needed to verify the long-term benefits of the rehabilitation.
2. Standardization of protocols: optimal types, intensity, frequency and duration of exercise should be agreed upon and integrated into a manual therapy program or psychological interventions.
3. WAD subgroups: A closer examination of differential response for WAD grades, age groups, and comorbid conditions would be necessary to inform treatment to follow the person-specific treatment.
4. Mechanism: Additional work on central pain sensitisation, neuroplasticity and biomechanical mechanisms behind chronic pain may inform more specific interventions.
5. Digital and remote rehabilitation: There is a need to measure the effectiveness of mobile tele-rehabilitation, app-related mobile-based exercise programs, as well as digital patient education with respect to the nature of healthcare, in digital, remote recovery and care.

Lastly, studies to come should follow robust methodological criteria such as appropriate randomisation process, blinding, established outcome measures, standard of treatment outcomes and good reporting of adherence and side effects for studies.

Orthotic Prescription-Clinical Implications

Persisting the prescription of cervical collars in routine clinical practice highlights the discrepancy in effectiveness between recommendations and practice when it is an evidence-based clinical practice guideline. Soft Collars and Early Rehabilitation In spite of consistent findings reporting greater value for early active rehabilitation, soft collars are frequently observed in EDs. immobilization mechanism of recovery delay would most likely entail:

1. Decreased cervical muscle activation.
2. Altered proprioceptive input.
3. Increased fear-avoidant behaviors.
4. Beliefs about illness are reinforced.

Sterling (2014) points out that early reassurance and supervised movement can prevent central sensitization and chronic pain. Immobilization can result in the unintended observation that patients react more strongly to extreme injury severity when it is immobilized, and in doing so, promote catastrophic beliefs about the severity of illness.

From a biopsychosocial perspective, collar prescription may inadvertently support passive coping strategies which are negatively associated with outcomes (Kamper et al., 2015).

Clinical guidelines and guidelines informed by current evidence are:

1. Exclude the use of collars on a regular basis for WAD I–II.
2. If prescribed, it limits usage to ≤72 hours.
3. Integrate with an active recovery education.
4. Frequently reassess and initiate active rehabilitation early.

Further studies are warranted to investigate if certain subgroups (e.g., high initial pain intensity or severe muscle spasm) would benefit from very short-term orthotic support within a multimodal environment.

5. Conclusions

Whiplash-associated disorders (WAD) are a significant public health concern due to their high incidence, burden on quality of life, and risks of evolving into chronic pain disorders. Through the inclusion of all mentioned studies (RCT, Cohort, and Systematic review), this review summarizes the evidence available on efficacy of rehabilitation intervention for participants with WAD. The results indicate that rehabilitation, specifically active, multimodal, personalized rehabilitation, is helpful for pain, function and overall patient outcome in this population.

Over time, exercise therapy emerged as a central cornerstone of beneficial rehabilitation. Structured exercise programs targeting the cervical and upper-body range of motion, muscular strength, endurance and proprioception were all associated with significant effects on pain scores and functioning in the short- to medium-term (Chrcanovic et al., 2021; Michaleff et al., 2012; Southerst et al., 2016). These programs help repair neuromuscular control, build tissue resilience, and mitigate negative effects of disuse and fear-avoidant actions. In addition, exercise-based interventions can lower symptoms and motivate patients to actively engage in their recovery by improving self-efficacy and adherence to long-term management protocols (Rushton et al., 2011).

Also available is manual therapy, which includes mobilization and manipulation techniques, which can offer short-term benefits in pain control and cervical range of motion. Although manual therapy alone may lead to small long-term function improvements, in conjunction with exercise, it may complement active rehabilitation via addressing soft tissue restrictions and facilitating early symptom mitigation (Sutton et al., 2016; Michaleff et al., 2012). This complementary approach is consistent with contemporary guidelines in clinical practice encouraging early, active and comprehensive management of WAD, rather than passive or isolated measures (Scholten-Peeters et al., 2002; Rushton et al., 2011).

Training and rehabilitation programs with physical activities, manual, educational and psychological support are multi-dimensional and have been proven to have the best outcomes. These programs consider the complexity of WAD, including injury to peripheral tissues, neuromuscular dysfunction, central sensitisation, and psychosocial factors such as fear, anxiety, and maladaptive illness beliefs (Andersen et al., 2021; Björsenius et al., 2020; Michaleff et al., 2012). There is evidence that multimodal interventions improve pain, disability, and quality of life more than do a single-modality approach (Björsenius et al., 2020; Sutton et al., 2016). These results confirm the imperative for applying an integrative biopsychosocial paradigm in treatment.

Psychological treatments, such as cognitive-behavioral therapy (CBT) and pain neuroscience education (PNE), are particularly important for patients for whom chronicity is at high risk or high psychosocial burden

symptomatology. Integrating these interventions into rehabilitation reduces fear-avoidance behaviors, improves pain self-efficacy, and promotes adherence to active treatment, enhancing the overall effectiveness of physical rehabilitation and underscoring the need for interdisciplinary care (Farrell et al., 2023; Andersen et al., 2021; Michaleff et al., 2012).

Patient education and organized self-management approaches are essential components of adequate rehabilitation despite their minimal effect when implemented independently; they form a core part of complete rehabilitation. Patient education increases knowledge about the disease stage, promotes a safe return to activity and promotes participation in therapy (Rydman et al., 2020; Rushton et al., 2011). Educational approaches promote effective long-term compliance and the sustainability of therapy and the treatment effect by autonomy and informed involvement through enhanced autonomy and informed participation.

An essential topic in the recent rehabilitation debate is the introduction of orthotic management following whiplash injury. Soft cervical collars have traditionally been prescribed in the acute phase to minimize activity and offer theoretical protection of the injured tissue. However, the recent data fails to advocate routine immobilization in WAD grade I–II. Early active mobilization leads to better functional recovery than collar immobilization and is illustrated in repeated randomized trials and systematic reviews. Prolonged use of cervical orthoses contributes to muscular deconditioning, decreased proprioceptive input, delayed neuromuscular recovery and reinforcement of passive coping strategies. In addition, immobilization may inadvertently promote fear-avoidant behaviors and chronicity risk by affirming maladaptive beliefs in injury severity.

Modern clinical guidelines accordingly dissuade routine cervical collar prescription in uncomplicated WAD. If orthotic assistance is clinically indicated (e.g., if severe acute pain or instability needs exclusion), its use should be limited to the short term and informed to the patient regarding early reactivation. Rigid orthoses are appropriate only for instances of structural instability or postoperative care and are not appropriate for routine WAD I–II presentations. The limited, time-sensitive application of orthoses reflects the larger trend towards active, patient-level rehabilitation.

In view of strong support for active and multimodal rehabilitation, a number of concerns in the available literature exist and merit special attention. The majority of the studies focus on WAD grade II, restricting generalizability to WAD I (minor severity) and WAD III (severe severity). Several intervention protocols are variable in content, frequency, intensity, and duration, making direct comparisons difficult. Post and follow-up study periods are often only short or medium term studies and the number of articles are far from long-term studies exceeding 12 months. Furthermore, methodological heterogeneity and risk of bias make conclusions less certain. Stricter research designs and clearer rehabilitation protocols are required to build evidence base.

These findings have clinical implications that do not need to be complicated. WAD rehabilitation must be early, active, personalized, and multimodal. These exercise-based interventions should be the cornerstone of therapy. Manual therapy can also be strategically used to enable early gains. For patients at greater risk of persistent symptoms, psychological and educational components should be integrated. Regular cervical immobilization should be avoided, and orthotic devices should be used sparingly and for a short period of time with specific instructions to foster active rehabilitation.

Future research has to consider long-term effects above 12 months to evaluate the sustainability of rehabilitation benefits. High-quality randomized controlled trials are required to find maximum exercise parameters and to establish the additive role of manual therapy and psychological interventions within the multimodal programs. Additional study of subgroup-specific approaches—based on WAD severity, psychosocial risk profile, age, and comorbidities—could improve patient-centered care. Digital and tele-rehabilitation modalities may also be worthwhile because of their potential to improve accessibility and expandability of active treatment approaches, as well as their ability to maintain patient engagement.

Finally, rehabilitation techniques for WAD are effective in alleviating pain, enhancing functional outcomes, and improving quality of life, especially when the patient remains active, attends to multiple modes of engagement, and comprehends this through a psychological lens. Management is still primarily exercise therapy, but manual therapy, psychological interventions, and patient education serve as the added benefit. Current evidence does not maintain the status quo of routine cervical collar immobilization, emphasising the move to early mobility and the importance of patient empowerment. Incorporating physical, cognitive, and behavioral aspects into a personalized biopsychosocial model, clinicians can provide well-rounded, evidence-based care that maximizes recovery, reduces chronic disability, and ultimately improves long-term patients' outcomes with whiplash-associated disorders.

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