

# An update on the management of post-traumatic headache

Mark Obermann, Steffen Naegel, Bert Bosche and Dagny Holle

**Abstract:** Recent studies from the UK give the debate about how to deal best with patients suffering from whiplash injury new impetus. Following whiplash injury, about 90% of patients complain about head and/or neck pain, as well as dizziness, sleep problems and anxiety. These symptoms are often referred to as whiplash-associated disorders. In the majority of cases, these complaints develop within a few days or weeks following the accident. However, 30–50% of patients experience prolonged symptoms for more than 6 months, with headache as the main complaint. In accordance with the bio-psycho-social model of chronic post-traumatic headache, the following treatment options have been suggested: (1) proper patient education with detailed explanation of the condition; (2) support of normal movement; (3) avoiding immobilization; (4) resumption of work; and (5) targeted physiotherapy. Based on current study data, intensified physiotherapy seems not to be superior to standard therapy with simple patient education and can therefore not be recommended considering cost-benefit aspects.

**Keywords:** MINT Study, post-traumatic headache, PROMISE Study, treatment, whiplash injury

## Background

Whiplash injuries of the cervical spine are the most common injuries of police captured traffic accidents involving personal injury in Germany [Schmidt, 1989]. About 80% of road accident victims suffer a more or less severe neck trauma in the context of car accidents [Evans, 1992]. The incidence of whiplash injury in Germany is 200 people per 100,000 population per year [Jörg and Menger, 1998]. In the UK, the annual cost to the healthcare system is estimated to be £3.1 billion (EUR 4.1 billion) [Lamb *et al.* 2013]. Headaches as a result of head and neck trauma are one of the most common secondary headache types. They are also one of the most controversial headache topics due to medico-legal aspects, unclear pathophysiological mechanisms and the unresolved role of associated psychological features. This becomes even more controversial regarding chronic post-traumatic headache following mild closed head injury or whiplash.

A whiplash injury is typically an intense, passively imposed, unexpected dorsal acceleration force (rear impact) sufficient to elicit a relevant translational,

rotational or retro flexional movement of the cervical spine, usually followed by a less vigorous counter-swing anteriorly. For front or side force impacts, a similar mechanism may be assumed that mainly affects the posterior or lateral neck muscles as well as the ligaments and cervical spine bone *via* an ante or lateral flexion. Whiplash injuries may also develop under other conditions, for example, during climbing or repelling, or in contact sports. Movements related to rotation or torsion about the longitudinal axis of the body in relation to impact time, as is the case with backwards turned neck, head or trunk, may lead to complicated injury patterns [Ferrari, 2002a].

However, these complicated injury patterns generally occur only in very serious accidents with severe accompanying injuries. On the modified Quebec Task Force (QTF) classification, 90–95% of all whiplash injuries are classified as mild to moderate (grade 0 to II) [Spitzer *et al.* 1995]. Often symptoms like soreness, neck pain and headache develop with a latency of several hours. Slight petechial hemorrhage in the muscles and ligaments is sometimes thought to be responsible. Reliable scientific

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**Table 1.** Whiplash associated symptoms.

Pain syndromes	Vegetative syndromes	Neurasthenic syndromes	Depressives syndromes
Post-traumatic headache	Orthostatic dysregulation	Irritability	Emotional lability
Neck pain	Hyperhidrosis	Reduced concentration	Reduced motivation
Shoulder and arm pain	Dizziness	Sleep disturbance	Mood disturbances
	Tremor	Fatigue	Anxiety
	Tinnitus	Loss of efficiency	Reduced state of health

data on this, however, are scarce. So far, these changes could not be detected at least with conventional imaging methods – computerized tomography (CT) and magnetic resonance imaging (MRI). Recent studies showed that suspected damages to the alar ligaments had been overestimated in the past [Ferrari, 2002b; Hartwig *et al.* 2004; Pfirmann *et al.* 2000; Poeck, 2002].

In addition to the main symptoms of neck pain with neck stiffness and tension in the shoulder, arm and neck muscles with accompanying headache, the post-traumatic syndrome after whiplash injury is complex with multiple complaints and many different symptoms. This multitude of symptoms is generally referred to as ‘whiplash associated disorders’ (Table 1) [Schrader *et al.* 2002]. Vegetative symptoms, derating and transient alteration of mood, drive and affective state are often reported as accompanying symptoms.

Different mechanisms are discussed for the development of post-traumatic pain syndrome after whiplash injury. Malfunction of the descending, serotonergic pain inhibitory system in the brain stem, a possible neurochemical dysregulation, neurohumoral and/or neurohormonal systems with extra- and intracellular electrolyte imbalance, as well as increase of excitatory amino acids, reduction of endogenous opioids or nitric oxide (NO) have been discussed [Alexander, 2003; Chung and Han, 2002; Ferrari, 2002c]. For the development of post-traumatic headache, it was assumed that an activation of the trigeminal system by vertebrae C2 to C5 afferents (cervicogenic headache) by convergence of trigeminal (meningeal) and cervical afferents in the spinal dorsal horn and consecutive sensitization of central nociceptive neurons would be the pathophysiological explanation for the development of headache after whiplash

injury [Busch *et al.* 2004]. However, an immediate, structural involvement of the brain in terms of a so-called cervicocephalic syndrome has not been confirmed by methodologically sound studies so far [Alexander, 2003; Ferrari, 2002d; Poeck, 1999]. Psychological mechanisms were awarded a major role for the perception of pain and the development of chronic pain in many studies [Ferrari, 2002c, 2002d; Busch *et al.* 2004]. An accident related transient amnesia could only be expected from a severity QTF III, structural central nervous system (CNS) damage that can be objectified with imaging not until a severity QTF IV [Keidel *et al.* 1998].

The general course of post-traumatic headache is positive. Only 12% of patients with initial symptoms report having them 6 months after the causing incident and not returning to their previous state of health by that time [Suissa *et al.* 2001]. Within these 6 months, however, there is a large variety of the clinical courses regarding individual whiplash associated symptoms. Time to completed remission ranged between 17 and 262 days in a large Canadian study [Suissa *et al.* 2001].

Several factors leading to a prolonged state of disease have been discussed intensively in the literature. Main factors were female gender, advanced age, severe initial pain of the cervical muscles, pain spreading to the arms with accompanying numbness, headache, concussion in the previous medical history and pre-existing psychiatric conditions such as depression, as well as sociodemographic and psychosocial factors of illness perception and processing are important [Suissa *et al.* 2001; Kivioja *et al.* 2004; Peolsson and Gerdle, 2004; Richter *et al.* 2004; Scholten-Peters *et al.* 2003; Suissa, 2003]. Legal issues such as compensation claims for damages or social security matters seem of considerable importance

in regard to remission of symptoms [Scholten-Peeters *et al.* 2003; Suissa, 2003; Michaleff *et al.* 2014].

### Classification

The International Classification of Headache Disorders (ICHD) has reached its third sequel (ICHD-3 beta) with post-traumatic headache attributed to whiplash injury remaining in chapter 5.3 and 5.4. Acute post-traumatic headache attributed to whiplash injury (5.3) remained unaltered compared with the ICHD-2, but the formerly termed ‘chronic post-traumatic headache attributed to whiplash injury’ has been changed to ‘persistent post-traumatic headache attributed to whiplash injury’ to emphasize the continuous development from the acute event to the persisting pain following the whiplash injury. This terminology proposes a considerably different mechanism than other chronic headache forms (e.g. chronic migraine)

### MINT and PROMISE studies

The MINT study (Managing Inquiries of the Neck Trial) and the subsequent PROMISE study extended the evidence-based treatment of patients after whiplash injury following car accidents tremendously [Lamb *et al.* 2013; Michaleff *et al.* 2014]. Even though both studies were not intended to investigate post-traumatic headache specifically, they are still interesting with regard to overall treatment of these complex and demanding patients. In the MINT study [McClune *et al.* 2003], the standard treatment, including simple treatment of symptoms and brief information about the condition as it corresponds to the usual extent in an emergency room, was compared with an active treatment and more detailed information including an information booklet (“The Whiplash Book”). In a second step of the study, patients were able to report back after 3 weeks when they did not show satisfactory improvement in symptoms and were then randomized in a group with physical therapy (up to 6 sessions within 8 weeks) and a group with only one physical therapy session and a refresher of the already given advice. The patient group with the intensive physical therapy again received detailed information about their condition that contained one issue of ‘The Whiplash Book’, an affirmation of a good prognosis of their condition, the encouragement of resuming everyday activities as soon as possible, advice to perform neck exercises regularly, and information that neck pain is a normal response of the body to the accident, as

well as the information that analgesics should be used regularly, while a neck brace should not be used [Lamb *et al.* 2013].

The physiotherapy and educational program of the second step included manual therapy (joint mobilization without manipulation), other soft tissue techniques, endurance training, tips for dealing with pain, information about the rapid resumption of daily activities, some simple behavioral techniques to deal with fears and a screening questionnaire on whether post-traumatic stress could be an issue.

Overall, 3851 patients participated between December 2005 and November 2007 in 12 National Health Service (NHS) departments in the UK. The whiplash injury had to be less than 6 weeks previous and had to have a severity level between QTF I and QTF III (Table 2). Patients under 18 years of age, having suffered a prolonged loss of consciousness, a Glasgow Coma Score <12, fractures or dislocations of the spine or other bones, and patients that had to be hospitalized or showed strong psychiatric symptoms were excluded.

There was no significant difference between the standard care and the active patient program in the primary endpoint of the study, which was the Neck Disability Index (NDI) after 4 months [group difference: -0.5 points NDI, 95% confidence interval (CI) -1.5 to 2.5]. Even after 8 and 12 months, the NDI showed no difference. In the second stage of the study, a moderately significant effect in favor of the physiotherapy series (group difference -3.7 points NDI, 95% CI -6.1 to -1.3) was shown for the NDI compared with education and single physiotherapy session after 4 months. This effect, however, could no longer be detected after 8 and 12 months. It was concluded by the authors that this minor benefit would not justify the additional expenditure in regard to economic efficacy. At least for the UK healthcare system, it was rejected as inadequate [Lamb *et al.* 2013].

The PROMISE study examined whether patients with chronic whiplash-associated disorders would benefit from intensive physiotherapy [Michaleff *et al.* 2014]. Here, 172 patients were enrolled and received either an extensive physiotherapy training program ( $n = 86$ ) or behavioral advice only ( $n = 86$ ). Patients had to suffer their whiplash associated symptoms for longer than 3 months but not for over a year. The advice group had a 30 minute session with a physiotherapist during

**Table 2.** Clinical characteristics of whiplash injury severity (Quebec Task Force [QTF]).

QTF grade	Clinical presentation
0	No complaint about neck pain No physical signs
I	Neck complaint of pain, stiffness or tenderness only No physical signs
II	Neck complaint Musculoskeletal signs including decreased range of movement and point tenderness
III	Neck complaint Musculoskeletal signs Neurological signs including: decreased or absent deep tendon reflexes, muscle weakness and sensory deficits
IV	Neck complaint and fracture or dislocation

which they read the advice booklet, practiced the exercises with minimum guidance from the physiotherapist, and had any questions or concerns clarified. The extensive physiotherapy program consisted of individually tailored and supervised exercise sessions lasting 1 hour for over 12 weeks (2 physiotherapy sessions per week for 8 weeks, 1 session per week for the remaining 4 weeks). This training entailed specific cervical spine exercises (e.g. craniocervical flexion training, neck extensor training and scapular training), posture re-education and sensorimotor exercises (e.g. kinaesthetic sense, balance and eye movement control). Manual therapy techniques were used in the first week in patients identified by the physiotherapist to benefit. Additional aerobic training was prescribed from weeks 1 to 12 in a submaximum and progressive way. After 12 weeks, there was no treatment effect on a scale from 0–10 showing a group difference of 0.0 (95% CI -0.7 to 0.7) between both groups. Even after 6 and 12 months, the differences did not become substantially larger [Michaleff *et al.* 2014]. The authors concluded that education and advice is as effective as more costly interventions. Which interventions may be helpful and how they may be effectively delivered is subject to further investigation.

### Impact on future treatment recommendations

Re-evaluating the results of both studies again in relation to the effect strengths of therapy, 37% of

patients who received the standard therapy and 42% of the detailed education group reported feeling ‘better’ or ‘much better’ compared with their condition right after the accident [Ferrari, 2013]. However, in conversion of these results, it means that over half of the affected patients had not reached their old level a year after the accident – at least in their subjective assessment. This raises the question what do we accomplish with our therapy in these patients? Do we even harm them? Is to be treated in an emergency room and to be examined thoroughly, including imaging and sometimes receiving extensive manual therapy, invasive pain therapy or physical therapy harmful to our patients in the end? These and many other questions have been raised by the MINT and PROMISE studies and left them unanswered at the same time. Hopefully, some of these questions will be answered in studies still to come [Ferrari, 2013; Nijs and Ickmans, 2014].

What role do patients’ expectations play in this context? A population-based study from Canada showed that patients who expected to quickly regain their former health had more than three-fold better prognosis compared to patients who initially believed they would probably never recover [Carroll *et al.* 2014]. This influence of expectation of individual patients remained stable, even when adjusted for sociodemographic background, symptoms and pain severity, medical history, comorbidities and collision-related factors.

### Conclusion

In future treatment attempts, doctors should foremost try to correct false expectations of patients in regard to whiplash injuries. This also includes legal expectations. Treating physicians should abstain from extensive workup and invasive or prolonged treatments, as this may be entirely unnecessary and may even harm patients.

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