

Original articles

# The role of physical injury in motor and sensory conversion symptoms: A systematic and narrative review

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## Abstract

**Objectives:** Conversion symptoms are currently conceptualized as physical symptoms induced by psychological trauma, conflict, or stress. Historical accounts also included physical injury as an important precipitant. We aimed to determine (a) the frequency of reported physical injury prior to onset in published studies of patients with motor or sensory conversion symptoms and (b) the clinical characteristics of patients in whom onset was associated with physical injury. **Methods:** Firstly, we employed a systematic review of all reports of adults with motor or sensory conversion symptoms published between 1965 and 2005. Secondly, we used a narrative review of the literature on this topic, especially possible mechanisms. **Results:** A total of 133 eligible studies, which recorded precipitating factors, including

869 patients, were found. Physical injury prior to symptom onset was reported in 324 patients (37%). Clinical features associated with physical injury included younger age, weakness (vs. movement disorder), paraparesis (vs. hemiparesis), and neurological versus psychiatric study settings. **Conclusions:** Despite the current dominance of a psychological view of conversion symptoms, physical injury prior to onset has been frequently reported in papers published since 1965. While the data are of low quality, they nevertheless suggest that physical trauma has a role in many patients in the onset of motor and sensory conversion symptoms. We discuss possible mechanisms for this association.

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## Introduction

Symptoms such as weakness and nonepileptic attacks, which are unexplained by disease (and which may be referred to as conversion symptoms), account for 3–5% of all new neurological outpatients [1,2].

The prevailing view of the etiology of such symptoms is a psychological one. Breuer and Freud's conversion hypothesis has been especially influential in stressing the primacy of psychological factors, a theory enshrined in the name

*conversion disorder* within *DSM-IV*. However, in the 19th and early 20th centuries, the term *traumatic hysteria* was widely used to describe an observed relationship between physical trauma and 'hysterical' symptoms [3]. Diagnostic terms such as *railway spine* and *shell shock* are reminders of this relationship. Although current theory retains a role for sexual and physical injury in childhood as predisposing factors, the idea that physical injury per se might be sufficient to precipitate conversion symptoms has been largely lost from modern descriptions.

In this study, we aimed to determine (a) how frequently physical injury has been reported as a recent antecedent of motor and sensory conversion symptoms in modern (since 1965) reports and (b) the clinical characteristics of patients with conversion symptoms associated with physical injury.

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Lastly, the implications of the findings of this review for contemporary theories and definitions of motor and sensory conversion symptoms are discussed via a narrative review.

## Methods

### *Search strategy for studies*

We searched the following databases: MEDLINE (from 1966), CINAHL (from 1982), EMBASE (from 1980), and PsycINFO (from 1965) all to June 2005. All database-controlled vocabulary headings for conversion disorder and hysteria were used, in addition to the following text words: psychosomatic, psychogenic, somatization, unexplained, conversion, nonorganic, and dissociative. These were combined with text words for weakness, paralysis, sensory disturbance, and movement disorders. All references under the heading 'conversion disorder' or with the text word hysterical were also examined. The titles and abstracts were reviewed online, and copies of all publications that might conceivably contain relevant data were obtained. The reference lists of all these publications were also examined for additional relevant studies published after 1965. We did not contact authors for additional information.

### *Study inclusion and exclusion*

Studies were included if they met all the following criteria:

1. The study participants were adults aged 16 years or above.
2. Their symptoms were described as medically unexplained, nonorganic, psychogenic, hysterical, conversion, or functional. In the case of psychogenic movement disorders, we accepted a diagnosis that, according to the Fahn criteria, was 'documented,' 'clinically established,' or 'probable' [4]. Note, therefore, that the patients did not have to have a *DSM-IV* diagnosis of conversion disorder, they simply have to have a motor or sensory symptom unexplained by disease.
3. The symptoms described were motor (weakness, paralysis, movement disorder, or gait disorder) or sensory (numbness or altered sensation, not visual or hearing difficulties). In studies of conversion disorder where there were mixed symptoms, we accepted data if more than 75% of the included patients had symptoms that were motor or sensory.
4. The study made some mention of recent factors prior to onset in one or more patients.
5. The study was published in English.

Although there is some evidence that motor and sensory symptoms as part of reflex sympathetic dystrophy and complex regional pain syndromes may have clinical similarities to those seen in conversion disorder, this is a

controversial area, and studies reporting patients with motor and sensory symptoms with these diagnoses were excluded unless they were specifically reported using one of the words in Criteria 2. Patients with factitious disorder or malingering were not included.

### *Data extraction*

All reports were reviewed independently by three investigators (J.S., H.A., and M.Z.) using a proforma and any discrepancies arbitrated by two others (A.C. and M.S.). We collected data regarding (a) the nature of the symptoms, (b) the presence and nature of physical injury or surgery immediately prior to the onset of the motor or sensory symptoms, (c) the sex and age of participants, (d) the speciality setting in which the patient was seen, and (e) whether the presence or absence of physical injury was likely to be an independent factor in the study design; for example, studies in military populations are likely to have more than average numbers of subjects with physical injury, and by definition, studies in postsurgical or head injury samples have all received a physical injury.

### *Data analysis*

We combined data from all eligible studies to determine the overall frequency of physical trauma reported in patients with motor and sensory conversion symptoms, excluding those where there may have been a bias toward reporting cases with physical injury (e.g., studies in military settings, medicolegal settings, or surgical series). These were analyzed separately and not included in the pooled data or subgroup analysis. Physical trauma included both physical injury and surgery. After seeking statistical advice (R.P.), we decided that it was not possible to analyze the degree of heterogeneity in all of the data using statistical methods because of the small size of most studies. Instead, we used subgroup analyses to explore heterogeneity in the data, looking at the frequency of injury in studies with less than 5 subjects, in those with 6–20 subjects, and in studies with greater than 20 subjects. For studies with more than 20 subjects, we determined mean frequency with 95% confidence intervals. We also carried out an analysis of age, sex, setting of the study, and the distribution and type of symptoms. Fisher's Exact Test and parametric (*t* test) or nonparametric tests (Mann–Whitney) were used as appropriate.

## Results

### *Searching*

Searching found 133 published studies that met the study entry criteria (see Supplemental file).

In 12 additional studies of 50 patients in total, the study setting or design was not independent of the variable of physical trauma, and hence, these were excluded from further analysis. The reasons for nonindependence were the following: studies of patients exclusively in military settings (3 studies, 20 patients) [5–7]; after head, face, or spinal injury (4 studies, 14 patients) [8–11]; exclusively from a pain unit (1 study, 4 patients) [12]; or as postsurgical complications (3 studies, 7 patients) [13–15]. In one further study, patients with physical trauma could not have appeared since all the patients developed symptoms after Bell's palsy (1 study, 4 patients) [16]. There were no studies from medicolegal settings.

An additional 92 studies were found, which contained some data on patients with the symptoms of interest but did not meet the study entry criteria for the following reasons: (a) the study participants were children, (b) less than 75% of the patients in the study could be said to have motor or sensory symptoms, (c) there were no data on factors at onset of any kind in the report, (d) it was not clearly established whether the symptoms were regarded as unexplained by disease, and (e) duplicate publication.

#### Studies included

Out of the 133 studies identified, 132 reported on a total of 869 patients (see Supplemental file for references).

An additional single study by Zhang et al. [17] described 1316 cases of 'hysterical paralysis' seen between 1957 and 1984 in a Chinese acupuncture center. As this single study was so large, and its quality uncertain, we have not combined it with the other studies but present its findings alongside the combined data from the other studies.

The studies were mostly small, with the number of patients included ranging from 1 to 52 (median, 3). Of these studies, 95 were composed of five or fewer patients, with 48 single case reports.

#### Analysis

Of the 869 patients, 324 (37%) were reported to have had a physical injury prior to onset. Included in this number were 44 patients with symptom onset after surgery (6% of all 922 patients). In the 12 excluded studies described above, the rate of physical injury was 54% (27/50).

Table 1 shows an analysis of the variables extracted. The denominators vary because of incomplete reporting in the original publications. Physical injury was numerically but not significantly more commonly recorded in males (43%) than in females (35%) (NS) and was marginally more likely to be noted preceding onset of weakness (41%) than movement disorders (34%) ( $P=.04$ ). It was much more likely to be reported in patients with paraparesis (64%) than

Table 1

The frequency of physical injury reported in 132 studies including 869 patients with motor and sensory conversion symptoms (excluding the paper by Zhang et al. [17]): analysis of pooled data and associated clinical characteristics

	Physical injury (n/total n)	Percentage with physical injury	$P^a$	Comparison
Physical injury in all studies	324/869	37		
Surgery prior to onset <sup>b</sup>	44/869	6		
Symptom				
Weakness/Paralysis	162/397	41	.04	Weakness vs. movement disorder
Movement disorder	120/357	34		
Gait disorder	12/48	28		
Sensory disturbance	30/67	45		
Sex				
Male	94/220	43	NS	Male vs. female
Female	145/414	35		
Side of symptoms				
Lateralized	77/226	34	<.0001	Lateralized vs. both legs
Right-sided symptoms	25/73	34	NS	Right vs. left
Left-sided symptoms	33/103	32		
Both legs	63/99	64		
Arms and legs	11/25	44		
Setting				
Neurological/Medical	148/490	30	.002	Neurological/Medical vs. psychiatry
Psychiatric	31/173	18		
Rehabilitation	65/99	66		
Spinal/Neurosurgery/Other surgery	60/76	79		
Other	17/28	65		
Study size				
Studies where $n>20$ ( $n=14$ )	173/413	42		
Studies where $n>5$ and $<20$ ( $n=24$ )	71/257	28		
Studies where $n=5$ or less ( $n=96$ )	80/199	40		

Denominators vary because of incomplete information in some reports.

<sup>a</sup> Fisher's Exact Test was used.

<sup>b</sup> Patients with onset after surgery are counted here as a subset of all physical injury.

with lateralized (34%) (hemiparetic or monoparetic) symptoms ( $P<.0001$ ). Patients in whom physical injury was noted (age was available for 71% of patients) were younger (mean, 35.6 years vs. 40.8 years) ( $P=.002$ , Mann–Whitney—not shown in Table 1).

The rate of reported physical injury prior to conversion symptoms was higher in neurological and general medical settings (30%) than in psychiatric settings (18%) ( $P=.002$ ). The highest frequency was in surgical (79%) (where surgery prior to onset was counted as physical injury) and rehabilitation settings (65%).

Because it was not possible to examine for heterogeneity in all the data (as explained in Methods), we performed a subgroup analysis of studies according to size (Table 1) (in case, for example, physical trauma is more commonly found in case reports). No relationship between study size and frequency of trauma was found.

By comparison with the pooled data, the large Chinese study composed of 1316 patients who had acupuncture for hysterical paralysis reported ‘trauma’ in 287 cases (21.8%), ‘surgery’ in 207 cases (15.7%), and intramuscular injection of drugs in 18 cases (1.4%) [17]. The report is brief and it was not clear whether ‘trauma’ in this paper referred to physical and/or emotional trauma. If it refers to physical trauma, the combined total for physical trauma for this study (39%) is close to the pooled value in the other included studies.

It was not possible to seek associations between types of injury and symptoms, as the nature of the injury was often not clearly stated. However, in 131 out of the 324 cases in which injury was reported, road traffic accident was by far the most common type of injury, followed by ‘falls’ and minor injuries. Concussion, sporting injuries, ankle sprain, exercise, war injuries, and assault were all mentioned more than once. Although some of these injuries were potentially life-threatening, a substantial minority (and because of a lack of detail possibly more) were minor in nature.

## Discussion

In the post-1965 literature regarding motor or sensory conversion symptoms, in those cases where preceding factors were reported, we found a relatively high frequency of physical trauma prior to onset. This finding suggests that there has been a neglect of physical trauma in contemporary thinking about conversion disorder. We discuss possible mechanisms whereby physical trauma might lead to conversion symptoms below.

## Limitations

This review had a number of methodological limitations: Firstly, there is the problem of recall bias. Physical injury is common and patients may mistakenly attribute symptoms to it. The fact that these reported cases

developed conversion symptoms immediately after physical injury makes this explanation less likely. Second, the data may not be representative of the population of patients with motor and sensory conversion symptoms. Potential sources of bias are (a) English language literature only, (b) publication bias favoring studies in which an association was found, and (c) the exclusion of studies where no details of onset were stated. This last category is especially important since only a minority of the literature on conversion disorder makes mention of precipitating events. Third, the study was about conversion symptoms and not conversion disorder (we ignored the controversial criteria in *DSM-IV* for a recent psychological stressor in order to avoid circularity). Fourth, because of the number of single cases or small series, we could not statistically combine all of the data to examine heterogeneity. The pooled figures, especially the subgroup analysis, should therefore be treated with caution since they assume a degree of homogeneity that may not be present. Fifth, there is the possibility that, in some cases, the diagnosis of a conversion symptom may have been wrong. There is no ‘gold standard’ on which elements of the history or physical examination constitute a diagnosis of conversion symptoms except that the diagnosis should be made by a competent physician. Studies with conversion symptoms generally do not specify the details of how the diagnosis was made, and there will inevitably be heterogeneity in how carefully this was done. On the positive side, our own systematic review on this topic found that, since 1970, less than 5% of cases of conversion symptoms turn out, with hindsight, to be due to disease at follow-up, in keeping with other neurological and psychiatric disorders [18]. Sixth, there is a possibility that some of the patients diagnosed with conversion symptoms may have actually been malingering to gain financial compensation. We return to this issue later in this discussion. Lastly, the subgroup analysis of sex, age, and other factors is limited by the incomplete reporting of these variables in the study reports. Despite these potential limitations, the frequency of reported physical trauma is sufficiently striking to warrant further discussion.

## Interpretation of subgroup analysis

Bearing in mind these limitations, the subgroup analysis provides some interesting observations. Younger people may be likely to have motor or sensory conversion symptoms in association with physical injury simply because they are more likely to be exposed to physical injury. The findings on paraparesis are discussed below. It is perhaps of most interest to find a difference in the frequency of injury reported from psychiatric settings (18%) versus all medical and surgical settings (38%). Perhaps psychiatrists have been less likely than neurologists to see ‘posttraumatic’ conversion symptoms because



of referral bias or are simply less likely to elicit and record it.

#### *Narrative review*

##### *The historical background of ‘traumatic hysteria’*

In his book *Post-Traumatic Neurosis: From Railway Spine to the Whiplash*, Michael Trimble describes the checkered history of the relationship between physical injury and symptoms unexplained by disease. A common sequence is for a posttraumatic condition to be initially described in organic terms (*railway spine*, *spinal concussion*, and *shell shock*) and then to be subsequently seen as psychological. Controversy continues to surround the etiology and nosology of contemporary posttraumatic somatic syndromes such as whiplash injury (although there are signs of a more harmonious view of these symptoms emerging that incorporates biological, psychological, and social factors [19]).

From the mid-19th century to the late 19th century onwards, physical injury was commonly cited as a precipitating cause in vulnerable individuals suffering from motor and sensory ‘hysteria.’ At this time, Charcot [20], Page [21], Oppenheim [22], Fox [23], and Janet [24] all wrote at length about traumatic hysteria. Charcot, for example, records hysterical symptoms after train crashes, burns, falls, an assault, and a dog bite. Opinion was divided as to whether traumatic hysteria (which was said to occur not infrequently in men) was the same as ‘ordinary’ hysteria (which was more common in women). After the First World War, the diagnosis fell in to disrepute, partly because of the complications it caused in medicolegal and workers’ compensation cases [25].

It is harder to find discussion of physical trauma leading to motor and sensory conversion symptoms in later 20th century literature. Debate continues about ‘accident neurosis’ [26], whiplash injury, and postconcussion syndrome, which are not typically associated with conversion symptoms. However, the conversion disorder literature appears remarkable for frequently reporting physical injury in patients with motor conversion symptoms but barely passing comment on it as a possible precipitant.

The current *DSM-IV* diagnostic criteria for conversion disorder require that ‘psychological factors are judged to be associated with the symptom or deficit because conflicts or other stressors precede the initiation or exacerbation of the symptom or deficit.’ This leaves the door ajar for a physical injury to be considered a ‘stressor,’ but only if mediated through a psychological mechanism. ICD-10 refers to these symptoms as dissociative (conversion) motor disorder, which suggests a compromise between two rather different proposed mechanisms for these symptoms. In the next section, we explore whether, in the light of our findings, psychodynamic or dissociative mechanisms remain a sufficient basis for the association between all conversion symptoms and physical trauma.

#### *Potential mechanisms for the possible relationship between physical injury and conversion symptoms*

**Psychological mechanisms.** The most obvious potential connection between physical injury and conversion symptoms is the psychological impact of the injury. This hypothesis is uncontroversial and sits well with both psychodynamic and cognitive behavioral views of the condition. For example, a patient involved in a minor road traffic accident with a minor neck hyperextension injury would normally recover within a week or two. However, in a vulnerable individual, this injury could be the trigger for a cascade of psychological processes leading to conversion symptoms and disability.

a) *Dissociation.* There is a recognized association between physical injury such as car accidents and peritraumatic psychological dissociative symptoms. Peritraumatic dissociation, in turn, often occurring together with panic, is known to be associated with posttraumatic stress disorder [27, 28], as well as other psychiatric disorders and physical symptoms such as pain [29]. It is not yet known whether such peritraumatic dissociation may also predispose to ‘dissociative’ weakness or sensory symptoms but the idea is plausible. Anecdotal cases in which patients develop conversion symptoms after almost being injured are interesting in this respect. Janet recounted a famous case:

‘A man travelling by train had done an imprudent thing: while the train was running, he had got down on the step in order to pass from one door to the other, when he became aware that the train was about to enter a tunnel. It occurred to him that his left side, which projected, was going to be knocked slantwise and crushed against the arch of the tunnel. This thought caused him to swoon away but happily for him, he did not fall on the track, but was taken back inside the carriage, and his left side was not even grazed. In spite of this, he had a left hemiplegia’ [24]

b) *The conversion hypothesis.* From a psychodynamic perspective, weakness, numbness, or abnormal movements can be seen as symbolizing loss of function and helplessness. A physical injury could be a potent reminder of past physical injuries sustained in neglectful or abusive circumstances. Such a potent reminder might induce unresolved conflicts to resurface. These, in turn, according to classical conversion theory, might be converted back into physical symptoms. While there is little empirical evidence for the conversion hypothesis, the idea that past traumas may sensitize individuals to more recent physical trauma is perhaps more plausible. Some studies [30], but by no means all [31–33], have found that patients with conversion disorder are more likely than controls to have suffered sexual and physical abuse in the past. The extent of past physical abuse may correlate with number of conversion symptoms, the effect possibly being mediated by hypnotic suggestibility [30].

c) *Cognitive behavioral mechanisms.* Although one might expect more severe injuries to be associated with more psychological threat, the relationship is highly variable and depends more on the perception of the injured person than on objective severity, particularly for minor injuries. A cognitive behavioral model of motor conversion symptoms after an accident could include catastrophic cognitions about injury-related symptoms, such as ideas of permanent damage, attention, and amplification of minor somatic symptoms of weakness and reattribution (in which a mild, preexisting symptom is reattributed to an injury). Behaviors, particularly excessive rest or disuse of a painful limb, may be especially important in promoting the symptom of weakness after an injury.

*Biological mechanisms.* Is it possible for an injury to cause motor or sensory conversion symptoms without any of the psychological reactions above?

From everyday experience, it is likely that pain in itself can, at least transiently, lead to a degree of weakness, which can be overcome only with effort. There are plausible biological explanations for this phenomenon with evidence of mechanisms at both spinal and cerebral level in the nervous system that could act independently of emotional or conscious processing [34]. Farina et al. [35] have suggested that the motor cortex may have even evolved deliberately to be inhibited at times of pain in order to allow the spinal motor system to freely develop protective responses to noxious stimulation.

Immobility of a limb is a natural immediate reaction to injury and pain. We have all temporarily ‘cradled’ an arm that has been injured, which we later cautiously move, gradually increasing activity until the pain has gone. Conversely, immobility after injury can increase pain and pain increases immobility. Is it plausible that such a positive feedback loop could exist purely between these two symptoms, without a significant psychological reaction? Such a mechanism is often suggested as being important in the etiology of complex regional pain syndrome (CRPS) type 1. CRPS type 1 is also often associated with limb weakness. For example, in two studies of this problem, 79% and 95% of subjects had weakness, often of the ‘give-way’ variety without any nerve injury [36,37]. The question arises whether the patients with conversion symptoms after physical injury in our analysis are actually cases of CRPS type 1 incorrectly classified or whether in fact complex regional pain is a clinical syndrome with much in common with conversion disorder.

Similarly, the experience of ‘going weak at the knees’ in response to sudden back pain is common; yet, no one would regard this as a psychological reaction. In our experience working in a regional neurosciences center, severe and sudden back pain can be associated with leg weakness and numbness that have positive features of motor and sensory conversion symptoms. Such patients are often admitted for exclusion of cauda equina compression

and discharged if the MRI scan is normal [38]. It is interesting in this respect that we found a higher frequency of injury in association with conversion paraparesis than with hemiparesis. It is relatively easy to see how pain in the lower back could physiologically affect motor control to both legs, whereas it is less intuitively obvious how a severe painful stimulus might cause a hemiparesis.

Furthermore, organic disease is known to be a potent risk factor for developing motor conversion symptoms with reported rates of 20–60% [39–46]. With respect to the theme of this article, many of the injuries documented were trivial or were of limbs rather than the head, but the possibility that minor biological changes in the brain induced by injury may play a part in some individuals’ susceptibility to conversion symptoms cannot be excluded.

There is an emerging literature on the biology of motor and sensory conversion symptoms, based on functional imaging and neurophysiological studies [47]. Vuilleumier et al. [48], for example, found ‘within-patient’ evidence of contralateral hypofunction of thalamus, caudate, and putamen in four patients with unilateral motor and sensory conversion symptoms using SPECT. Such an approach has the potential to elaborate on differences between the mechanisms of, for example, spontaneous ‘functional’ hemiparesis compared to ‘functional’ paraparesis associated with physical injury.

*Social mechanisms.* In any discussion of the development of symptoms after injury, it would be foolish not to consider the role that society, and the legal and social welfare system in particular, can play in perpetuating symptoms. One ‘social’ hypothesis would be that a transient conversion symptom in a patient with a mild injury may consciously or unconsciously persist in large part, because of the expectation of financial reward, either through the courts or in disability payments. However, financial motivation may not be the only issue here. For a patient with a conversion symptom after an injury, the legal system can offer something that is hard to find elsewhere—a professional prepared to spend time with the patient and who will attempt to prove that their symptoms are genuine, that they are due to damage, and that they are not the patient’s fault. Similarly, the social welfare system can validate an illness as genuine and worthy of financial benefit. The negative role that lawyers and doctors can play in perpetuating symptoms has been discussed by Andrew Malleon in his recent book *Whiplash and Other Useful Illnesses* [25].

## Conclusion

We have found that physical injury has been reported relatively frequently in modern reports of motor or sensory conversion symptoms. Such an association may be an artifact of reporting bias or uncontrolled data and does not, of course, prove causation. Any etiological role for injury

must be seen in the context of other potential predisposing and precipitating factors such as childhood experience, life events, personality, dissociation, emotional disorder, and illness beliefs. We certainly would not want to argue for a return of the overly simplistic 19th century term *traumatic hysteria*. However, it appears that older observations of the role of physical trauma have been neglected. This opens up the debate about how physical and biological factors fit in to the development of conversion symptoms.

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## Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.jpsychores.2008.07.010.

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