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Using crash information to improve the treatment of crash injuries

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ABSTRACT

This report examines whether there is evidence for the proposition that knowledge of the nature of a road crash aids in the treatment of injuries that arise from the crash. We reviewed published reports in which the utility of crash reports for triage was examined. We also reviewed the evidence in relation to chronic injury and whiplash injury in particular. There is some evidence that crash reports and information about the crash can assist in triage decisions and, in one study, steering wheel deformation was a good predictor of abdominal injury (which is hard to diagnose in some cases). There was very little direct evidence in relation to the treatment of chronic injury, but indirect evidence suggests that crash parameters that can be established, such as the change in velocity, are a poor predictor of chronic complaints. Any perceived benefit of crash reports in the treatment of chronic symptoms may arise as a result of their use in counselling the patient.

KEYWORDS

Accident, Injury, Medical treatment

Summary

This report examines whether there is evidence for the proposition that knowledge of the nature of a road crash aids in the treatment of injuries that result in the crash. We reviewed published reports in which the utility of crash reports for triage was examined. We also reviewed the evidence in relation to chronic injury and whiplash injury in particular.

MECHANISTIC FACTORS THAT PREDICT INJURY SEVERITY

Several mechanistic factors about a crash have been identified that differentiate serious from non-serious acute injury. These include:

Velocity change as measured by "vehicle crush" (Jones & Champion, 1989)
Extrication time (Palanca et al., 2003)
Cabin intrusion (Newgard, Lewis & Jolly, 2002; Newgard, Martens & Lyons, 2002; Palanca et al., 2003; and Stefanopoulos et al., 2003)
High speed (Palanca et al., 2003)
Number of structures within the passenger compartment that were deformed due to the crash (including steering wheel, dashboard and windshield) (Stefanopoulos et al., 2003)
Restraint use (Newgard, Lewis & Jolly, 2002 and Newgard, Martens & Lyons, 2002)
Steering wheel deformation (Newgard, Martens & Lyons, 2002)

DEVELOPING A SCREENING TOOL FOR TRIAGE DECISIONS

Newgard, Lewis and Jolly (2002) showed that crash information could be used in a triage screening tool that had good sensitivity and reasonable specificity. However, the crash variables had a much lower level of predictive power than the physiological variable, the Glasgow Coma Scale. Crash factors had, on their own, a low level of specificity, which meant that many non-severely injured people were over-triaged. However, a certain level of over-triaging is considered acceptable if the screening tool has a high level of sensitivity.

HOW MECHANISTIC INFORMATION SHOULD BE COLLECTED

In general, it is often emergency services personnel who collect crash information when it is to be used routinely in triage. Written descriptions are often in error and in one study it was found that photographs are more reliable and useful to the assessor. Photographs are used routinely in South Australia in trauma assessments.

USING MECHANISTIC VARIABLES TO PREDICT SPECIFIC INJURIES

Reiff et al. (2002) found that certain crash variables, in conjunction with other clinical signs, indicated the presence of diaphragmatic rupture, an injury that is difficult to diagnose non-invasively. Crashes in which the change in velocity was greater than 40 km/h and in which the passenger compartment intrusion was greater than 30 cm were indicative of a high risk of diaphragmatic rupture.

BEYOND MECHANISTIC FACTORS

There has been much less research on the use of crash information in the treatment beyond the acute stages of injury. In Zurich, Switzerland, there is a project in which injured people may seek an assessment to clarify and explain diagnoses and injuries, discuss and assess matters in the person's broader life and suggest therapeutic strategies to overcome persistent symptoms. The assessments include a mechanical assessment (that incorporates crash factors), a medical assessment, and a biomechanical assessment that is largely a synthesis of the first two assessments.

There has been no formal evaluation of this program. There has been one study that used data from the program and this study concluded that in half the cases in which a mechanistic analysis could not explain a person's injury, the biomechanical assessment that considered the person's medical history and the "collision circumstances" could. However, this study is limited, and the efficacy of the program remains unknown.

There is other indirect evidence that crash information is of limited prognostic value for predicting chronic injury. It appears that the transition from acute to chronic injury is better predicted by clinical indicators, and psychosocial factors, and these indicators may be used to target early intervention programs to minimise the progression to chronic injury.

Contents

1 Introduction

This report is a review of research evidence for the proposition that there is an advantage in doctors obtaining information about a road crash in the treatment of the injuries that result from the crash. We have conducted an extensive literature search for articles on this topic. The results of this search show that there has been a moderate degree of published research that has looked at whether crash factors can be used to understand the severity of a person's injuries and hence should be considered when making triage decisions (Jones & Champion, 1989; Newgard, Lewis & Jolly, 2002; Newgard, Martens & Lyons, 2002; Palanca, Taylor, Bailey & Cameron, 2003; and Stefanopoulos et al., 2003). We also found one published paper (Reiff et al., 2002) that looked at whether information about a crash can be used to diagnose particular injuries - in this case diaphragmatic rupture, which is not usually diagnosed except through invasive surgical procedures.

The reports cited above pertain to the acute management of injury. However, these reports do not deal with the management of injuries beyond the acute phase. The question of whether crash factors can be used to better understand and treat long term injuries has not been examined in the published literature. There has been at least one project in which crash information is used to guide the management of longer-term injuries, however, there has been no rigorous evaluation of this program. This project is being carried out at the Institute of Biomedical Engineering in Switzerland in which crash information is assessed and presented to people with whiplash injuries to aid their recovery. However the impact of this process is not currently being evaluated (Schimitt, 2005).

This report reviews the published literature on whether information about a crash can be used to guide the acute treatment of people injured in the crash and will also specifically discuss the prognostic value of crash information in cases of acute whiplash injury, and the utility of such information in the treatment of people with chronic whiplash symptoms.

2 Mechanistic factors that predict injury severity

A number of studies have attempted to identify mechanistic factors related to injury severity in motor vehicle crashes. The goal of these studies has been to identify mechanistic factors that can be recorded by emergency service personal in order to improve triage decisions and pre-hospital life support for people involved in vehicle crashes. The following mechanistic factors have been found to differentiate serious from non-serious injuries:

- Velocity change as measured by "vehicle crush" (Jones & Champion, 1989)
- Extrication time (Palanca et al., 2003)
- Cabin intrusion (Newgard, Lewis & Jolly, 2002; Newgard, Martens & Lyons, 2002; Palanca et al., 2003; and Stefanopoulos et al., 2003)
- High speed (not stated how this was measured) (Palanca et al., 2003)
- Number of structures within the passenger compartment that were deformed due to the crash (including steering wheel, dashboard and windshield) (Stefanopoulos et al., 2003)
- Restraint use (Newgard, Lewis & Jolly, 2002 and Newgard, Martens & Lyons, 2002)
- Steering wheel deformation (Newgard, Martens & Lyons, 2002)

We identified two studies that have investigated the usefulness of mechanistic factors in predicting the seriousness of injury, that stand out for their use of rigorous research methods: Newgard, Martens & Lyons (2002) and for relevance to the Australian context Palanca et al., (2003).

The first of these studies is a prospective observational study conducted by Newgard, Martens and Lyons (2002). This study took place over 22 months in urban and suburban Chicago. The study was of 559 people injured in car crashes who were taken to one of two hospitals. One hospital was a Level 1 trauma Centre and the other a Level 2 trauma centre. Polaroid instant cameras were given to 12 fire departments. Members of each department were trained in the camera's use and they were instructed to take photos at each crash site attended where the injured were to be taken to one of the two participating hospitals. Fire department personnel were instructed to take photos of the primary point of external vehicle impact and the occupant compartment. The vehicles in the photos were scored based on the primary site of impact, severity of impact, passenger space intrusion (minor compartment intrusion was defined as less than 18 inches (45.7 cm) and major intrusion was equal to or greater than 18 inches), steering wheel deformation, and windshield integrity. A patient chart review was conducted to record participants': Abbreviated Injury Scale (AIS); Injury Severity Score (ISS), length of hospital stay; and total hospital costs.

In this study, only steering wheel deformation was associated with an increasing Injury Severity Score (ISS) ($p < 0.05$) while lack of restraint use, passenger space intrusion and steering wheel deformation were all associated with an increase in hospital stay ($p < 0.05$) and costs ($p < 0.05$). Windshield integrity and external vehicle damage were not associated with ISS, hospital stay or hospital charges ($p > 0.05$).

Palanca et al. (2003) carried out a retrospective analysis of the trauma database at Royal Melbourne Hospital (RMH) in Australia. The RMH serves a local population of about 600,000, and deals with approximately 850 trauma admissions a year. The study period included cases from 1 January 1996 to 31 December 2000. Crash factors investigated included: ejection from vehicle; fatality in same vehicle; high speed (>60 km/h); intrusion into passenger compartment (>30 cm); extrication time (>20 min); and vehicle rollover. Apparently these details are collected routinely at vehicle crashes, but how or by whom is not specified in this paper. Participants were defined as having a major injury if they met at least one of the following criteria: ISS > 15; admission to intensive care > 24 h; urgent surgery for intracranial, intrathoracic or intra-abdominal injury, or fixation of pelvic or spinal fracture; or death after injury.

Six hundred and twenty one participants were included in this study. Of these participants, 40.7% were determined to have experienced major trauma, while 59.3% experienced minor trauma. Univariate analyses indicate that prolonged extrication time, cabin intrusion and high speed were associated with major injury ($p < 0.05$).

While all these studies (Jones & Champion, 1989; Newgard, Martens & Lyons, 2002; Palanca, Taylor, Bailey & Cameron, 2003 and Stefanopoulos et al., 2003) highlight the potential usefulness of using mechanistic factors in predicting injury severity it should be kept in mind that such information is likely to remain only a supplement to physiological and anatomical indicators in triage. Garthe and Mango (2005) write that mechanistic factors should be used "in combination with assessments of vital signs, level of consciousness and anatomic injuries at the scene". (p.2)

Triage decisions include how the injured person will be transported, where they will be transported, and how they will be treated (Palanca et al., 2003) . They must minimise under-triage (decisions must be sensitive) and over-triage (decisions should be specific) although the former criterion is of greater importance (Newgard, Lewis & Jolly, 2002). As discussed in the following Section it seems that the best triage decisions will be made when considering mechanistic factors in conjunction with other clinical factors.

3 Developing a screening tool for triage decisions

The American College of Surgeons has stated that transport to a trauma facility may be based on mechanistic (crash) criteria alone (Committee on Trauma, 1997). However it seems that the most effective tools to determine injury severity for patients involved in vehicle crashes include both mechanistic and physiological variables. A useful example of the development of such a triage screening tool is provided in a study conducted by Newgard, Lewis & Jolly (2002) on using out of hospital factors to predict the severity of injury in paediatric patients involved in vehicle crashes.

Newgard, Lewis and Jolly (2002) conducted a prospective analysis of data from the American National Sampling System Crashworthiness Data System database. This database consists of a comprehensive national probability sample of vehicle crashes. Cases from January 1993 through to December 1999 that involved children up to the age of 15 were included in the study. A number of out-of-hospital variables that were thought to predict injury severity, and were both available through the database and considered to be easily obtainable by on scene emergency service personnel, were analysed in the study. These variables included: age, sex, weight, Glasgow Coma Scale (GCS), primary point of vehicular impact, passenger space intrusion (PSI), intrusion location, restraint use, seat location, entrapment and airbag deployment. Children with a ISS of greater than 16 were considered to have experienced severe trauma and to be in need of trauma centre care. A classification and Regression Tree (CART) analysis was used to create a decision tree that would separate children with severe injuries from children with minor injuries. The variables included in the final decision tree were selected so as to create a simple decision tree that had high sensitivity (to ensure that under-triage of severely injured children was minimised). The decision tree chosen consisted of three variables, the first being a GCS of less than 15 (indicating a brain injury). The second variable was a PSI of 15 cm or more, and the third variable was lack of appropriate restraint use. Together and applied in this order, these three factors were found to have a sensitivity of 92% and a specificity of 73%. That is 92% of children with severe trauma were correctly identified as experiencing severe trauma and 73% of children who had minor trauma were assessed as such. Of the 8,392 subjects, 47 had severe injury. The GCS criterion identified 15 of the 47 severely injured children and, in doing so, also captured 9 non-severely injured children. The two mechanistic criteria identified a further 29 severely injured children, but also drew in a further 2,315 non-severely injured children as well. This lack of specificity was regarded as acceptable as preferable to the under-triage of the severely injured: the screening tool only missed 3 children (of 47) who had severe injuries.

This method of developing screening criteria considers the need for emergency personnel to be able to collect information for the screening tool easily and quickly, and the need to develop a simple screening tool that is easy to apply and is both highly sensitive and highly specific. In this study two mechanistic variables were included in the final screening tool indicating the usefulness of including mechanistic factors in any triage screening applied to crash victims.

4 How mechanistic information should be collected

A number of studies have been conducted that look at the best method of collecting and presenting the important mechanistic details of a vehicle accident. The use of written or verbal descriptions of important mechanistic features of a vehicle accident by emergency medical services staff has been criticised as being frequently inaccurate (Hunt et al., 1993; Hunt et al., 1997; and Santana & Martinez, 1995).

Santana and Martinez (1995) found that in comparison with police reports (which the authors considered to be highly accurate), the run reports, or descriptions of the accident compiled by emergency medical staff, were often inaccurate. The results of this study indicated that in 74% of all crashes there was at least one discrepancy between police reports and the emergency medical staff reports. In 46% of cases there were multiple discrepancies.

Hunt et al. (1993) and Hunt et al. (1997) investigate the accuracy and effectiveness of emergency medical technicians recording mechanistic information at vehicle crashes photographically. The results of the Hunt et al. (1993) study indicate that emergency technicians were unable to determine the area of damage to a vehicle and the severity of damage in 48% and 61% of emergency medical service run reports respectively. In comparison there were no instances where emergency medical technicians were unable to determine both the area and severity of damage from crash photographs. A further study by Hunt et al. (1997) suggests that, in a majority of cases, emergency medical technicians can take clear photographs of important details of a vehicle crash in adverse weather and lighting conditions and quickly enough so as not to interfere with patient care. These two studies suggest that photographs of a vehicle crash provide a more accurate format from which to determine the important mechanistic variables of the crash compared with verbal or written crash descriptions. Furthermore, taking photographs has been shown to be a highly effective and practical way of collecting mechanistic information.

The South Australian Ambulance Service has routinely recorded crash information to assist in the early management of injury. A certain amount of crash data is recorded on the Ambulance Officer Report besides clinical signs and presumptive diagnoses. The crash information includes the type of crash, whether the occupant was ejected, an estimate of the impact force and helmet/seat belt use. Additionally, since 1994, photographs are taken by ambulance officers routinely at the scenes of crashes to provide backup information during trauma assessment. (Following their use, the photographs are destroyed). The data collected has proved itself valuable to trauma services in South Australia (Grantham, 2005).

5 Using mechanistic variables to predict specific injuries

Reiff et al. (2002) looked at whether mechanistic features of a vehicle crash can be used to diagnose diaphragmatic rupture. Diaphragmatic rupture is difficult to diagnose and in the past doctors have identified it when carrying out surgical explorations for other injuries. Considering the recent trend toward non-operative management of patients, diaphragmatic rupture is less likely to be diagnosed in this manner and hence Reiff et al. attempted to identify out of hospital factors that may accurately predict diaphragmatic rupture. The results of this study suggest that patients with diaphragmatic rupture tend to experience higher changes in velocity (delta-v greater than 40 km/h) and greater occupant compartment intrusion (greater than 30 cm). Combining these mechanistic factors with the presence of other injuries led to the production of diagnostic tools with various sensitivity and specificity ratings, the most balanced of which achieved a sensitivity of 81.2% and a specificity of 71.1%. The study demonstrates that mechanistic variables can be used to indicate a specific injury that is otherwise difficult to diagnose.

6 Beyond mechanistic factors

The preceding discussion has focussed on the use of crash information in the acute stage of trauma management. In Zurich, Switzerland, there is a project called 'Sanacons', that also uses crash information as part of an evidence-based approach to the management of injury. This project has provided data for a research paper that will be discussed later. A description of the service being provided is provided (in German) on the project's website: http://www.sanacons.ch/. Additionally we have been in correspondence with Kai-Uwe Schmitt, one of the projects principal investigators, to discuss the nature of the work that he is carrying out. Dr Schmitt provided us with some additional information on the project.

One of the project's aims is to provide an independent technical evaluation to people who have been injured in a crash. The project offers injured crash participants a chance to receive a secondary opinion from a medical physician as yet not involved in their treatment. The project aims to:

1. Clarify and explain diagnoses and the reasons for people's injuries
2. Discuss with the injured person what is going on in their broader life
3. Offer suggestions as to Individual diagnoses and useful therapeutic strategies.

The justifications for providing this service are (1) that the circumstances surrounding an injury sustained in a vehicle crash are often not clear; and (2) sometimes oversimplifications about the biomechanics of a crash lead medical professionals to make unfounded diagnoses which can lead to incorrect treatments. The project attempts to rectify these problems by providing injured people with a thorough biomedical assessment of their crash. In essence, the consultation combines facts about the crash with evidence-based knowledge of biomechanics and treatment to provide advice to patients themselves; it is counselling with technical and biomedical focus.

There has been no formal evaluation of this project. We understand that some data is now being collected for an evaluation (Schmitt, 2005), but no analysis has been reported to date. However, there has been one paper that examined the ability of the assessment to account for chronic whiplash injury. This paper is discussed below.

Schmitt, Walz, Vetter and Muser (2003) analysed 668 cases of cervical spine disorder that resulted in a minimum of 4 weeks sick leave. They investigated the ability of three different assessment methods in predicting whiplash injury *post hoc*. The three assessment methods were:

- Mechanical Assessment: An assessment, usually based on photos of the vehicles involved in the crash and in some cases a full crash reconstruction, used to determine the collision induced change in velocity (delta-v) sustained by the injured person's vehicle.
- Medical Assessment: The medical files of the injured person were reviewed taking into consideration the injured person's medical history, the findings of the initial medical assessment related to injuries sustained in the immediate crash and the results of any follow up examinations.
- Biomechanical Assessment: An assessment that took into account the mechanical aspects of the crash and the medical history of the patient as well as the individual's physique so an estimate of the motion of their spine during the collision could be estimated.

Schmitt et al. conclude that when attempting to explain a person's whiplash injuries that were sustained in a vehicle accident, any technical analysis of the crash, or medical assessment of the injury, should be supplemented by a consideration of relevant biomechanical factors. They report that in 49% of cases where a mechanistic assessment (based primarily on delta-v scores) could not explain the extent of a person's injuries, a biomechanical assessment that considered the person's medical history and the "collision circumstances" could. Specifically, they found that patients that had pre-existing neck damage or pre-existing signs of neck damage exhibited significantly greater Quebec Task Force (QTF) grades of whiplash associated disorders than patients with no pre-existing neck damage or signs of neck damage respectively. These two findings provide some evidence that both medical and biomechanical assessment methods provide added diagnostic function to a purely mechanistic analysis.

There are a number of limitations to this piece of research and the exact intention of the study is unclear. The aim was not to assess the therapeutic efficacy of the service. Primarily it is claimed that a biomechanical assessment explains injuries better than a mechanical assessment, however, the specific factors responsible for this improved accuracy are not identified by the authors. Secondly, it appears that, knowing all the facts, including the extent of the injury/disability, the assessor made a subjective judgement as to whether the addition of more information in the biomechanical assessment was able to better explain the presence of the injury. It is thus unclear whether it was a specific aspect of the biomechanical assessment that improved the explanation of the injury, or whether it was simply that there was more information in the biomechanical assessment than in the mechanistic assessment. Furthermore, while the type of information included in the three assessments is loosely explained the exact information included in each assessment is not explicitly stated.

These limitations mean that we do not understand what these methods are actually assessing, nor do we know if the service has any therapeutic value. In summary these limitations mean that while this study suggests some interesting directions for further research, the claims made by the authors need to be elucidated before we fully understand the usefulness of these different assessment techniques.

While the Sanacons project may not have been evaluated, it appears to be based on a philosophy of evidence-based diagnosis and treatment. This approach is supported by other research and research reviews that have systematically identified risk factors for chronic whiplash injury.

Scholten-Peeters et al. (2003) conducted a review to ascertain clinically relevant factors in the prognosis of whiplash injury. In that review, they found only limited utility in crash related factors for predicting the prognosis of whiplash injury. They found that initial symptoms were useful in prognosing delayed recovery. In their review, there was also limited support for the use of psychosocial variables to prognose delayed recovery.

Ryan et al., (1994) conducted a study in Adelaide in which the crash severity, as defined by the delta-v, was estimated in individual cases. No association between delayed recovery and crash severity could be discerned. In the study, the only variable collected that was predictive of delayed outcome was lack of awareness of the impeding collision. The effect of this factor on recovery was substantial (odds ratio 15.0).

It may be that the information that is able to be collected in a crash investigation for a mechanistic assessment of a crash is incapable of representing the mechanics of the crash as experienced by the neck of the injured occupant. Without a detailed crash reconstruction, the loads of the neck may not be able to be properly assessed by estimating a delta-v from a crash reconstruction (Kettler et al, 2004).

Krafft, Kullgren and Ydenius (2002) reviewed 66 rear impact crashes in which specially fitted crash pulse recorders had measured the vehicle acceleration in the crash. While the crash pulse magnitude appeared to have limited correlation with the duration of symptoms, and accounted for some of the variation in the duration of symptoms between cases, the pulse could not distinguish the grade of whiplash, graded according to the Quebec Task Force classification. Furthermore, the direct measurement of delta-v bore no relationship to the duration of symptoms. So even where details of the crash pulse are known, their prognostic value is not great. It is therefore not surprising that less precise estimates of delta-v have little prognostic value.

Harder, Veilleux et al. (1998) analysed data on individuals who had made a claim for whiplash in the Province of Québec, Canada. They assumed that the proportion of the cohort that had recovered at a particular time could be described as an exponential function; that is, the rate of recovery was proportional to the number of individuals who had not yet recovered. They then created a model that described the influence of a number of factors on the recovery time. The most significant factors for delaying recovery were a mixture of gross crash factors (belt use, type of vehicle and location of crash), injury factors and socio-demographic factors: Additional injuries besides whiplash, female gender, older age, a greater number of dependents, being involved in a severe crash, in a vehicle that was not a car, and not wearing a seatbelt were all predictive of delayed recovery. By profiling patients, their model could predict delayed recovery. Those individuals who had, at most, two risk factors present for delayed recovery had a median time to recovery of 19 days, whereas individuals having six or more risk factors present had a median recovery time of 71 days.

7 Summary and recommendations

It is logical, and does not need to be particularly emphasised in this report, that the provision of evidence in the diagnosis and treatment of injury will allow better clinical decisions to be made, thereby improving treatment and rehabilitation outcomes. By extension, when there is clinically relevant information about the crash available, clinical decisions in the acute stages of trauma management may be improved. The evidence is consistent in support of the use of crash information as a triage tool. Furthermore, as was found by Reiff et al, (2002) certain injuries that are difficult to diagnose clinically, may be indicated by specific evidence gathered about the crash. While it appears that the use of crash information may provide a useful supplement in triage, we cannot say if triage would be significantly improved with the addition of crash information. In Newgard, Lewis & Jolly (2002), the decision tree that was developed included two pieces of crash information (cabin intrusion and appropriate restraint). However, it should be noted that the crash variables increased the sensitivity of the screening tool at the expense of its specificity; may non-severely injured people would also be identified as requiring major trauma services.

The case for the use of crash reports in the management of chronic injury is not supported by this review. The paucity of research in this area does not allow us to find any direct evidence for or against the proposition. Although there does appear to be some utility in crash information in post-hoc reviews of cases, the indirect evidence suggests that the prognostic value of the data in crash reports appears limited. The explanation for this may be that the transition from acute to chronic injury is determined by many factors apart from observable tissue damage and forces present during the impact. In the case of chronic whiplash pain, the prognosis of acute injury is better predicted by factors such as initial clinical signs and, more controversially, a host of psychosocial variables (Côté et al., 2001; Scholten-Peeters et al., 2003). Additionally, if there are certain mechanical aspects that affect the duration of symptoms in whiplash patients, they may not be able to be estimated by routine crash analysis.

Research on chronic whiplash has shown that a consideration of crude crash variables, medical and psychosocial variables may be able to identify individuals at risk of developing chronic symptoms. The identification of at-risk individuals and early-intervention in the management of their symptoms is a promising approach to the early resolution of whiplash injury (Harder and Potts, 2003).

Inasmuch as the Sanacons project has value, it may be that the value lies in the multi-disciplinary approach to the review of cases. By taking into account the medical history of the subject, treatments to date, and the severity and possible biomechanics of the crash, targeted interventions can be recommended, and the resolution of the symptoms may then be positively reinforced by counselling each subject.

We therefore recommend that crash reports should not be relied upon to prognose the course of injuries such as whiplash as the prognostic value of crash reports in these cases is in doubt. However, it is feasible that the information might be useful in a therapeutic setting if it is thought desirable that the patient should understand the crash, and the mechanism of their ailment as part of the process of recovery, as is anecdotally the case in the Sanacons project. To prove such a proposition might require the use of a controlled trial.

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