

**"Whiplash Associated Disorders (WAD) - Redefining
Whiplash and its Management" by the Quebec Task Force: A
Critical Evaluation**

Michael D. Freeman

Arthur C. Croft

Annette M. Rossignol

Submitted to *Spine*, December 1996
Accepted September 12, 1997, in Press

"Whiplash Associated Disorders (WAD) - Redefining Whiplash and its Management" by the Quebec Task Force: A Critical Evaluation.....	1
INTRODUCTION	2
Materials and Methods.....	4
Results and Discussion	4
Selection Bias	5
Information Bias in the Cohort Study.....	11
Confusing and Unconventional Use of Terminology	11
Questionable use of Terminology in the Text	12
Unsupported Conclusions and Recommendations.....	13
Inappropriate Generalizations from the Cohort Study.....	17
CONCLUSION.....	19
REFERENCES	19

"WHIPLASH ASSOCIATED DISORDERS (WAD) - REDEFINING WHIPLASH AND ITS MANAGEMENT" BY THE QUEBEC TASK FORCE: A CRITICAL EVALUATION

INTRODUCTION

In January 1995, the Societe de l'assurance Automobile du Quebec (SAAQ) published a text entitled, *Whiplash Associated Disorders (WAD)--Redefining Whiplash and its Management* (referred to, henceforth, as the "text"). The text was authored by the Quebec Task Force on Whiplash-Associated Disorders, which was chaired by Walter O. Spitzer, M.D., M.P.H., F.R.C.P.C., and consisted of an eminent panel of experts in medicine, epidemiology and biostatistics, chiropractic, and other disciplines. The reported mandate of the Task Force was to address a variety of issues concerning whiplash injuries, including:

1. the prevention of whiplash injuries;
2. an examination of the natural history of the condition;
3. the formulation of practical clinical guidelines for diagnosis and management of the condition;
4. the development of a strategy for the education of health care providers regarding whiplash injuries; and,
5. the development of recommendations for occupational and personal rehabilitation for whiplash-injured individuals.

The Task Force set out to comprehensively review the literature on the subject in order to respond to the issues of the mandate. In addition, a retrospective cohort study was performed on SAAQ data of whiplash-diagnosed individuals in Quebec who collected

compensation for their injuries in 1987.

The strategy of the Task Force was to use the "preeminence of evidence" for developing the guidelines, and that, no matter how eminent the panel members were in their respective fields of specialty, their opinions were "always subordinate to evidence" (section 1, page 3).

The Task Force first set about this task by instructing its members on the anatomy, pathophysiology, and biomechanics of whiplash injuries. Then, they examined the existing literature on the subject, using a technique called "the best synthesis of evidence," to determine which literature was scientifically suitable for inclusion in the study. The Task Force then studied its cohort and analyzed the resulting data. Lastly, based upon the results of the literature search and the cohort study, conclusions and recommendations were made regarding the research questions that had been asked. In addition to the text, which was several hundred pages long and available from the SAAQ (it is self-referred to as the "Official Report"), the Task Force published a 73-page pull-out supplement in the April 15, 1995 issue of the journal *Spine* (i) (referred to, henceforth, as the "supplement"). When the text and supplement were published, synopsis versions of the conclusions and recommendations were published widely in the popular press, under headlines such as *Whiplash Treatments Found to be Ineffective*, and *Much Whiplash Aid is Rated Worthless* (ii, iii, iv).

It is our contention that some of the most critical conclusions and recommendations, as well as the methodology used by the Task Force in reaching those conclusions, are flawed to the point that the validity of the document must be questioned. The purpose of this paper is to describe our findings of the examination of the text and

supplement and to present an analysis of potential sources of bias and other weaknesses.

Materials and Methods

Initially, we reviewed both the primary text and the supplement published by the Quebec Task Force. After examining both publications it was determined that only the primary text would be critiqued because it contained a more complete discussion of the study, and because the supplement contained no unique information.

Initially, only the Task Force's methodology was examined, particularly for sources of bias which might have threatened either the internal or external validity of the study. Internal validity is defined as the lack of bias in the study, and is threatened by comparison and information biases. External validity refers to the generalizability of the results of the study; in the case of this study, how the results and conclusion from the cohort study apply to the general population.

After a review of the methodology, it became evident that there were other problems with the document that posed an equally large threat to the accuracy of the study's conclusions as did the study's lack of validity. These problems consisted of the confusing use of terminology, and conclusions and recommendations that were neither supported by the literature review nor by the results of the cohort study. They were, in some cases, contrary to findings reported in the literature cited by the Task Force.

Results and Discussion

We found five separate categories of methodologic flaws within the text. These categories were:

1. selection bias (a threat to internal validity);
2. information bias in the cohort study (a threat to internal validity);
3. confusing and unconventional use of terminology;

4. unsupported conclusions and recommendations; and,
5. inappropriate generalizations from the cohort study (a threat to external validity).

Selection Bias

Selection Bias in Article Selection

The first area in which bias was noted was the manner of selection of articles considered eligible for inclusion in the study. In section 1 of the text, page 6, the statement was made that an *a priori* "criteria of quality when accepting or rejecting studies" could not be used because it would have resulted in the rejection of "virtually all articles considered" for inclusion in the formal literature review. In spite of this declaration, nearly all of the articles considered were rejected. Specifically, of the 10,382 articles reviewed, 62 were deemed acceptable (section 1, page 4), yielding an acceptance rate of 0.6%, and a rejection rate of 99.4%. Wholesale rejection of existing literature is not a source of bias per se if it does not result in an unrepresentative selection of the literature. However, the variability of all of the literature is difficult to assess and, with such a small sample of the literature, the degree to which the accepted literature is representative of the whole pool of relevant literature cannot be determined.

The literature that was considered for review included searches of the computerized databases beginning in 1980 and continuing to April of 1994. Sources included computerized databases such as MEDLINE, TRIS, and NTIS. Also searched were reports by government agencies, and the Task Force members were asked to supply studies of which they were aware (chapter 5.1, page 3). Literature from before 1980 was included if it was considered either "seminal" or "important" by members of the Task

Force. The criteria for gauging these characteristics was not provided. The seemingly arbitrary and nebulous nature of article selection for the period prior to 1980 contrasts greatly with the pan-inclusive search of the subsequent literature. There is no explanation for the discrepancy in search methodology for the periods before and after 1980. However, the use of noncomparable criteria for article selection may have seriously undermined the accuracy of the literature review.

Selection Bias in the Cohort Study

With the SAAQ whiplash-associated disorder cohort, the Task Force study set out to estimate the incidence of "**compensated** [emphasis added] whiplash injury" in Quebec and describe its variation by age, gender, and geographical region (section 6, page 2). The study subjects were identified from the SAAQ's database of individuals with ICD-9 diagnostic code 847.0 (cervical sprains and strains, including whiplash injury) and included only individuals who had received compensation for their injuries in 1987 in Quebec. Information for each individual receiving compensation was gathered from the computer database of the SAAQ. The following variables were considered:

1. demographic data (gender, age, area of residence, marital status, employment status, net income, and number of dependents);
2. collision-related data (vehicle type, occupant position, presence of multiple injuries, etc.);
3. the duration of compensation for time lost from work;
4. any recurrence of time loss compensation; and
5. the total cost to SAAQ.

No information was gathered about treatment rendered, symptoms, or the extent of

functional impairment of the individuals receiving compensation. Several types of compensation were available from the SAAQ (section 6, page 17):

1. an allowance to replace regular income, with a one week waiting period before time loss payments could be collected;
2. reimbursement for expenses associated with the accident, such as damaged clothing;
3. a lump sum payment for bodily injury;
4. an allowance for rehabilitation, the example of which was given as re-fitting a vehicle or home with special equipment; and
5. payments made in case of death.

Not included as compensation was most of the cost of treatment for whiplash injuries because Quebec has universal health care insurance and private plans that provide for treatment of whiplash injuries. The text mentions that the SAAQ would reimburse for treatment when it was not provided by any other insurance, but the amount of reimbursement for treatment not otherwise covered was reported to be \$0.00 for 1987 (section 6, page 4), whereas in the supplement, Table 6 enumerated numerous categories of expenditure not mentioned in the "Official Report." The reason for this disparity is unclear. Notwithstanding this inconsistency, it is apparent from the text that only

individuals who sought compensation, regardless of treatment history, were included in the cohort.

Also not included in the cohort were individuals who suffered whiplash injuries during the course of their employment because, in Quebec, industrial injuries are the responsibility of another insurer. The selection criteria for subject eligibility for the cohort eliminated an unknown number of the following whiplash-injured individuals:

1. Whiplash-injured individuals who sought no professional treatment and were not disabled;
2. whiplash-injured individuals who sought treatment for their injuries, but no compensation;
3. whiplash-injured individuals who were injured in the course of their employment;
4. whiplash-injured individuals who may have sought and received compensation, but were not diagnosed with the ICD-9 code 847.0;
5. whiplash-injured individuals with less than one week of time loss (the SAAQ will not pay time loss until more than one week has elapsed); and
6. whiplash-injured individuals who were disabled for more than one week, but chose not to seek compensation.

Had the Task Force used the data generated by their study to estimate the incidence of "compensated whiplash injury" in Quebec and describe its variation by age, gender, and geographical region, as they had originally set forth, selection bias would have been a much less significant issue. However, in the results section (section 6, pages 5-12) the authors did not confine themselves to inferences regarding 847.0-diagnosed individuals receiving compensation. The data were extrapolated to all whiplash-injured individuals in Quebec in 1987, not just those receiving compensation.

Another substantial source of selection bias resulted from the elimination of large

portions of the cohort. For example, of the original 4766 subjects, 1743 (36.6%) were excluded because their computer file contained no police report. In accidents where property damage exceeds CAN\$500, or accidents in which occupants are injured and require immediate medical attention, or accidents involving animals larger than 50 kg, police may be summoned to the scene (v). This usually results in the generation of a police report of the accident. Thus, police reports are not randomly associated with accidents.

Eliminating all individuals from the cohort study who had no police report associated with their compensation history would exclude whiplash-injured individuals who had a delay in onset of symptoms requiring medical care and/or who had less than CAN\$500 property damage to their vehicle. Determination of whether this exclusion might be a source of selection bias requires examination of the literature regarding delayed symptom onset and the rate of whiplash injury at sub-vehicular damage velocities.

Several authors have reported delay of onset symptoms in whiplash-injured individuals (vi, vii, viii, ix). For example, Hildingsson and Toolanen, in one of the 11 studies the Task Force accepted for their prognosis section, reported the following onset of symptoms in their cohort of 93 whiplash-injured patients (x): 65 patients were symptomatic within one hour; 77 patients were symptomatic within 5 hours; and 85 patients were symptomatic within 15 hours. Thus, 30% of these patients would not have been symptomatic immediately after the accident, and would not have met one of the response criteria of the Quebec Police Department. This figure is comparable to the 36.6% of the cohort that did not have police reports in their compensation claim file.

Several studies have examined damage thresholds for various vehicles. For example, Szabo et al. found that 1981-83 Ford Escorts could withstand multiple impacts at

10 mph without sustaining damage (xi). Bailey et al. reported the damage thresholds for a 1980 Toyota Tercel, a 1977 Honda Civic, a 1980 Chevrolet Citation, and a 1981 Ford Escort as 8.1 mph, 8.2 mph, 8.4 mph, and 10.2 mph, respectively (xii).

Wooley et al. tested a 1979 Pontiac Grand Prix, a 1979 Ford E-150 van, a 1978 Honda Accord, a 1979 Ford F-250 pick-up, a 1983 Ford Thunderbird, and a 1989 Chevrolet Citation and reported damage thresholds at 9.9 mph, 9.9 mph, 11.0 mph, 11.7 mph, 12.1 mph, and 12.7 mph, respectively (xiii).

Concerning the rate of occupant injury, Foret-Bruno et al. (xiv) reported that, at velocity changes below 9.3 mph, the injury rate was 36%, while at velocity changes greater than 9.3 mph, the injury rate was only 20%, pointing to an inverse relationship between vehicle damage and occupant injury. Olsson et al. (xv) found that 18% of these injuries occurred at crashes of less than 6.2 mph, and that 60% of injuries occurred between 6.2 and 12.4 mph. These findings nullify another of the Quebec police department response criteria because the majority of whiplash injuries occur at speeds that are unlikely to result in significant vehicle damage.

It is reasonable to conclude that a substantial subpopulation of whiplash-injured individuals were eliminated from the Task Force's cohort study by the police report selection criteria. These persons may have had a different history of compensation and recurrence than the group that was studied, resulting in study results that are difficult to interpret and that lack external validity. Moreover, the subpopulation of the cohort that was studied for recurrences did not include an additional 1,348 (28.3%) subjects who were given other diagnoses in addition to the ICD-9 diagnostic code 847.0. Accordingly, some of the most seriously injured individuals probably were excluded from the study by this

selection criteria, further undermining the interpretability and external validity of the study findings.

Information Bias in the Cohort Study

Information bias threatens the validity of the cohort study as a result of the use of ICD-9 diagnostic code 847.0 as the criteria for whiplash injury. In section 7, page 2, the Task Force remarked that diagnosis in whiplash was "confusing and non-standard," thereby suggesting that misdiagnosis may be common. We agree with this assessment. Therefore, it is probable that some whiplash cases were overlooked due to misclassification or the use of codes other than 847.0.

Confusing and Unconventional Use of Terminology

The **Results and Discussion** section of the cohort study (section 6, pages 5-15) contains numerous references to the portion of the study population that had "recovered" at the time of cessation of compensation. However, without any data gathered concerning the symptoms, level of treatment, or functional impairment at the time of cessation of compensation, it would not be possible to infer anything beyond the fact that the individual no longer was receiving compensation.

Although it is not unreasonable to assume that an unknown percentage of the cohort stopped receiving compensation because they had indeed "recovered" in the conventional sense of the word, alternative explanations for time loss cessation are also likely:

1. the individual partially recovered to the point that he/she could return to work;
2. the individual did not recover function but was able to find employment in another, less taxing line of work; and

3. the individual did not recover but returned to work at a decreased level of function due to economic pressure (it is unknown how influential this factor may have been because there is no information given in the text concerning the rate of reimbursement from SAAQ; presumably, earlier return to work would be a larger factor with lower reimbursement rates).

In the section following the description of the cohort study (section 6, page 2), recovery is defined as the "end of disability compensation." However, there is no reference cited for this unusual use of the word; the use of "recovery" in this manner is inconsistent with its usual meaning and is, at best, confusing and, at worst, misleading.

Other words or phrases used to describe findings from the cohort study, which cannot be inferred from the data that were collected, are:

1. "return to activity," because the actual level of activity was not measured and cannot be accurately inferred from duration of compensation;
2. "time of absence" from work, because duration of compensation does not necessarily measure time away from work;
3. "whiplash injury," because only the admittedly inaccurate diagnosis of ICD-9 code 847.0 was used to determine the existence of whiplash injury; and
4. "relapse or recurrence of symptoms," because no information was collected about the level of symptomatology, and "relapse" may have been inferred incorrectly from the reinstatement of time loss compensation.

Table 3.1 enumerates the locations in the text where the above listed and similar phrases were found.

Table 3.1:

Questionable use of Terminology in the Text

Location of	

Citation in Text		
Section #	Page #	Quote from Text
6	9	"Among the study cohort members, more than one fifth (22.1%) recovered within one week of the collision."
6	9	"Among those who sustained only a whiplash injury ..."
6	10	"The return to activity curve ... reveals that approximately 50% of the 2,810 whiplash subjects recovered within one month of the collisions, while 64% recovered within 60 days ... at six months and one year after the collision date, the proportion of subjects who had recovered was 87% and 97%, respectively."
6	14	"The data showed that longer time to return to activity after whiplash were found in subjects ..."
6	15	"Being in a severe collision ... [was] associated with a longer time of absence ."
6	15	"Rear-end collisions ... were found to be associated with a higher rate of relapse or recurrence of symptoms of whiplash subjects."

Unsupported Conclusions and Recommendations

The Self-limited and Short-lived Nature of Whiplash Injuries

In several places in the text, the Task Force reports that whiplash injuries are relatively benign. In section 7, page 2, they note: "Whiplash-associated disorders are usually self-limited." In section 7, page 3, they note: "Patients should be reassured that Whiplash-associated disorders are almost always self-limited." Again in section 7, page 10, they note: "The clinical management of WAD patients should recognize that most WAD...is self-limited." In chapter 8.1, page 3, they note: "Patients should be reassured that most WAD are benign and self-limiting."

There were no references cited in the section on prognosis of whiplash injuries to support these statements. Indeed, Table 5.3.4.4, "Prevalence of symptoms at follow-up," lists the four studies on prognosis which were accepted for review along with the findings of those authors. Norris and Watt found that 66% of their cohort had neck pain at an average of two years post injury (xvi); Radanov et al. found that 27% of their cohort were

symptomatic six months post-accident (xvii), and in a study published two years later, reported that 27% of their cohort continued to have headaches six months post-accident (xviii). Hildingsson and Toolanen found that 44% of their cohort were symptomatic an average of two years post-accident (x).

Even based upon the only literature accepted by the Task Force in this study which addressed long-term symptomatology, it appears that whiplash-associated disorders are frequently not self-limited and that a substantial number of injured individuals have long-term, chronic symptoms as a result of their injuries.

Additionally, there were no data collected on the physical status of the compensated whiplash injured subjects in the Quebec whiplash-associated disorder cohort study that would have allowed for an inference regarding recovery rates.

Favorable Prognosis

In section 7, page 2, the authors note: "All interventions...should be accompanied by reassurance about the favorable prognosis..."

A "favorable prognosis" is usually forecast in conditions that are known to spontaneously resolve without any residual symptoms or disability. Relying only on the literature cited by the Quebec Task Force, whiplash is a disorder that leaves 27% to 66% of the injured population symptomatic at six months to two years post-injury. They cited no studies in their text that would lend support to this statement about favorable prognosis.

Pain is not Harmful

In section 7, page 3, the Task Force recommended: "The key message to the WAD patient is that the pain is not harmful, [and] is usually short-lived... ." The Task Force did

not study the nature or severity of pain experienced by the subjects of their cohort study, and none of the prognosis studies accepted for inclusion support the statement that WAD pain is not harmful or that it is short-lived. To the contrary, the pain apparently is long-lived in a substantial proportion of cases. The degree of harm caused by pain from whiplash injuries is a complex subject that was not investigated by the Task Force.

Whiplash Results in Temporary Discomfort

In section 7, page 3, the Task Force reports: "...most incidents of WAD are self-limited, involving temporary discomfort, and rarely resulting in permanent harm.

The studies cited in Table 5.3.4.4 of the text do not support the statement that the "discomfort" is temporary for a substantial percentage of injured individuals. Additionally, using the term "discomfort" in lieu of "pain" may be misleading, because it may suggest to some that the pain experienced by whiplash-injured individuals is minimal or trivial. The degree of pain experienced by the average whiplash-injured individual was not studied by the QTF, in either its cohort study or its review of the literature.

A literature search was conducted to determine if there were other studies that contradicted the Task Force's conclusions that whiplash injuries short-lived, self limited, and temporary in nature. In addition to the four studies cited by the Task Force, 27 additional studies were found which reported on follow-up of acutely whiplash-injured individuals more than six months post-injury. A minimum quality criteria was established for these studies, which was as follows:

1. they followed a minimum of 30 relatively unselected acute whiplash patients; either patients presenting to a hospital emergency room, if the study was a prospective design, or a randomly assembled group of patients who were purposely recruited for the study, in a retrospective design;

2. the number of patients who had neck symptoms at the baseline evaluation was given, allowing for a comparison with those with neck symptoms at final follow-up;
3. the study gave enough detail regarding study design that it was clear how the authors arrived at their conclusions; and,
4. the study did not duplicate the results of a previously reviewed study which followed the same cohort.

Table 3.2 lists the 11 studies that fit the preceding criteria by author, year of study, cohort size, length of follow-up, and proportion of cohort with neck pain at final follow-up, with respect to those who initially presented with neck pain. The results of this literature search clearly contradict the Task Force's conclusions regarding the permanency of whiplash injuries.

Table 3.2:

Prognosis studies that fit the minimum quality criteria for inclusion

Author	Year	Cohort Size	Mean Follow-up (months)	% Chronic
Deans et al. (xix)	1986	85	12	42
Maimaris et al. (xx)	1988	102	26	34
Miles et al. (xxi)	1988	73	24	29
McKinney et al. (xxii)	1989	167	24	38
Olsson et al. (xxiii)	1990	33	12	36
Radanov et al. (xxiv)	1991	78	6	24
Watkinson et al. (xxv)	1991	35	128	26
Radanov et al. (xxvi)	1993	88	6	34
Gargan and Bannister (xxvii)	1994	50	24	60
Radanov et al. (xxviii)	1995	108	24	19
Nygren et al. (xxix)	1996	250	72	23

Inappropriate Generalizations from the Cohort Study

In section 6, page 15, the annual incidence rate of compensated insurance claims for whiplash injury in Quebec in 1987 was reported as 70/100,000, based upon the results of the cohort study. This rate is compared with that "of other countries," and Saskatchewan, where the rate was stated to be as "high as 700 per 100,000." However, due to the aforementioned substantial problems with subject selection criteria, the composition of the cohort, with regard to actual whiplash injury, is not clear. Moreover, there is no mention in the text of whether the selection criteria for these other cohorts were comparable. Thus, direct comparison of whiplash injury rates may not be comparable

between these groups.

CONCLUSION

The validity of the conclusions and recommendations of the Quebec Task Force regarding the natural course of whiplash injuries is questionable. This stems from the presence of bias and unconventional terminology used in both the literature search and the cohort study. Although the Quebec Task Force set out to "redefine whiplash and its management," striving for the desirable goal of clarification of the numerous contentious issues surrounding the injury, its publications have instead further confused the subject. Fundamental issues concerning the disorder continue to be debated in the literature, as evidenced by a recent publication by Schrader et al. who hypothesized that chronic symptoms as a result of whiplash were not real and were primarily the result of avarice (xxx). This study was later criticized for, among other faults, having "severe and fatal" selection bias (xxxi, xxxii, xxxiii).

We are in agreement with the Quebec Task Force concerning the need for high quality research concerning the true epidemiologic characteristics of whiplash injuries. Although the whiplash literature is extensive, no definitive studies have established widely accepted standards for either acute or chronic whiplash regarding effective treatment, prognosis, and risk factors for progression from the acute to the chronic stage.

Perhaps the unintended result of the publication of the Task Force findings will be to stimulate discussion in the literature and improve the quality of research on whiplash injuries.

REFERENCES

Spitzer WO, Skovron ML, Salmi LR, Cassidy JD, Duranceau J, Suissa S, Zeiss E. Scientific monograph of the Quebec Task Force on Whiplash-Associated Disorders: redefining “whiplash“ and its management. *Spine* 1995;20(8S):1S-73S.

Altman LK. Whiplash treatments found to be ineffective. *New York Times* May 2, 1995:C1,6.

Altman LK. Much whiplash aid is rated worthless. *San Diego Union Tribune* May 2, 1995:A8.

Altman LK. Whiplash can heal on own in days. *Lakeland Ledger* May 7, 1995:Science and Technology section.

Gagne S. Conversation with Officer Sylvain Gagne of the Quebec Police Department, 7-15-96.

Gotten N. Survey of one hundred cases of whiplash after settlement of litigation. *JAMA* 1956;162(9):865-867.

Deans GT, Magalliard JN, Kerr M, Rutherford WH. Neck sprain - a major cause of disability following car accidents. *Injury* 1987;18:10-12.

Larder DR, Twiss MK, Mackay GM. Neck injury to car occupants using seat belts. *29th Ann Proc Am Assoc Auto Med* 1985:153-165.

Kischka U, Ettlin T, Heim S, Schmid G. Cerebral symptoms following whiplash. *Eur Neurol* 1991;31(3):136-140.

Hildingsson C, Toolanen G. Outcome after soft-tissue injury of the cervical spine. A prospective study of 93 car-accident victims. *Acta Orthopod Scand* 1990;61:357-9.

Szabo TJ, Welcher J. Dynamics of low speed crash tests with energy absorbing

bumpers. SAE Tech Paper Series 1992;921573:1-9.

Bailey MN, Wong BC, Lawrence JM. Data and methods for estimating the severity of minor impacts. SAE Tech Paper Series 1995;950352:1339-174.

Wooley RL, Strother CE, James MB. Rear stiffness coefficients derived from barrier test data. SAE International Congress, Detroit, MI 1991:910120.

Foret-Bruno Jy, Dauvilliers F, Tarriere C. Influence of the seat and head rest stiffness on the risk of cervical injuries. 13th International Technical Conference on Experimental Safety Vehicles. 1991;S-8-W-19:968-974.

Olsson I, Bunketorp O, Carlsson G, et al. An in-depth study of neck injuries in rear end collisions. 1990 International IRCOBI Conference, Bron, Lyon, France. Sept 12-14,1990:1-15.

Norris SH, Watt I. The prognosis of neck injuries resulting from rear-end vehicle collisions. J Bone Joint Surg [Br] 1983;65:608-11.

Radanov BP, Di Stefano G, Schnidrig A, Sturzenegger M, Augustiny KF. Cognitive functioning after common whiplash. A controlled follow-up study. Arch Neurol 1993;50:87-91.

Radanov BP, Sturzenegger M, Di Stefano G, Schnidrig A, Aljinovic M. Factors influencing recovery from headache after common whiplash. Br Med J 1993;307:652-5.

Deans GT, McGalliard JN, Rutherford WH. Incidence and duration of neck pain among patients injured in car accidents. Br Med J 1986;292:94-5.

Maimaris C, Barnes MR, Allen MJ. "Whiplash injuries" of the neck: a retrospective study. Injury 1988;19(5):393-6.

Miles KA, Maimaris C, Finlay D, Barnes MR. The incidence and prognostic

significance of radiological abnormalities in soft tissue injuries to the cervical spine.

Skeletal Radiol 1988;17:493-6.

McKinney LA, Dornan JO, Ryan M. the role of physiotherapy in the management of acute neck sprains following road-traffic accidents. *Arch Emerg Med* 1989;6:27-33.

Olsson I, Bunketorp O, Carlsson G, et al. An in-depth study of neck injuries in rear end collisions. 1990 International IRCOBI Conference, Bron, Lyon France September 12-14:1-15.

Radanov BP, Di Stefano GD, Schnidrig A, Ballinari P. Role of psychological stress in recovery from common whiplash. *Lancet* 1991;338:712-5.

Watkinson A, Gargan MG, Bannister GC. Prognostic factors in soft tissue injuries of the cervical spine. *Injury* 1991;22(4):307-9.

Radanov BP, Di Stefano G, Schnidrig A, Sturzenegger M. Psychosocial stress, cognitive performance and disability after common whiplash. *J Psychosom Res* 1993;37(1):1-10.

Gargan MF, Bannister GC. The rate of recovery following whiplash injury. *Eur Spine J* 1994;3:162-4.

Radanov BP, Sturzenegger M, Di Stefano G. Long-term outcome after whiplash injury: a 2-year follow-up considering features of injury mechanisms and somatic, radiologic, and psychosocial findings. *Medicine* 1995;74(5):281-97.

Nygren A, Berglund A. Long term follow up of whiplash associated disorders (WAD). Swedish experience on insurance material. Whiplash '96 Abstracts, Brussels, Belgium. 1996:34-5.

Schrader H, Obelieniene D, Bovim G, et al. Natural evolution of late whiplash

syndrome outside the medicolegal context. *Lancet* 1996;347:1201-11.

Freeman MD, Croft AC. Late Whiplash Syndrome. *Lancet* 1996;348(9020):125.

Bjorgen IA: Late Whiplash Syndrome. *Lancet* 1996;348(9020):124.

de Mol BA, Heijer T: Late Whiplash Syndrome. *Lancet* 1996;348(9020):124-125.