"Risk for acute injury"

By Ronald J. Farabaugh, D.C
614-898-0787

1) <u>Female gender (Women have less musculature in the neck, therefore, cannot resist an impact as well as a male)</u>

69) Ommaya A, Backaitis S, Fan W, Partyka S: Automotive neck injuries. Ninth Internatl Technical Conference on Experimental Safety Vehicles, US Department of Transportation, National Highway Traffic Safety Administration, Kyoto Japan, Nov 1-4, 1982, pp 274-278.
106) Pearce JMS: Whiplash injury: a reappraisal. J Neurol Neurosurg Psychiatr 52:1329-1331, 1989.
107) Hohl M: Soft tissue injuries of the neck in automobile accidents: factors influencing prognosis. J Bone Joint Surg 56A(8):1675-1682, 1974.
108) Balla JI: The late whiplash syndrome. Aust NZ J Surg 50(6):610-614, 1980.
464) Bylund P-O, Björnstig U: Sick leave and disability pension among passenger car occupants injured in urban traffic. Spine 23(9):1023-1028, 1998.
467) Dolinis J: Risk factors for 'whiplash' in drivers: a cohort study of rear-end traffic crashes. Injury 28(3):173-179, 1997.
470) van den Kroonenberg A, Philippens H, Cappon J, Wismans J, Hell W, Langweider K: Human head-neck response during low-speed rear end impacts. Proceedings of the 42nd Stapp Car Crash Conference, SAE 983157, 207-221, 1998.
475) Morris AP, Thomas P: Neck injuries in the UK co-operative crash study. SAE 962433, 317-329, 1996.476
482) Satoh S, Naito S, Konishi T, Yoshikawa M, Morita N, Okada T, Kageyama T, Matsuzaki I: An examination of reasons for prolonged treatment in Japanese patients with whiplash injuries. J Musculoskel Pain 5(2):71-84, 1997.
513) Mayou R, Bryant B: Outcome of 'whiplash' neck injury. Injury 27(9):617-623, 1996.
514) Maag U, Laberge-Nadeau, Tao X: Neck strains in car crashes: incidence, associations, length of compensation and cost to insurer. Thirty-seventh AAAM Proceedings, 1993.

2) <u>Weighing less than 130 lbs. (Less weight means the occupant dosen't load the seat back as much/long and is thrown forward much quicker and faster creating higher "G" forces.)</u>

634) Banks R, Martini J, Smith H, Bowels A, Mcnish T, Howard R: Alignment of the lumbar vertebrae in a driving posture. J.Crash Prevention and Injury Control 2(2):123-130, 2000

3) <u>History of neck injury (Any previous injuries mean that the tissue has already been weakened)</u>

467) Dolinis J: Risk factors for 'whiplash' in drivers: a cohort study of rear-end traffic crashes. Injury 28(3):173-179, 1997.
643) Jakobsson L, Norin H, Isaksson-Hellman I: Parameters influencing the risk of AIS1 neck injuries in frontal and side impacts. International Research Council on the Biomechanics of Impact (IRCOBI) Conference Proceedings, Montpellier, France, September 20-22, 2000.

4) <u>Head restraint below head's center of gravity (males & females); large topset.</u>

685) Chapline JF, Ferguson SA, Lillis RP, Lund AK, William AF. Neck Pain and head restraint position relative to the drivers head in rear-end collisions. Accident Analysis and Prevention 2000; 32:287-297

5) History of CAD injury (Previous injuries weaken the tissues and they do respond as well as strong tissues)

660) Khan S, Bannister G, Gargan M, Asopa V, Edward A. Prognosis following a second whiplash injury. Injury-International Journal of the Care of the Injured 2000;31:249-251.

6) Poor head restraint geometry/tall occupant (e.g., _80th percentile male) (The head rest when set too low acts as a fulcrum and thereby causes an increased chance of injury.)

488) Viano D: Head restraint position during normal driving: implication to neck injury risk in rear crashes. Accid Anal and Prev 28(6):665-674, 1996.
558) Ono K, Kanno M: Influences of the physical parameters on the risk to neck injuries in low impact speed rear end collisions. Accid Anal and Prev 28(4):493-499, 1996.

7) Rear vs. other vector impacts (There is an abnormal "S" shape curve that forms from the ramping and straightening of the thoracic and cervical spine which damages the spine before head strike)

49h) 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. S-8-W-19, 968-974, 1991.
60i) Bourbeau R, Desjardins D, Maag U, Laberge-Nadeau C: Neck injuries among belted and unbelted occupants of the front seat of cars. J. Trauma 35(5):794-799, 1993.
69) Ommaya A, Backaitis S, Fan W, Partyka S: Automotive neck injuries. Ninth Internatl Technical Conference on Experimental Safety Vehicles, US Department of Transportation, National Highway Traffic Safety Administration, Kyoto Japan, Nov 1-4, 1982, pp 274-278.
72a) Data Link: Car crash outcomes in rear impacts. Appendix A to Current Issues of Occupant Protection in Car Rear Impacts. Washington, D.C., Data Link, inc., 1989.
73) Deans GT, Magalliard JN, Kerr M, Rutherford WH: Neck sprain-a major cause of disability following car accidents. Injury 18:10-12, 1987.
73a) Yoganandan N, Haffner M, Maiman DJ, et al.: Epidemiology and injury biomechanics of motor vehicle related trauma to the human spine. SAE 892438, in Proceedings of the 33rd Stapp Car Crash Conference, Detroit, MI, Society of Automotive Engineers, 223-242, 1989.
73b) Balla JI: Report to the Motor Accidents Board of Victoria on whiplash injuries. In (Chapter 10) Headache and cervical disorders. In Hopkins A, ed., Headache: Problems in Diagnosis and Management. London, Saunders, 1988, pp256-269.
73d) HUK-Verband: Sicherheit im auto: das unfallgeschehen und seine Folgen HUK-Verband, Muchen, 34-35, 1975.
73e) Otte D, Rether JR: Risks and mechanisms of injuries to the cervical spine in traffic accidents. International IRCOBI/AAAM Conference on the Biomechanics of Impact, Goetborg, Sweden, 17-31, 1985.
73f) Magnússon T: Extracervical symptoms after whiplash trauma. Cephalalgia 14(3):223-227, 1994.
73g) Deutscher C: Bewegungsablauf von Farzeuginsassen biem Heckaufprall. Eurotax (International), CH-8807 Freinbach, 1994.
464) Bylund P-O, Björnstig U: Sick leave and disability pension among passenger car occupants injured in urban traffic. Spine 23(9):1023-1028,
1998. 474-477,
474) Serra LL, Gallicchio B, Serra FP, Grillo G, Ferrari M: BAEP and E.M.G. changes from whiplash injuries. Acta Neurol 16(5-6):262-270, 1994.
475) Morris AP, Thomas P: Neck injuries in the UK co-operative crash study. SAE 962433, 317-329, 1996.
476) Borchgrevink GE, Lereim I, R_yneland L, Bj_rndal A, Haraldseth O: National health insurance consumption and chronic symptoms following mild neck sprain injuries in car accidents. Scand J Soc Med 24(4):264-271, 1996.

477) Borchgrevink GE, Stiles TC, Borchgrevink PC, Lereim I: Personality profile among symptomatic and recovered patients with neck sprain injury, measures by MCMI-I acutely and 6 months after car accidents. J Psychosomatic Res 42(4):357-367, 1997.
562) Freeman MD, Croft AC: Late whiplash risk factor analysis of a random sample of patients with chronic spine pain. J Musculoskel Pain. In
press.
594) Paying For Auto Injuries: A Consumer Panel Survey of Auto Accident Victims. Insurance Research Council, May, 1994, p9.
610) Temming J, Zobel R,. Frequency and risk of cervical spine distortion injuries in passenger car accidents: significance of human factors data. International IRCOBI Conference on the Biomechanics of Impact. September 16-18, 1998, Goteborg, Sweden, 219-233.
662) Richter M, Otte D, Pohlemann T, Kretteck C, Blauth M. Whiplash-type neck distortion in restrained cart drivers: frequency, causes and long term results. European Sine Journal 2000;9:109-117.

8) <u>Use of seat belts/shoulder harness (i.e., standard three-point restraints) (The use of seatbelts prevents chest and facial injuries, but it actually increases the likelihood of injuries to the cervical spine.)</u>

12) Dunn EJ, Blazar S: Soft-Tissue injuries of the lower cervical spine. Instructional Course Lectures, American Academy Orthopaedic Surgeons,
Vol XXXVI, 499-512, 1987.
49b) National Accident Sampling System/Crashworthiness Data System 1988-1990. U.S. Dept. of Transportation, National Highway Traffic Safety Administration, 1991.
68) Nygren A: Injuries to car occupants-some aspects of interior safety of cars. Acta Oto-Laryngologica (Suppl #394), 1984.
69) Ommaya A, Backaitis S, Fan W, Partyka S: Automotive neck injuries. Ninth Internatl Technical Conference on Experimental Safety Vehicles, US Department of Transportation, National Highway Traffic Safety Administration, Kyoto Japan, Nov 1-4, 1982, pp 274-278.
73) Deans GT, Magalliard JN, Kerr M, Rutherford WH: Neck sprain-a major cause of disability following car accidents. Injury 18:10-12, 1987.
74) Allen MJ, Barnes MR, Bodivala GG: The effect of seatbelt legislation on injuries sustained by car occupants. Injury 16:471, 1985.
79) Hayes CW, Conway WF, Walsh JW, Coppage L, Gerwin AS: Seat belt injuries: radiological and clinical correlation. RadioGraphics 11:23-36, 1991.
93f) Roh LS, Fazzalaro W: Transection of the trachea due to improper application of automatic seatbelt (submarine effect). J Forensic Sci 38(4):972-977, 1993.
97a) Kallieris D, Mattern R, Miltner E, et al.: Considerations for a neck injury criterion. SAE 912916, in Proceedings of the 35th Stapp Car Crash
Conference, Detroit, MI, Society of Automotive Engineers, 401-415, 1991.
475) Morris AP, Thomas P: Neck injuries in the UK co-operative crash study. SAE 962433, 317-329, 1996.
476) Borchgrevink GE, Lereim I, R_yneland L, Bj_rndal A, Haraldseth O: National health insurance consumption and chronic symptoms following mild neck sprain injuries in car accidents. Scand J Soc Med 24(4):264-271, 1996.
478) Lange JE, Voas RB: Nightime observations of safety belt use: an evaluation of California's primary law. AJPH 88(11):1718, 1998.
479) Versteegen GJ, Kingma J, Meijler WJ, ten Duis HJ. Neck sprain in patients injured in car accidents: a retrospective study covering the period 1970-1994. Eur Spine J 7:195-200, 1998.
480) Evans E: Safety-belt effectivenss: the influence of crash severity and selective recruitment. Accid Anal and Prev 28(4):423-433, 1996.
481) Teifke A, Degreif J, Geist M, Schild H, Strunk H, Schunk K Der Sicherheitsgurt: Auswirkungen auf das Verletzungsmuster von Autoinsassin. Rof Fortschr Geb Rontgenstr Neuren Bildgeb Verfahr 159:278-283, 1993.
482) Satoh S, Naito S, Konishi T, Yoshikawa M, Morita N, Okada T, Kageyama T, Matsuzaki I: An examination of reasons for prolonged treatment in Japanese patients with whiplash injuries. J Musculoskel Pain 5(2):71-84, 1997.*.

662) Richter M, Otte D, Pohlemann T, Kretteck C, Blauth M. Whiplash-type neck distortion in restrained cart drivers: frequency, causes and long term results. European Sine Journal 2000;9:109-117.

9) <u>Body mass index/head neck index (i.e., decreased risk with increasing mass and neck size)</u>

465) Freeman MD, Croft AC, Rossignol AM: Chronic neck pain and whiplash: a case-control study of the relationship between acute whiplash injuries and chronic neck pain. Submitted.
470) van den Kroonenberg A, Philippens H, Cappon J, Wismans J, Hell W, Langweider K: Human head-neck response during low-speed rear end impacts. Proceedings of the 42nd Stapp Car Crash Conference, SAE 983157, 207-221, 1998.

10) <u>Out-of-position occupant (e.g., leaning forward/slumped) (Out of position increases the likelihood of striking something inside of the vehicle and the out of position creates force on the body that is not equal and thereby is more likely to damage tissue)</u>

53a) Romilly DP, Thomson RW, Navin FPD, Macnabb MJ: Low speed rear impacts and the elastic properties of automobiles. Proceedings: 12th International Conference of Experimental Safety Vehicles, Gothenburg, 1-14, May/June, 1989.
63) Hu AA, Bean SP, Zimmerman RM: Response of belted dummy and cadaver to rear impact. SAE 770929, in Proceedings of the Twenty-First Stapp Car Crash Conference, Society of Automobile Engineers, 587-635, 1977.
99a) Warner CY, Strother CE, James MB, et al.: Occupant protection in rear end collisions: II. The role of seat back deformation in injury reduction. SAE 912914, in Proceedings of the 35th Stapp Car Crash Conference, Detroit, MI,
100b) Berton RJ: Whiplash: tests of the influential variables. SAE 680080, Automotive Engineering Congress, Detroit, MI, Jan, 1968.
100c) Foret-Bruno JY, Tarriere C, LeCoz JY, et al.: Risk of cervical lesions in real-world and simulated collisions. 34th AAAM Conference Proceedings, Scottsdale, AZ, p373, Oct, 1990.
100d) Olsson I, Bunketorp O: An in-depth study of neck injuries in rear end collisions. IRCOBI, p269, Sep, 1990.
100e) Severy DM, Brink HM, Baird JD: Preliminary findings of head support designs. SAE 670921 in Proceedings of the 11th Stapp Car Crash Conference, 1967.

11) <u>Non-failure of seat back (The failure of the seatback actually absorbs some of the impact energy)</u>

49h) 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. S-8-W-19, 968-974, 1991.
49j) States JD, Korn MW, Masengill JB: The enigma of whiplash injuries. Americam Association for Automotive, 13th Annual Conference, Minneapolis, MN, 83-108, 1969.
101d) Kihlberg JK: Flexion-torsion neck injury in rear impacts. Proceedings of the 13th Annual Conference of the American Association for Automotive Medicine, Ann Arbor, Michigan, 1-16, 1969. (MOVE)

12) <u>Having the head turned at impact (Creates uneven stress on the ligaments of the spine)</u>

73) Deans GT, Magalliard JN, Kerr M, Rutherford WH: Neck sprain-a major cause of disability following car accidents. Injury 18:10-12, 1987.
615) Winklestein BA, Nightingale RW, Richardson WJ, Myers BS. Cervical Facet Joint Mechanics: Its Application to Whiplash Injury. 43rd Stapp Car Crash Conference Proceedings 99SC15, 1999, 243-252.
663) Winklestein BA, Nightingale RW, Richardson WJ, Myers BS. Cervical facet capsule and its role in whiplash injury - A biomechanical investigation. Spine 2000 ;25:1238-1246.

13) <u>Non-awareness of impending impact (When occupant is aware of the crash they can brace which reduces the forces that act on the body)</u>

96l) Ryan GA, Taylor GW, Moore VM, Dolinis J: Neck strain in car occupants: injury status after 6 months and crash-related factors. Injury 25(8):533-537, 1994.
101j) Sturzenegger M, Di Stefano G, Radanov B, Schnidrig A: Presenting symptoms and signs after whiplash injury: the influence of accident mechanisms. Neurology 44(4):668-693, 1994.
467) Dolinis J: Risk factors for 'whiplash' in drivers: a cohort study of rear-end traffic crashes. Injury 28(3):173-179, 1997.

14) <u>Increasing age (i.e., middle age and beyond) (The tissues become less pliable as a person ages and as the hormonal changes cause a reduced musculature or weakness)</u>

49i) Lövsund P, Nygren A, Salen B, Tingvall C: Neck injuries in rear end collisions among front and rear seat occupants. International IRCOBI Conference on the Biomechanics of Impacts, Bergisch-Gladbach, Germany, 319-325, 1988.
69) Ommaya A, Backaitis S, Fan W, Partyka S: Automotive neck injuries. Ninth Internatl Technical Conference on Experimental Safety Vehicles, US Department of Transportation, National Highway Traffic Safety Administration, Kyoto Japan, Nov 1-4, 1982, pp 274-278.
73e) Otte D, Rether JR: Risks and mechanisms of injuries to the cervical spine in traffic accidents. International IRCOBI/AAAM Conference on the Biomechanics of Impact, Goetborg, Sweden, 17-31, 1985.
98a) Radanov BP, Di Stefano GD, Schnidrig A, Ballinari P: Role of psychological stress in recovery from common whiplash. Lancet 338:712-715, 1991.
482) Satoh S, Naito S, Konishi T, Yoshikawa M, Morita N, Okada T, Kageyama T, Matsuzaki I: An examination of reasons for prolonged treatment in Japanese patients with whiplash injuries. J Musculoskel Pain 5(2):71-84, 1997.

15) <u>Front vs. rear seat position (Multiple factors including the seat back resistance and the potential to strike something are increase in the front seat)</u>

49i) Lövsund P, Nygren A, Salen B, Tingvall C: Neck injuries in rear end collisions among front and rear seat occupants. International IRCOBI Conference on the Biomechanics of Impacts, Bergisch-Gladbach, Germany, 319-325, 1988.
73e) Otte D, Rether JR: Risks and mechanisms of injuries to the cervical spine in traffic accidents. International IRCOBI/AAAM Conference on the Biomechanics of Impact, Goetborg, Sweden, 17-31, 1985.
100f) States JD, Balcerak JD, Williams JS, et al.: Injury frequency and head restraint effectiveness in rear end impact accidents. In Proceedings of the 16th Stapp Car Crash Conference, Detroit, MI, 228-257, 1972.
101d) Kihlberg JK: Flexion-torsion neck injury in rear impacts. Proceedings of the 13th Annual Conference of the American Association for Automotive Medicine, Ann Arbor, Michigan, 1-16, 1969. (MOVE)
101g) Carlsson G, Nilsson S, Nilsson-Ehle A, et al.: Neck injuries in rear-end car collisions: Biomechanical considerations to improve head restraints. Proceedings of the International IRCOBI/AAAM Conference on the Biomechanics of Impacts, Göteborg, Sweden, 277-289, 1995.
101h) Otremski I, Marsh JL, Wilde BR, et al.: Soft tissue cervical spinal injuries in motor vehicle accidents. Injury 20:349-351, 1989.

16) <u>Impact by vehicle of greater mass (i.e., _25% greater) (Force = MASS x Acceleration, larger mass = more force)</u>

559) Kornhauser M: Delta-v thresholds for cervical spine injury. SAE Technical Paper Series, 960093, 1-13, 1996.
560) Wood DP: Safety and the car size effect: a fundamental explanation. Accid Anal and Prev 29(2):139-151, 1997.

594) Paying For Auto Injuries: A Consumer Panel Survey of Auto Accident Victims. Insurance Research Council, May, 1994, p9.
685) Chapline JF, Fergerson SA, Lillis RP, Lund AK, William AF. Neck Pain And head restraint position relative to the drivers head in rear-end collisions. Accident Analysis and Prevention 2000;3:287-297.

17) <u>Crash speed under 10 mph (Coefficient of restitution the car dose not crush or crumple therefore the energy is transferred to the occupant and is not absorbed by the car)</u>

49h) 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. S-8-W-19, 968-974, 1991.

18) <u>Rear Struck Occupant, when bullet vehicle has longitudinally mounted motor</u>

594) Paying For Auto Injuries: A Consumer Panel Survey of Auto Accident Victims. Insurance Research Council, May, 1994, p9.

About Dr. Farabaugh: Dr. Farabaugh has been in practice since 1982. He is certified in LOW SPEED REAR IMPACT CRASH RECONSTRUCTION through the Spine Research Institute of San Diego (SRISD), and holds a subspecialty as a Certified Chiropractic Sports Physician. He is also Past President of the Ohio State Chiropractic Association where he now serves as Treatment Guideline Chairman (2001-2003).

"Risk for late whiplash"

By Ronald J. Farabaugh, D.C
614-898-0787

1) <u>Female gender</u>

68) Nygren A: Injuries to car occupants-some aspects of interior safety of cars. Acta Oto-Laryngologica (Suppl #394), 1984.
482) Satoh S, Naito S, Konishi T, Yoshikawa M, Morita N, Okada T, Kageyama T, Matsuzaki I: An examination of reasons for prolonged treatment in Japanese patients with whiplash injuries. J Musculoskel Pain 5(2):71-84, 1997.
594) Paying For Auto Injuries: A Consumer Panel Survey of Auto Accident Victims. Insurance Research Council, May, 1994, p9.
607) Richter M, Ote D, Blauth M. Acceleration related injury of the cervical spine in restrained car drivers. Investigations on the trauma mechanism and severity of injury. Orthopaedic 1999;28:414-423.
662) Richter M, Otte D, Pohlemann T, Kretteck C, Blauth M. Whiplash-type neck distortion in restrained cart drivers: frequency, causes and long term results. European Sine Journal 2000;9:109-117.

2) <u>Rear vector vs. other vectors</u>

594) Paying For Auto Injuries: A Consumer Panel Survey of Auto Accident Victims. Insurance Research Council, May, 1994, p9.

3) <u>Body mass index in females only</u>

562) Freeman MD, Croft AC: Late whiplash risk factor analysis of a random sample of patients with chronic spine pain. J Musculoskel Pain. In press.

4) <u>Immediate/early onset of symptoms (i.e., within 12 hours) and/or severe initial symptoms</u>

98a) Radanov BP, Di Stefano GD, Schnidrig A, Ballinari P: Role of psychological stress in recovery from common whiplash. Lancet 338:712-715, 1991.
109a) Parmar HV, Raymakers R: Neck injuries from rear impact road traffic accidents: prognosis in persons seeking compensation. Injury 24(2):75-78, 1993.
166b) Radanov BP, Distefano GD, Schnidrig A, et al.: Cognitive functioning after common whiplash: a controlled follow-up study. Arch Neurol 50:87-91, 1993.
284l) Radanov BP, Sturzenegger M, Di Stefan G, Schnidrig A: Relationship between early somatic, radiological, cognitive and psychosocial findings and outcome during a one-year follow-up in 117 patients suffering from common whiplash. Br J Rheum 33:442-448, 1994.
284n) Radanov BP, Di Stefano G, Schnidrig A, Sturzenegger M: Psychosocial stress, cognitive performance and disability after common whiplash. J Psychosom Res 37(1):1-10, 1993.
482) Satoh S, Naito S, Konishi T, Yoshikawa M, Morita N, Okada T, Kageyama T, Matsuzaki I: An examination of reasons for prolonged treatment in Japanese patients with whiplash injuries. J Musculoskel Pain 5(2):71-84, 1997.

5) <u>Ligamentous instability.</u>

6) Initial back pain

284n) Radanov BP, Di Stefano G, Schnidrig A, Sturzenegger M: Psychosocial stress, cognitive performance and disability after common whiplash. J Psychosom Res 37(1):1-10, 1993.

7) Greater subjective cognitive impairment

166b) Radanov BP, Distefano GD, Schnidrig A, et al.: Cognitive functioning after common whiplash: a controlled follow-up study. Arch Neurol 50:87-91, 1993.
284l) Radanov BP, Sturzenegger M, Di Stefan G, Schnidrig A: Relationship between early somatic, radiological, cognitive and psychosocial findings and outcome during a one-year follow-up in 117 patients suffering from common whiplash. Br J Rheum 33:442-448, 1994.

8) Greater number of initial symptoms

166b) Radanov BP, Distefano GD, Schnidrig A, et al.: Cognitive functioning after common whiplash: a controlled follow-up study. Arch Neurol 50:87-91, 1993.

9) Use of seat belt shoulder harness (73,476)*. For neck (not back) pain (562); non-use had a protective effect.

73) Deans GT, Magalliard JN, Kerr M, Rutherford WH: Neck sprain-a major cause of disability following car accidents. Injury 18:10-12, 1987.
476) Borchgrevink GE, Lereim I, R_yneland L, Bj_rndal A, Haraldseth O: National health insurance consumption and chronic symptoms following mild neck sprain injuries in car accidents. Scand J Soc Med 24(4):264-271, 1996.
562) Freeman MD, Croft AC: Late whiplash risk factor analysis of a random sample of patients with chronic spine pain. J Musculoskel Pain. In press.

10) Initial physical findings of limited range of motion

109) Norris SH, Watt I: The prognosis of neck injuries resulting from rear-end vehicle collisions. J Bone Joint Surg 65B(5):608-611, 1983.
609) Sevenson MY, Aldman B, Bostrom O. et al. Transient pressure gradients in the pig spinal during experimental whiplash motion causing membrane dysfunction in spinal ganglion nerve cells. Orthopaedic 1998;27:820-826.

11) Neck Pain on palpation

692) Lee III WE. Biomechanical analysis and injury causation: an individual-specific and incident-specific approach. 43rd Annual proceedings of the Association for the Advancement of Automotive Medicine. September 20-21,1999, Barcelona, Spain,,438-439.

12) Muscle pain

692) Lee III WE. Biomechanical analysis and injury causation: an individual-specific and incident-specific approach. 43rd Annual proceedings of the Association for the Advancement of Automotive Medicine. September 20-21,1999, Barcelona, Spain,,438-439.

13) <u>Initial neurological symptoms. Radiating pain to the upper extremities (109).</u>

109) Norris SH, Watt I: The prognosis of neck injuries resulting from rear-end vehicle collisions. J Bone Joint Surg 65B(5):608-611, 1983.
692) Lee III WE. Biomechanical analysis and injury causation: an individual-specific and incident-specific approach. 43rd Annual proceedings of the Association for the Advancement of Automotive Medicine. September 20-21,1999, Barcelona, Spain,,438-439.

14) <u>Past history of neck pain (109a) or headache (284l).</u>

109a) Parmar HV, Raymakers R: Neck injuries from rear impact road traffic accidents: prognosis in persons seeking compensation. Injury 24(2):75-78, 1993.
284l) Radanov BP, Sturzenegger M, Di Stefan G, Schnidrig A: Relationship between early somatic, radiological, cognitive and psychosocial findings and outcome during a one-year follow-up in 117 patients suffering from common whiplash. Br J Rheum 33:442-448, 1994.

15) <u>Headache</u>

692) Lee III WE. Biomechanical analysis and injury causation: an individual-specific and incident-specific approach. 43rd Annual proceedings of the Association for the Advancement of Automotive Medicine. September 20-21,1999, Barcelona, Spain,,438-439.

16) <u>Initial degenerative changes seen on radiographs</u>

75) 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 17:493-496, 1988.
109) Norris SH, Watt I: The prognosis of neck injuries resulting from rear-end vehicle collisions. J Bone Joint Surg 65B(5):608-611, 1983.
109a) Parmar HV, Raymakers R: Neck injuries from rear impact road traffic accidents: prognosis in persons seeking compensation. Injury 24(2):75-78, 1993.
113) Watkinson A, Gargan MG, Bannister GC: Prognostic factors in soft tissue injuries of the cervical spine. Injury 22(4):307-309, 1991.

17) <u>Loss or reversal of cervical lordosis</u>

169r) Ettlin T, Kischka U, Reichmann S et al.: Cerebral symptoms after whiplash injury of the neck: a prospective clinical and neuropsychological study of whiplash injury. J Neurol Neurosurg Psychiatr 55(10):943-948, 1992.

18) <u>Increasing age (i.e., middle age and beyond)</u>

109a) Parmar HV, Raymakers R: Neck injuries from rear impact road traffic accidents: prognosis in persons seeking compensation. Injury 24(2):75-78, 1993.
166b) Radanov BP, Distefano GD, Schnidrig A, et al.: Cognitive functioning after common whiplash: a controlled follow-up study. Arch Neurol 50:87-91, 1993.
284n) Radanov BP, Di Stefano G, Schnidrig A, Sturzenegger M: Psychosocial stress, cognitive performance and disability after common whiplash. J Psychosom Res 37(1):1-10, 1993.
562) Freeman MD, Croft AC: Late whiplash risk factor analysis of a random sample of patients with chronic spine pain. J Musculoskel Pain. In press.
607) Richter M, Ote D, Blauth M. Acceleration related injury of the cervical spine in restrained car drivers. Investigations on the trauma mechanism and severity of injury. Orthopaedic 1999;28:414-423.
646) Brison RJ, Hartling L, Pickett W,. A prospective study of acceleration-extension injuries following rear-end motor vehicle collisions. Journal of Musculoskeletal Pain 2000;8:97-113.

19) <u>Front seat position</u>

109a) Parmar HV, Raymakers R: Neck injuries from rear impact road traffic accidents: prognosis in persons seeking compensation. Injury 24(2):75-78, 1993.

20) <u>Target vehicles manufactured from late 1988s through the 1990s (OR=2.7 vs in the early 1980s vehicles.)</u> <u>(Rear Impact Only)</u>

594) Paying For Auto Injuries: A Consumer Panel Survey of Auto Accident Victims. Insurance Research Council, May, 1994, p9.

About Dr. Farabaugh: Dr. Farabaugh has been in practice since 1982. He is certified in LOW SPEED REAR IMPACT CRASH RECONSTRUCTION through the Spine Research Institute of San Diego (SRISD), and holds a subspecialty as a Certified Chiropractic Sports Physician. He is also Past President of the Ohio State Chiropractic Association where he now serves as Treatment Guideline Chairman (2001-2003).