“Risk for acute injury”

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


2) **Weighing less than 130 lbs.** (Less weight means the occupant doesn’t load the seat back as much/long and is thrown forward much quicker and faster creating higher “G” forces.)


3) **History of neck injury** (Any previous injuries mean that the tissue has already been weakened)


4) **Head restraint below head’s center of gravity** (males & females; large topset)

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


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.)


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)


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


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


10) **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)**


11) **Non-failure of seat back (The failure of the seatback actually absorbs some of the impact energy)**


12) **Having the head turned at impact (Creates uneven stress on the ligaments of the spine)**

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


14) **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)


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


16) **Impact by vehicle of greater mass** (i.e., _25% greater_) (Force = MASS x Acceleration, larger mass = more force)

17) **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)


18) **Rear Struck Occupant, when bullet vehicle has longitudinally mounted motor**

“Risk for late whiplash”

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1) Female gender


2) Rear vector vs. other vectors


3) Body mass index in females only


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


5) Ligamentous instability.
6) Initial back pain


7) Greater subjective cognitive impairment


8) Greater number of initial symptoms


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


10) Initial physical findings of limited range of motion


11) Neck Pain on palpation


12) Muscle pain

13) **Initial neurological symptoms. Radiating pain to the upper extremities (109).**


14) **Past history of neck pain (109a) or headache (284l).**


15) **Headache**


16) **Initial degenerative changes seen on radiographs**


17) **Loss or reversal of cervical lordosis**


18) **Increasing age (i.e., middle age and beyond)**


19) **Front seat position**


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


*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).*

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