



## The Risk of Injury for Children Exposed to Whiplash Trauma

By Arthur Croft, DC, MS, MPH, FACO

Less than two percent of the literature about whiplash is devoted to children. When I wrote the first edition of my textbook in 1988,<sup>1</sup> I cited an older German study placing the risk for children at approximately one-sixth the risk of adults. By the time the second edition was published in 1995, a Swedish study had since been published putting the risk proportion in children closer to two-thirds that of adults.<sup>2</sup>

There were a few limitations of this study, particularly its design, which left us wondering how reliable this estimate really was. Several recently published papers have looked at the problem of scaling injury tolerances for the pediatric population. The results of one of these in tabular form follow:<sup>3</sup>

Age in Years	Based on calcaneal tendon material property		Based on spinal component material property			
	Tension	Extension	Tension	Extension	Compression	Flexion
1	0.24	0.14	0.248	0.141	0.239	0.137
3	0.34	0.22	0.302	0.187	0.291	0.182
6	0.46	0.31	0.369	0.248	0.355	0.242
5th female	0.63	0.50	0.630	0.501	0.630	0.501
50th male	1.00	1.00	1.000	1.000	1.000	1.000

The authors juxtaposed a comparison method, based on the relative strength of calcaneal tendon, to a more sophisticated method, based on spinal component material properties. The latter included a consideration of the gradually ossifying pediatric spine, relative differences in tissue modulus between pediatric and adult *annulus* fibrosis, differing facet joint angles between children and adults, and so on. The data are normalized to the 50th percentile adult male (5'10"). For comparison purposes, a smaller female is included. In extension and flexion, for example, a six-year-old spine has about 25% and 24% the strength of the adult male, respectively. However, if geometric scaling and tissue modulus changes told the whole story, clinically we would expect to see more injured children than adults, and clearly, this is not the case.

When it comes to occupant injury risk in specific crash conditions - such as low-speed rear impact crashes (LOSRIIC) - other variables may be more important than simple geometric or tissue modulus scaling. For example, kids more often ride in rear seats, which are generally safer than front seats. They tend also to have smaller backsets because of this-also reducing their risk of injury. Back seats in many cars still do not have shoulder harnesses, and this also would decrease the injury risk. Back seats have also been shown to be relatively safer than front seats, due to their reduced elasticity. And children have a greater cervical range of motion, with less lifetime injury history and no degenerative disease, which otherwise contributes to injury risk and poor outcome.

A recent poster presentation at the October meeting of the Association for the Advancement of Automotive Medicine (AAAM) meeting looked again at this poorly documented pediatric risk in LOSRIIC.<sup>4</sup> The study focused on a number of youths under age 17 presenting, over a period of one year, to ER departments in England. The goal was to compile data on incidence, severity, and clinical outcome. I have, however, discussed the potential bias of using a convenience sample from ER departments as being due to the fact that only a small percentage of cervical acceleration/deceleration (CAD) injury patients are seen at ERs, potentially compromising the study's external validity. However, probably 98% of the published outcome studies have used this very design! It is a convenient method for sampling. Another common problem is that many who present to the ER do so only out of fear that they may have serious injury. Some of these individuals actually are not injured, but are nevertheless falsely enrolled in these studies. More rightfully, they belong to a group that is merely *exposed* to whiplash - not actually injured by it. Interestingly, the authors suggested the high incidence of CAD in this group might be due to a *positive reporting bias* of patients attending the ER - which is possible - that did not consider the alternative bias. In other words, they suggested that those more seriously injured might be more inclined to present to an ER department. However, this concern does not seem to be borne out in the literature. In one prospective study of CAD-injured persons, only three of 254 were seen at the ER.<sup>5</sup> Most present to GPs, DCs, PTs, sports clinics and other secondary care centers.

In the present study, telephone contact was made with legal guardians and structured interviews were arranged. These took place approximately five days after a crash. Of course, we know nothing of the exposed or injured children who did not seek care at the hospital. With those graded as Grade 1 or higher, clinical review was also scheduled at 14 days, 28 days, and 56 days postinjury. Overall, 105 children were followed (39% were front seat passengers; 61% rear seat). Of these, 32% were involved in frontal crashes,

18% in side impacts, and 50% in rear impacts. Due to the significant differences in crash mechanics and resulting occupant kinematics, I hate to see these mixed studies, but this is also a common study design.

The overall incidence of CAD was 47% (49/105), with 60% of this group being symptomatic on the day of presentation to the ER. The remainder became symptomatic the next day. Again, most people become progressively less likely to present to an ER with longer lags in onset of symptoms, so it is likely that this sample was biased toward a more immediate onset. Slightly more children were female, but the difference was not significant. Almost half (47% or 23/49) of those injured were over the age of 12 years, and the age relationship was found to be significant. This age is also the age usually associated with puberty. Forty were graded as Grade 1 and the remainder as Grade 2. The average recovery period for the former was 6.4 days, and for the latter, 19.7 days.

The authors, as many have done before, due to the confusing terminology used by them, misquoted the Quebec Task Force on Whiplash-Associated Disorders as reporting a mean time to recovery of 28 days for CAD. In truth, the QTF defined *recovery* as a return to usual activities" and did not collect data on *clinical* recovery. In any case, and with the limitations offered as cautions by the authors and by myself, we now have perhaps better numbers for risk for the pediatric population in LOSRIC, and the observation that it clearly climbs as kids approach puberty.

### *References*

1. Croft AC, Soft tissue injuries: long- and short-term effects. In Foreman SM, Croft AC (eds) *Whiplash Injuries: the Cervical Acceleration/Deceleration Syndrome*, Baltimore, Williams & Wilkins, 1988.
2. Lövsund P, Nygren A, Salen B, Tingvall C: Neck injuries in rear end collisions among front and rear seat occupants. International Council on the Biomechanics of Impacts (IRCOBI) Conference, Bergisch-Gladbach, Germany, 319-325, 1988.
3. Yoganandan N, Pintar FA, Kumaresan S, Gennarelli TA, Sun E, Kuppa S, Maltese M, Eppinger RH: Pediatric and small female neck injury scale factors and tolerance based on human spine biomechanical characteristics. International Research Council on the Biomechanics of Impact (IRCOBI) Conference

Proceedings, Montpellier, France, Sept 20-22, 2000.

4. Boyd RJ, Massey R, Duane L, Yates DW: Whiplash-associated disorders in children attending the emergency department. 44<sup>th</sup> Annual Proceedings of the Association for the Advancement of Automotive Medicine, Chicago, IL, Oct 2-4, 2000, 485-489.

5. Dolinis J. Risk factors for 'whiplash' in drivers: a cohort study of rear-end traffic crashes. *Injury* 28(3):173-179, 1997.

*Arthur Croft, DC, MS, FACO, FACFE*

*Director, Spine Research Institute of San Diego*

*San Diego, California*

drcroft@srisd.com

---

Click [here](#) for more information about Arthur Croft, DC, MS, MPH, FACO.



Page printed from:

[http://www.chiroweb.com/mpacms/dc/article.php?id=32038&no\\_paginate=true&p\\_friendly=true&no\\_b=true](http://www.chiroweb.com/mpacms/dc/article.php?id=32038&no_paginate=true&p_friendly=true&no_b=true)