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Certificate of Accreditation for Continuing Legal Education

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CLE Credits

General	2.0

Certification Credits

Civil Trial	2.0

Litigation defense biomechanics was popularized in the early 1990's

- Invented by a McKinsey consultant for Allstate in the early 1990s (MIST)
- "Validated" from a biomechanical analysis of 6 crashes and a comparison to ADLs performed by a company called *Minorpac*
- The new program resulted in an increase in "fraudulent" cases from 2% to more than 20%, *in a single year* (Ins Res Council)
- The program provided the financial foundation for the current crop of companies providing biomechanical testimony for the defense

Who was Minorpac?

- 2 chiropractors from California who did DMEs and record reviews
- No background in engineering, biomechanics, crash reconstruction
- Claimed to have done experiments in the 1980s
  - No records of what was done, no recollection of what was done, who did it, or how it was done

Minorpac data

Comparison of Damages, Speed, and G-Force						
Damages	**Front car type**	**Weight**	**Rear car type**	**Weight**	**Estimated speed**	**Calculated G-force, people**
Bumper cover replaced, luggage lid aligned	87 Honda Accord	2,316	80 Mercury Bobcat	2,445	5 mph	0.6
Bumper scratch, cover replaced	85 Audi 5000s	2,704	90 Lexus LS400	3,759	2 mph	0.2
Bumper scratch	92 Toyota Previa	3,455	79 Chevy Caprice	3,675	5 mph	0.6
Bumper replaced	87 Toyota Tercel	2,060	91 Toyota Camry	2,735	5 mph	0.8
Bumper replaced	93 Ford Aerostar	3,296	91 Honda Civic	2,127	5 mph	0.4
Bumper and rear panel replaced, trunk lid aligned	85 Honda Accord	2,277	92 Toyota Previa	3,455	2.5 mph	1.3

Examples From Biomechanical Research	
Activity	**G force**
Jerking force felt in the neck when at the end stroke of a rowing machine.	0.2
Stepping off the height of a skateboard barefooted on to a concrete floor.	0.2
Driving over a four inch speed bump at a speed of 15 mph.	0.4
Bumping into someone while walking, causing a mildly altered gait.	0.4
Bumping into a parking curb at four mph.	0.6
Rolling into a curb.	0.6
Firing a 12-gauge shotgun.	0.7
Driving around a corner at a maximum rate.	0.7
Jerking felt when on roller skates and being pulled by a bicycle.	0.8
Bumping into someone while walking, and being pushed to one side momentarily.	0.8
Walk at a walking speed of five mph with both arms in the locked position into a wall.	0.9
Driving at 15 mph with brakes locked.	1.0
Standing on two phone books (six inches) and in bare feet stepping down onto half inch pile carpet.	1.3

Minorpac data were obviously faked by rank amateurs who knew nothing about crash reconstruction or biomechanics

The main thrust of the biomechanical opinion was that the crash was the same as every day activities

Premise behind ADL comparison

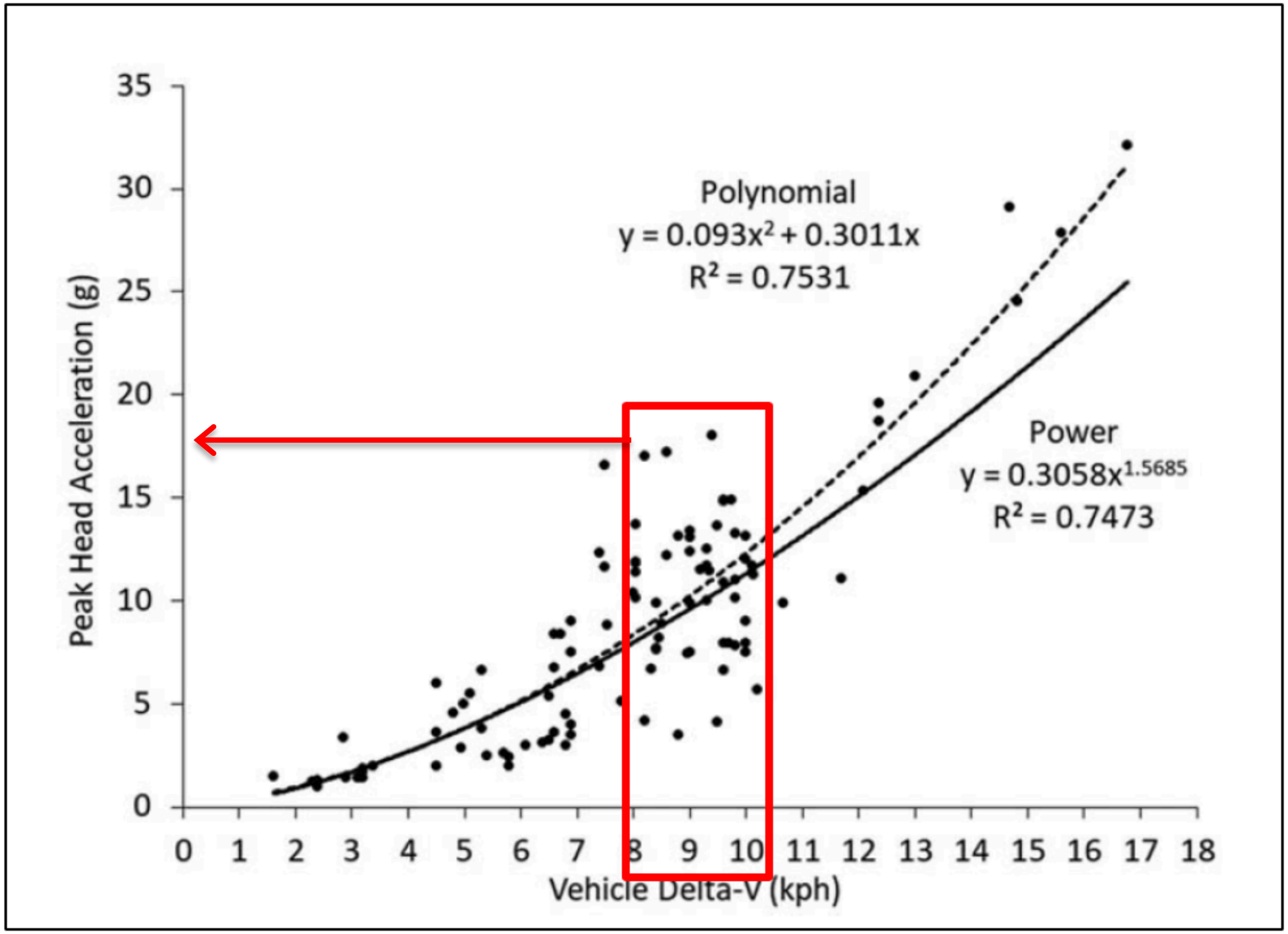
- No one knows how often people get hurt in crashes (?)
- There is no way to find out how often people get hurt in crashes by looking at crashes (?)
- Therefore, we use the field of *biomechanics* to allow us to make *scientific* comparisons using *accelerations* between crashes and some activity where we do know the risk of injury
- Let's use ADLs, because everyone knows how often people get hurt during ADLs

Questions

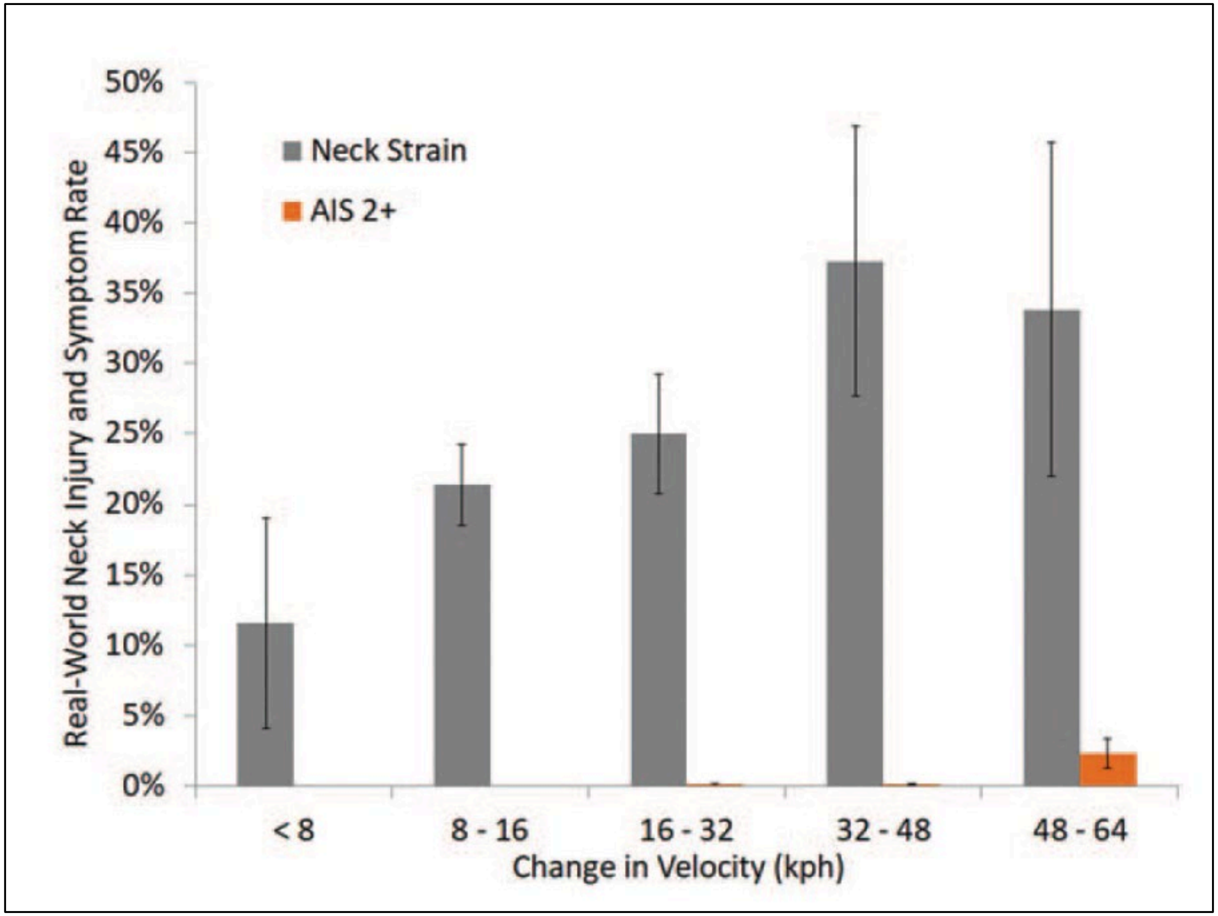
- What is the relevant scientific discipline for assessing injury risk from crashes?
- Do we really have no information on injury risk from low speed crashes?
- Is there any other example from science or medicine where we examine the *acceleration* of an activity to estimate the *risk* of injury from a completely different activity?
- Is acceleration a valid proxy for injury risk?

Does a 5 mph crash produce 0.6 g on the occupant?

Defense publication on crash testing shows the comparison is wrong



… as well as misleading and dishonest



Every day activities comparison

A Review and Methodologic Critique of the Literature Refuting Whiplash Syndrome

Michael D. Freeman, DC, PhD, MPH,* Arthur C. Croft, DC, MS,† Annette M. Rossignol, ScD,‡ David S. Weaver, DC,§ and Mark Reiser, PhD¶

The validity of whiplash syndrome has been a source of debate in the medical literature for many years. Some authors have published articles suggesting that whiplash injuries are impossible at certain collision speeds; others have stated that the problem is psychological, or is feigned as a means to obtain secondary financial gain. These articles contradict the majority of the literature, which shows that whiplash injuries and their sequelae are a highly prevalent problem that affects a significant proportion of the population. The authors of the current literature critique reviewed the biomedical and engineering literature relating to whiplash syndrome, searching for articles that refuted the validity of whiplash injuries. Twenty articles containing nine distinct statements refuting the validity of whiplash syndrome were found that fit the inclusion criteria. The methodology described in these articles was evaluated critically to determine if the authors' observations regarding the validity of whiplash syndrome were scientifically sound.

The authors of the current critique found that all of the articles contained significant methodologic flaws

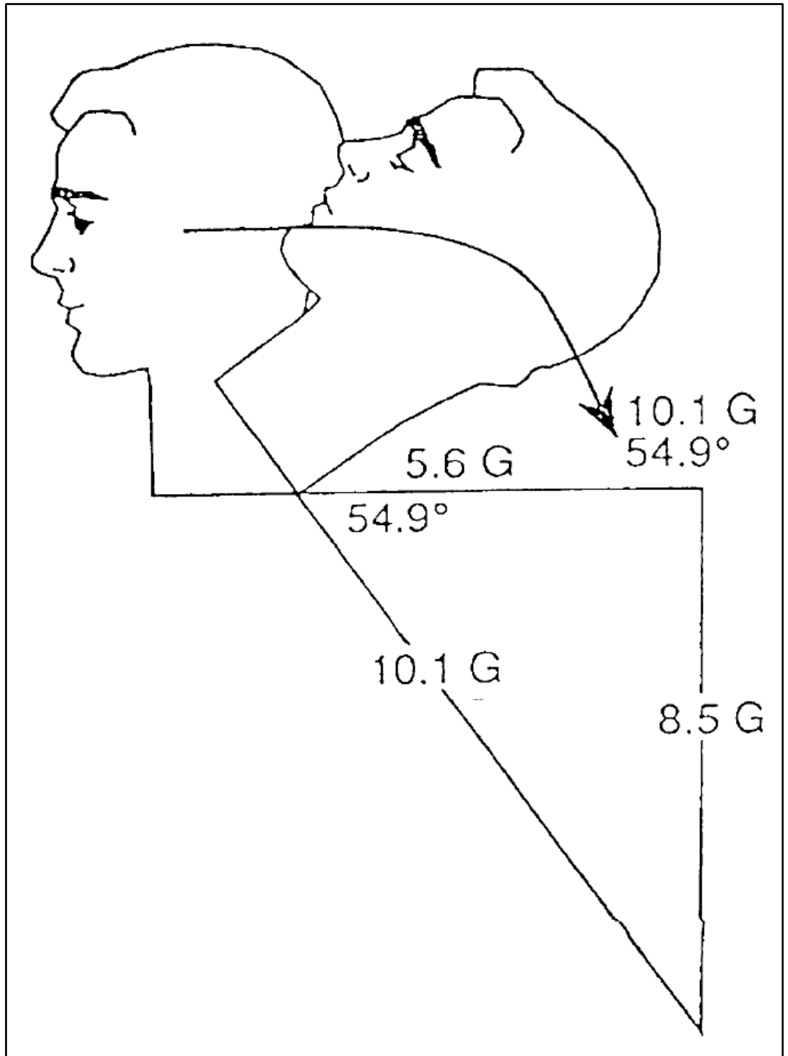
One of the more frequently disputed conditions in the medical literature in recent decades is the constellation of symptoms comprising acute whiplash and its chronic iteration, late whiplash (collectively known as whiplash syndrome). The primary reason for the dispute stems from the fact that the validity of whiplash syndrome often is a key issue in litigation arising from the alleged etiology of the whiplash, *i.e.*, a motor vehicle crash in which the injured party is not at fault. The judge and/or jury in such cases are asked to weigh opposing medical and scientific evidence supporting both the plaintiff's position that whiplash injuries and their sequelae are real and the defense position that the injuries are manufactured or greatly exaggerated. Over $29 billion per year is spent on whiplash injuries and litigation in the United States alone.[14]

It is not surprising, considering the financial stakes, that many medical experts have dedicated their professional careers to one side or another of the whiplash controversy. These experts increasingly are relying on medical and engineering literature to support both sides of the debate over the validity of whiplash syndrome.

A recent review of the literature reported over 10,000 articles relating to whiplash injuries.[44] The majority of this literature is devoted to probing fundamental questions about whiplash injuries, such as mechanism of injury, pathogenesis, and epidemiology. More than 30 epidemiologic studies have been published that document

Freeman paper (Spine 1999)

Allen paper



What is the scientific rigor of daily activity publications?

Integration of epidemiologic causation into US case law on injury causation

- US Court of Appeals opinion in 2016 that sets forth the generally accepted methodology for assessing injury causation
- Discussed a “3-step” process of injury causation
  - Described the use of epidemiologic methods for injury causation for the first time

FILED
United States Court of Appeals
Tenth Circuit

July 19, 2016

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Clerk of Court

PUBLISH

UNITED STATES COURT OF APPEALS

FOR THE TENTH CIRCUIT

DONALD L. ETHERTON,

Plaintiff - Appellee,

v.

OWNERS INSURANCE COMPANY,

Defendant - Appellant.

No. 14-1164

APPEAL FROM THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF COLORADO
(D.C. No. 1:10-CV-00892-PAB-KLM)

App. Vol. V at 1454-55. In short, Dr. Ramos employed a three-step methodology to determine the injury's cause.

At the November 17, 2011 Rule 702 hearing, Dr. Ramos described the methodology he used to assess injury causation in this case.[3] He testified that his first step was to determine general causation, meaning whether or not the type of injury that plaintiff sustained could have been caused by the type of collision that plaintiff was in. Docket No. 48 at 14. His second step was to consider whether there was a temporal relationship between plaintiff's injury and the collision. *Id.* His third step was to perform a differential diagnosis, in which he assessed specific causation by examining plaintiff's physical symptoms, medical records, reported medical history, and the applicable medical literature to identify and rule out alternative causes of plaintiff's injury. *Id.*

[3]Dr. Ramos cited a number of articles and textbooks in support of his methodology. *See* Docket No. 48 at 24-27 (citing Randall L. Braddom, Physical Medicine & Rehabilitation 110 (4th ed. 2010); Michael D. Freeman, Christopher J. Centeno & Sean S. Kohles, *A Systematic Approach to Clinical Determinations of Causation in Symptomatic Spinal Disk Injury Following Motor Vehicle Crash Trauma*, 1 Physical Medicine & Rehabilitation 951 (October 2009); American Medical Association Guides to the Evaluation of Permanent Impairment 224 (6th ed. 2007); American Medical Association Guides to the Evaluation of Disease & Injury Causation (J. Mark Melhorn & William E. Ackerman eds., 1st ed. 2007); Samuel McLean, David Williams & Daniel Clauw, *Fibromyalgia After Motor Vehicle Collision: Evidence & Implications*, 6 Traffic Injury Prevention 97 (June 2005)).

Clinical Review: Focused

A Systematic Approach to Clinical Determinations of Causation in Symptomatic Spinal Disk Injury Following Motor Vehicle Crash Trauma

Michael D. Freeman, PhD, MPH, DC, Christopher J. Centeno, MD, Sean S. Kohles, PhD

Clinical determinations of causation in cases of intervertebral disk (IVD) injury after a motor vehicle crash (MVC) are often disputed in medicolegal settings. No published systematic guidelines exist for making such determinations, which has resulted in infringement by nonclinical personnel into injury causation evaluations, a traditionally clinical activity. The result is causal determinations that are potentially disconnected from clinical observations of injury. The purpose of this review was to evaluate the current literature on causation, causal determinations after trauma and IVD injury after MVC, and to develop a practicable, logical, and literature-based approach to causation determinations of symptomatic IVD injury after MVC. The results of the review indicate IVD injury can result from any MVC regardless of magnitude, thus meeting the first criteria of causation, biologic plausibility. Individual determinations of causation depend entirely on the temporal association between the collision and the symptom onset (the second criterion) and a lack of a more probable explanation for the symptoms (the third). When these causal elements are met, clinicians can assert causation on a "more probable than not" or "reasonable probability" basis. Because of a lack of an established or reliable relationship between collision force and the probability of IVD injury the investigation of collision parameters is not a useful adjunct to causal determinations.

The 3 elements of a causal analysis of injury are:

1. Plausibility

    Hill criteria

    Risk of injury given the crash severity (epidemiology)

2. Temporality

    Sequence, proximity and latency

3. Lack of a more likely alternative explanation

    Risk of same condition at same time, given pre-crash condition of plaintiff, if the crash hadn’t occurred (epidemiology)

The 3-step methodology focuses on a “counterfactual causation” approach, which is the opposite of the defense approach

- *Defense: “How did this little crash cause all of these injuries? Most people walk away without a scratch!”*
- *Plaintiff: “If the crash didn’t happen what’s the chance the plaintiff would have needed to go to the ED on the same day, or have developed chronic pain that is still present a year later?”*
- The Etherton steps are designed to ignore the first question and answer the second.

Application to a low speed crash injury case

- A 40 year old man with a 3 year old history of neck treatment is involved in a no-damage (*i.e.* 5 mph dV) rear impact crash
- He has immediate onset of pain in the neck and right arm and goes to the ED, followed by presentation to chiro
- The doc refers him for an MRI which shows a right sided disk herniation at C5-6, and 1 month later undergoes neck surgery
- He develops chronic neck pain after the surgery, returns to chiro and can no longer work

- Defense ortho/ chiro/ neuro
  - 6 weeks of treatment and then all symptoms were due to pre-existing arthritis and attributable to 3 year-old symptoms
- Defense radiologist
  - No evidence of acute trauma, all conditions were stable and pre-existing
- Defense biomechanical
  - The same forces as sitting down in a chair and other daily activities, crash testing shows no risk of significant injury

First step: Plausibility

- Can you get a disk injury from a rear impact collision with no damage?

Giuliano V, Giuliano C, Pinto F, Scaglione M. The use of flexion and extension MR in the evaluation of cervical spine trauma: initial experience in 100 trauma patients compared with 100 normal subjects. Emerg Radiol. 2002;9(5):249-53.

Freeman MD, Croft AC, Nicodemus CN, Centeno CJ, Welkins WL. Significant spinal injury resulting from low-level accelerations: A case series of roller coaster injuries. Arch Phys Med Rehab November 2005;86:2126-30.

Lutz JD, Smith RR, Jones HM. CT myelography of a fragment of a lumbar disk sequestered posterior to the thecal sac. AJNR Am J Neuroradiol. 1990;11(3):610-1.

Sadanand V, Kelly M, Varughese G, Fourney DR. Sudden quadriplegia after acute cervical disc herniation. Can J Neurol Sci. 2005;32(3):356-8.

Freeman MD. Biomechanical, Mechanical, and Epidemiologic Characteristics of Low Speed Rear Impact Collisions. *Proceedings of 67th Annual Meeting of the American Academy of Forensic Sciences* 2015 Feb 16-21: Orlando, FL. D11:517-8.

- *"It is reasonable to conclude, as a general precept, that the forceful loading of the spine that can occur in any MVC is a biologically plausible (possible) cause of symptomatic disk injury."* ***Freeman et al, 2009***

- There is no established absolute injury threshold for virtually any injury type, based on crash severity

Real world crashes at 5 mph produce chronic injury in ***1 in 29***, and signs of disk injury in ***1 in 40***

Delta V (mph, [km/h])	Peak vehicle accel. (g)	Peak occupant head acc. (g)	Crash pulse duration (msec)	Any injury %	Injury >6 months %	Cervical disk injury %
3 [4.8]	6.1 [5.5, 6.7]	4.4 [3.5, 5.9]	55.8 [52.0, 59.6]	24.4 [14.8, 37.4]	1.9 [0.5, 6.8]	1.6 [0.3, 7.3]
4 [6.4]	6.7 [6.2, 7.2]	5.4 [4.5, 7.0]	61.3 [57.9, 64.7]	29.3 [19.6, 41.5]	2.5 [0.7, 8.2]	1.9 [0.5, 7.9]
5 [8.0]	7.2 [6.8, 7.7]	7.2 [6.0, 9.1]	66.7 [63.6, 69.8]	34.9 [25.0, 46.4]	3.5 [1.2, 9.8]	2.5 [0.7, 8.6]
6 [9.6]	7.8 [7.4, 8.2]	10.6 [7.9, 15.9]	79.2 [62.2, 75.2]	40.9 [30.4, 52.3]	4.7 [1.8, 11.8]	3.0 [0.9, 9.3]
7 [11.2]	8.3 [7.9, 8.7]	13 [10, 20]	77.6 [74.6, 80.6]	47.2 [35.5, 59.1]	6.4 [2.7, 14.2]	3.7 [1.3, 10.3]

Freeman MD. Biomechanical, Mechanical, and Epidemiologic Characteristics of Low Speed Rear Impact Collisions. *Proceedings of 67th Annual Meeting of the American Academy of Forensic Sciences* 2015 Feb 16-21: Orlando, FL. D11:517-8.

Step 2: Temporality

Temporal proximity is the most powerful measure of causality

Did the red ball *cause* the blue ball to move?

How about now?

Now?

Step 3: Alternative causes

- The assessment from Step 2 is used to evaluate the cumulative risk of competing causes, given the time between the crash and the symptom onset
  - What was the chance the man would spontaneously develop symptoms of a surgical disk at the same time as the crash?
- The average 40 year old male has a less than 1 in 2,000 risk of neck surgery in a year (US national hospital data)
  - This equates to 1 in 730,000 per day
  - And 1 in 18 million per hour

Attributable risk (causal) calculation

Risk of injury from crash	**1 in 40**		
	———————	**=**	**>18,000 to 1**
Risk of injury at same time, *but if crash doesn’t occur*	**1 in 730,000**		**>99.99% probability of cause**

Risk of injury from crash	**1 in 40**		
	———————	**=**	**>180 to 1**
Risk of injury at same time, *but if crash doesn’t occur* **X 100**	**1 in 7,300**		**>99% probability of cause**