KINEMATICS

Units 4 & 5 Dr. John P. Cise, Professor of Physics, Austin Com. College, 1212 Rio Grande St., Austin Tx., 78701 jpcise@austincc.edu & New York Times, January 15, 2017 by Sam Borden, Mika Grondahl & J Ward

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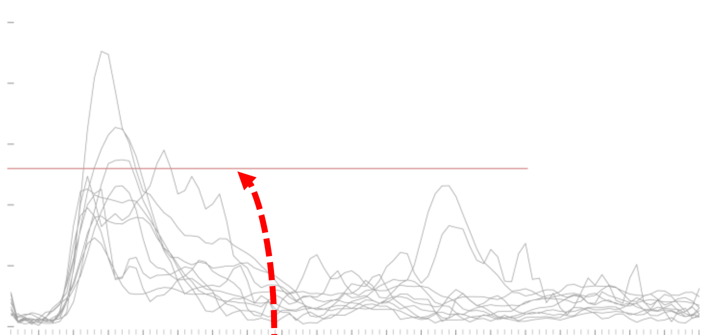
Player's Skull AFTER A FOOTBALL HIT

When player No. 81 took this blow to his head several years ago, it was just one of many concussions that have occurred throughout college football and the N.F.L. But what made this one different was that this player was wearing a mouth guard with motion sensors. The information from those sensors has given researchers a more detailed and precise window into what was happening within the player's brain in the milliseconds after the hit. Now, though, many scientists and medical experts believe that this understanding is incomplete. Yes, there is some movement in the skull, but the real damage from concussions, they say, actually occurs deeper in the brain – in the so-called white matter – as a result of fibers pulling and twisting after impact. To stick with the food analogy, think Jell-O, not an egg. You know what happens when you take a plate of Jell-O and give it a hard shake? The stretches and contortions approximate what is happening to all the wiring throughout the brain. The mouth guard that was used was developed by the bioengineer David Camarillo and his team at the Cam Lab at Stanford. Camarillo and others have speculated that **the most damaging blows are those that cause the head to snap quickly from ear to ear.**



G-forces of 10 hits (each line represents one hit)
25.8 Average maximum G-forces

INTRODUCTION: Purpose of this application is to show a football player collisions with average g forces of 25.8 g (g = 32 ft./s.^{2}) are similar to a car crashing into a wall at 30 mph stopping in 1.2 ft. (as stated in article below).

QUESTIONS: (a) Convert 30 mph to ft./s.?, (b) What is the deceleration in ft./s.^{2} of 25.8 g ?, (c) Find deceleration of a car stopping in 1.2 ft. with a initial speed of 30 mph? (d) How well does this car crash deceleration compare with football collision decelerations of 25.8 g on average?, (e) Find time for this car initially going at 30 mph to stop in 1.2. feet ?
HINTS: SEE BELOW

In this chart, we show the G-force data from just 10 of the 62 hits this offensive lineman accrued in a single game. The **(((average G-force, 25.8,))) is roughly equivalent to what we would see if the offensive lineman crashed his car into a wall going about 30 m.p.h.**

And remember: that was 62 times in a single game. Hits of this magnitude can happen hundreds, if not thousands, of times to college and N.F.L. players during practices and games throughout their careers. The design of helmets — and even the safety design of automobiles — still has a long way to go to protect people from brain disease incurred from severe and not-so-severe hits to the head.

HINTS: $x = v_{AVE}\, t$, $v_{AVE} = (V + V_0)/2$, $V = V_0 + a\, t$, $V^2 = V_0^2 + 2\, a\, x$, $X = V_0 t + 1/2\, a\, t^2$, 60 mph = 88 ft./s.

ANSWERS: (a) V_0 = 44 ft./s. , (b) 25.8 g = (25.8)(32 ft./s.^{2}) = 825.6 ft./s.^{2} , (c) a = ~ 807 ft./s.^{2} = ~ 25.2 g
(d) They compare very well….., (e) t = ~ 0.027 s.