C35 Full Nelson, Punches, or a Combination— Biomechanics of a Cervical Spine Injury

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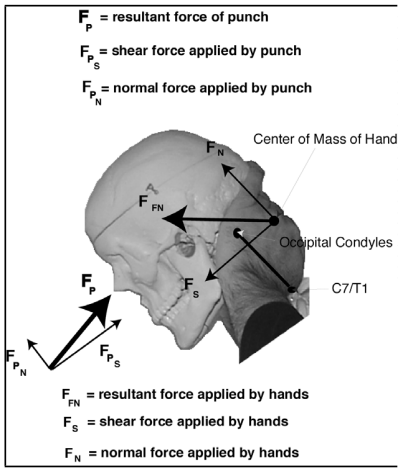
The goal of this presentation is to demonstrate a biomechanical analysis that determined what type of loading led to a fracture dislocation of C7/T1 in a manslaughter case.

A disorderly person was apprehended by the doorman of the establishment where the disorderly conduct occurred. The doorman placed the offender in a "full nelson" hold – placing his hands on the back of the suspect's head after looping his arms under the suspect's arms from behind. Police arrived on the scene, and when the suspect continued to kick and thrash, one of the officers allegedly struck the suspect in the face while he was still being held in the full nelson. The suspect was eventually taken to hospital and after several hours was taken to x-ray, revealing a dislocation of C7/T1 with C7 displaced anteriorly over T1. The suspect was paraplegic and eventually developed respiratory complications and died 6 weeks later. The police officer who allegedly threw the punches to the face was charged with manslaughter.

The x-ray in this case coincided with textbook depictions of cervical spine injuries caused by flexion. Testimony revealed that the suspect was struggling while his head was held in the forward flexed position by the full nelson, indicating that the spinal cord injury had not yet taken place even though the head was flexed near the limit of its range of motion. While the punches were unquestionably dynamic, the application of force to the back of the head and neck was quasi-static, so a static equilibrium analysis of the forces and moments at C7/T1 created by the full nelson was completed using the deceased's anthropometry and biomechanical data on ranges of motion of the neck and head link. By comparison with recent research results (Cusick and Yoganandan, 2002), it was found that approximately 20 kg of hand force to the back of the head would be sufficient to cause tissue failure at C7/T1. Large, strong males can exert this amount of force



The shear forces (force perpendicular to the neck axis from C7/T1 to the occiput) created by the punch act in the opposite direction to the shear forces created by the full nelson, either decreasing the net posterior to anterior shear force or creating a net anterior to posterior shear, decreasing or opposing the flexion moment that causes the forward dislocation of C7 on T1. The biomechanical analysis indicates that the punches did not contribute to the forward dislocation of C7 on T1, while the full nelson alone could have caused the injury.

Cusick, JF, and N. Yoganandan. "Biomechanics of the cervical spine 4: major injuries." Clinical Biomechanics Vol. 17(1): 1-20, 2002.

Biomechanics, Cervical Spine, Flexion Injury

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