

## Example Abstract

### SCALING OF NECK PERFORMANCE REQUIREMENTS IN SIDE IMPACTS

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#### Key Words

Side impacts; Neck; Scaling Law; Biofidelity; Crash testing

#### Research and/or Engineering Questions/Objective

Neck biofidelity performance requirements for different sized crash dummies and human body computer models are usually based on scaling of performance requirements derived for a 50<sup>th</sup> percentile body size. For this purpose so-called geometrical scaling laws are used. The objective of this study was to investigate the validity of the currently used scaling laws for the human neck in case of side impacts.

#### Methodology

The Naval Biodynamics Laboratory in New Orleans has carried out a large number of human volunteer tests in different test conditions. Earlier analysis of these data has resulted in sets of performance requirements which were presented as average data without making a distinction in different body sizes that were tested. In this study an analysis of a number of the NBDL tests has been carried out in order to study the influence of body size on the actual head-neck performance of the volunteers. On the basis of this new biofidelity criteria have been developed for different body sizes and the resulting criteria have been compared with scaling based performance criteria developed by Irwin and Mertz. Computer simulations with a simple lumped mass model of the head and neck will be used to support the analysis in this study.

#### Results

In the paper head acceleration data and displacement/rotation data will be presented as function of anthropometric data. The main finding is that the maximum lateral neck rotation defined in this study as the rotation in the impact plane of the link between T1 center and center of the occipital condyles is hardly effected by the body size of the volunteers. Application of geometrical scaling laws as developed by Irwin and Mertz however would result in significant different neck rotation values. New criteria for different body sizes in side impacts will be presented.

#### Limitations of this study

An important limitation of the current study is the limited test severity (7g) in the human volunteer tests. Furthermore, the human volunteers were restrained in a condition deviating from a real car environment. The new biofidelity requirements are only valid for adults.

#### What does the paper offer that is new in the field including in comparison to other work by the authors?

The analysis and comparison with scaling laws presented in this paper is new as well the resulting neck biofidelity performance requirements for different body sizes.

#### Conclusions

New biofidelity performance requirements for the human neck for different body sizes have been developed. These criteria deviate from criteria resulting from geometrical scaling laws as proposed by Irwin and Mertz.