Application of the Human Thorax FE Model in Passive Restraint Assessment

D. Gierczycka-Zbrozek[1]

I. INTRODUCTION

The design process of passive restraints is based on the measurements from anthropometric test devices. Responses of the ATDs do not completely cover prediction of possible injury outcome. To address certain phenomena and occupants' characteristics, it is necessary to introduce more detailed models. The THOMO model is an answer to this demand, aiming to develop a numerical model of a chest and upper extremities, which can be used to assess injury risk in different scenarios.

II. METHODS

The THOMO model of a 50th percentile occupant is seated unbelted in a driver's position. The airbag on a rigid steering wheel is located in front of the chest, at the level of the sternum (Figure 1a). The failure plastic strain value for both the compact and trabecular rib bone was reduced to 0.8%, to mimic the elderly occupant. The values of the reference and elderly rib bone failure strain based on the rib bone coupon tests performed by the THOMO Project partners. The injury assessment based on the number of rib fractures and chest deflection value. The rib fractures were determined based on element elimination during the simulation. Coupling between two software packages (MADYMO R7.3 and LS-Dyna V971, R5.1.1) was used to perform the calculations. The standard driver's airbag model is taken from the MADYMO database [2].

III. RESULTS

There were no rib fractures observed for the reference occupant. Four rib fractures were found for the elderly occupant, corresponding to AIS 2-3 (Figure 1b), although the chest deflection pattern is similar to the reference model (Figure 1c) and does not exceed the safe range for the 50th percentile male.

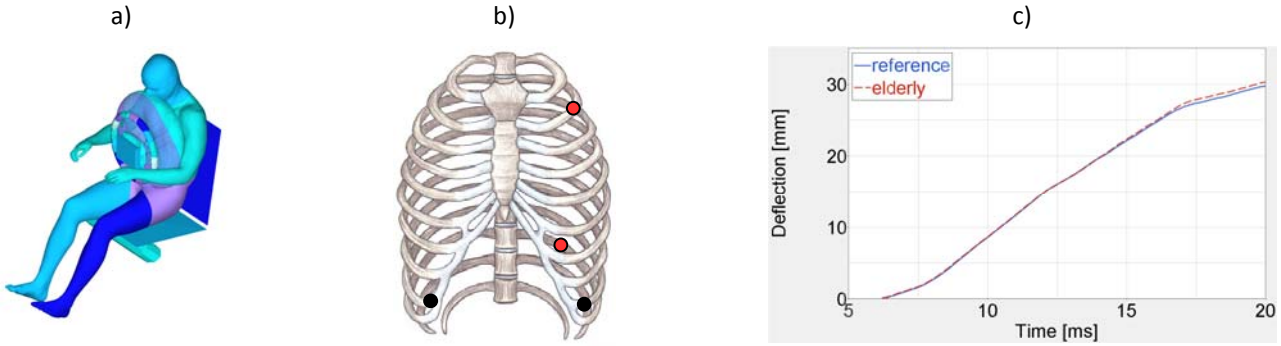

Figure 1 a) Test setup; b) elderly model rib fractures pattern: black dots mark the fractures in the front, red – in the back of the chest; c) chest deflection for the reference and elderly model. Reference model marked with a solid and elderly with a dashed line.

IV. DISCUSSION AND CONCLUSIONS

The increased stiffness of the human body models in case of the restraint-type loading, compared to hub-type (validation) loading, has to be considered [3]. At this stage of development, the THOMO model can be used for qualitative verification of the changes applied to passive restraint systems, allowing variations of the biomechanical parameters. This is the advantage of the human body models over the crash test dummies.

V. REFERENCES

[1] THOMO project website: www.thomo.eu.
[2] MADYMO Application manual
[3] MURAKAMI D. et al., SAE paper 2004-01-0325, 2004.

D. Gierczycka-Zbrozek is a PhD student in Mechanical Engineering at Warsaw University of Technology, Warsaw, Poland (dgierczycka@meil.pw.edu.pl, phone: +48 22 234 79 92, fax +48 22 234 75 13).