



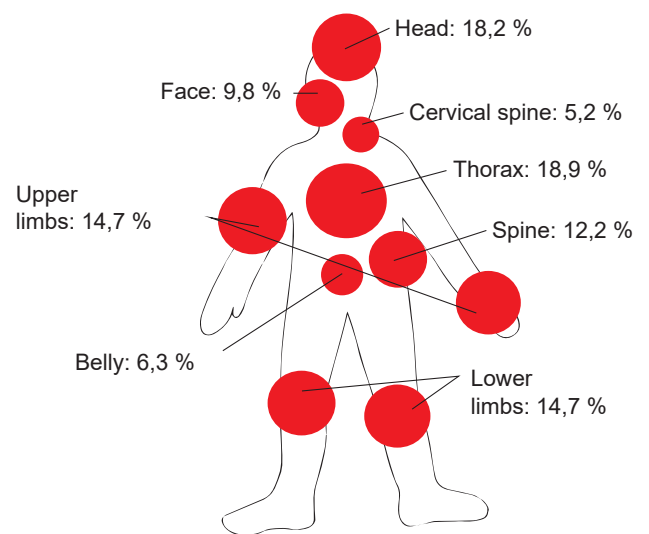
New type of head rest protects your head and cervical spine better

Although vehicle passengers, in comparison to other road users (e.g. pedestrians and cyclists), are relatively well protected, their injuries may occur in relatively low speeds. **The most vulnerable body parts of car passengers include head and cervical spine.** Based on the data from the In-depth analysis of road accidents, **cervical spine injuries occur in a third of road accidents.** The risk of a severe or even fatal injury at side impacts with a vehicle or a solid obstacle is high, therefore, it is necessary to ensure the vehicle passenger safety.

New head rest reacts as airbag

Head rests (active and passive ones) are used for protecting head or cervical spine. The head rest is currently essential equipment in modern vehicles. However, the majority of currently used head rests are unable to protect head and cervical spine at inclined and side impacts or during vehicle rotations. Therefore, the research focused on developing a new type of an active head rest. Such head rest should be able to **limit the movement of head sideways at an eccentric (deflected) impact.**

Our designed head rest will react similarly to an airbag at an eccentric or side impact. At a side impact the control unit sends an instruction to eject side arms of the head rest that should intercept the sudden movement of the passenger and reduce the extent of head and cervical spine movements up to a certain point.

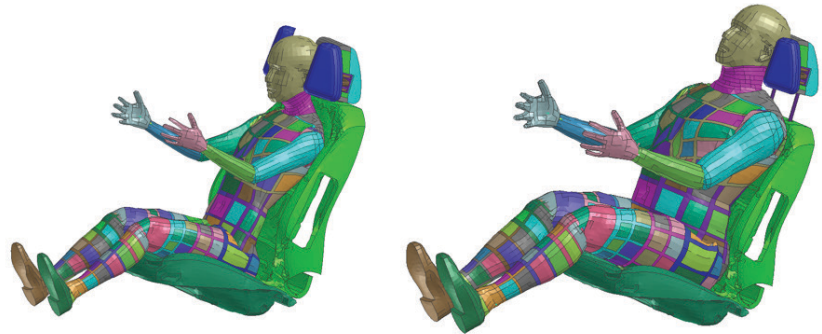


Total: 286 injuries

overview of vehicle passenger injuries at side impact



Testing of active head rest with innovative system

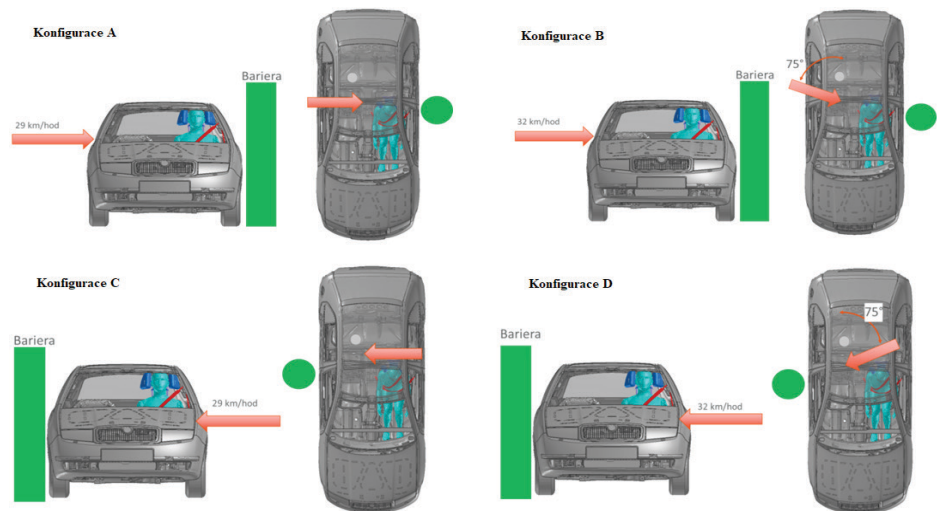


testing of active head rest – effect of driver's anthropometrics

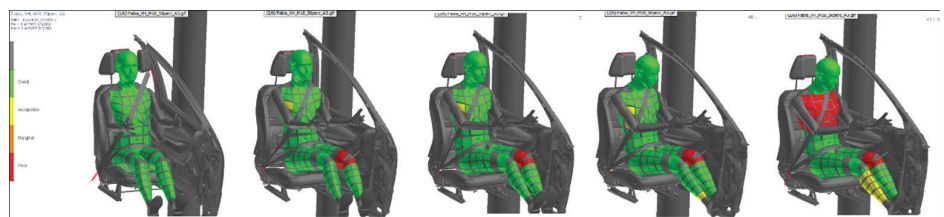
The development of the patented device already began in 2014. In order to optimize the designed head rest, the designed construction was further **tested through numeric simulations**. Computing modelling was using the assumption that the driver's head rest is correctly set and the driver is sitting in standard position. Subsequently, we used the numeric simulation to verify the functions while taking into account the variability of human population.

Regarding the amount of simulations, a single age category was selected for a detailed analysis, specifically, drivers in the age of 35 – 45. This category was selected considering the road traffic accident rate statistics in the Czech Republic between 2007 and 2017. Driver's anthropometry was taken into account as well.

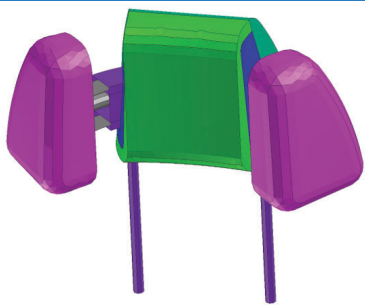
The active head rest was tested in four impact configurations: side impact to a rigid pole, side impact to a pole – right side, inclined impact to a rigid pole, and inclined impact to a pole – right side.



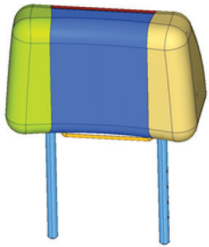
individual collision configurations: A – side impact, 29 km/h; B – inclined impact, 32 km/h; C – right side, side impact, 29 km/h; D – right side, inclined impact, 32 km/h



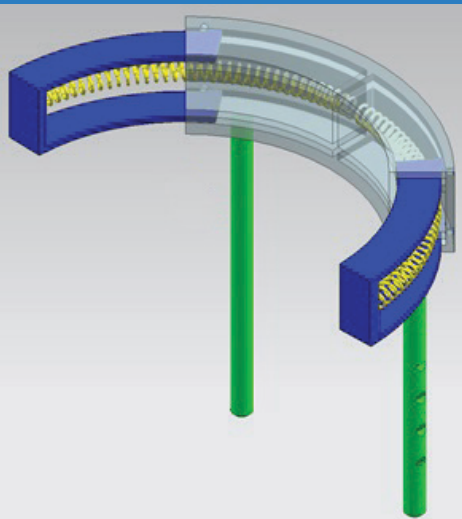
side impact on a pole with activated head rest with an innovative system



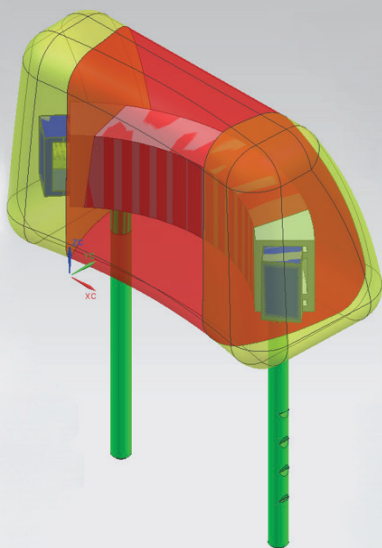
coloured representation of main parts of activated head rest



coloured representation of main parts of non-activated head rest

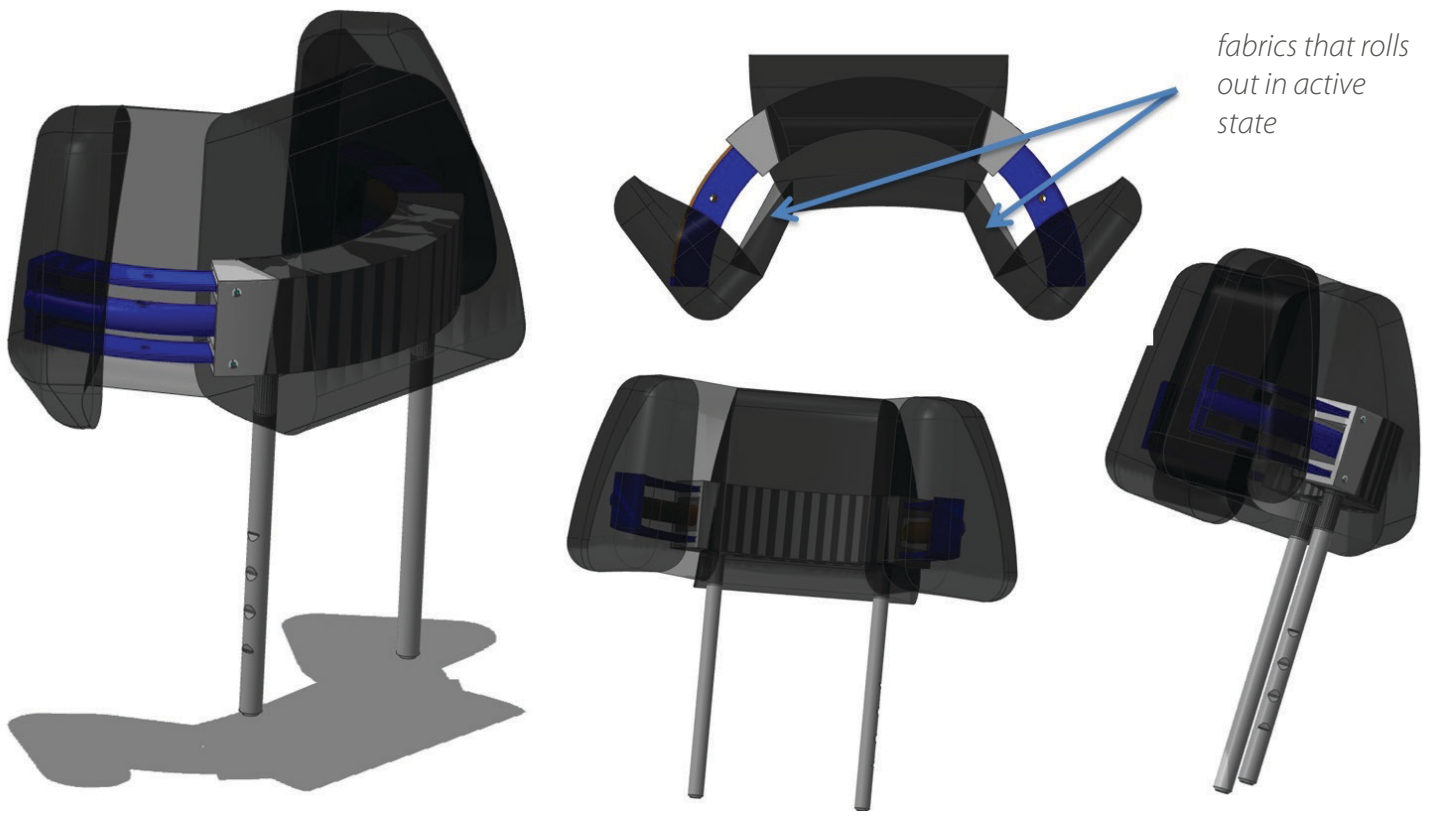


retractable mechanism of head rest after activation



coloured representation of main parts of head rest before activation





fabrics that rolls out in active state

active head rest model with an innovative system

How does the development continue?

The head rest is to be currently tested in more detailed and extensive numeric models, particularly at non-standard driver's head positions. Furthermore, it will be necessary to verify how the head rest can interact with airbags, what material will be used, etc. The results must be tested by real crashtests, which subsequently verify the function of the active head rest with an innovative system in real conditions.



active head rest model from a 3D printer



active state of head rest



non-active state of head rest





road traffic accidents



preparation of devices for an emergency vehicle



vehicle deformation scanning with the use of a 3D scanner



psychologist interview with a person involved in a road accident

Our idea came from the results of In-depth analysis of road accidents

Based on the findings of Transport Research Centre, neck injuries were inflicted to 37 % road users in the accidents that the team of In-depth analysis of road accidents investigated. At an accident spot, the team investigate the accident, its causes and consequences.

How is the investigation of researchers at the accident spot performed?

The team members obtain detailed information at the accident site, which they use for an **independent** description of the whole course of the accident. The team make complete photo documentation, produce a digital scheme of the accident site, and, alternatively, a 3-D model that serves as the basis for an analysis of the case in a special simulation programme. They also obtain information on injuries.

One of the important tasks for the team upon arrival at the accident site is to provide road users with psychological support. Specially trained transport psychologists help them manage the first critical moments. It is known that if a serious injury or death of a family member occurs at a road accident, then, consequently, 70 % people lose interest in everyday activities, such as job, study, housework, and hobbies, for the next three years.

More information on In-depth analysis of road accidents, see: <https://www.cdv.cz/laborator-dopravnich-nehod/>.



emergency vehicle trip to a road accident

Head rest was developed with the support the Technological Agency of the Czech Republic within programme Gama.

The programme focuses on support of the results of applied research and experimental development in terms of their use in practice and on the preparation of their subsequent commercial use.

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Program **Gama**



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