

Analysis of Factors Causing Occupant Hip Joint Injuries in a Crash Using Human Body Models

Yoshimitsu Kitada¹⁾ Tetsuya Nishimoto²⁾ Tomokazu Motomura³⁾ Yoshiaki Hara³⁾
Taei Shibahara¹⁾ Ryusuke Asahi¹⁾

1) Mazda Motor Corporation

3-1 Shinchu, Fuchu-cho, Aki-gun, Hiroshima 730-8670, Japan

2) Nihon University

1 Nakagawara, Tokusada, Tamuramachi, Koriyama, Fukushima, 963-8642 Japan

3) Nippon Medical School, Chiba Hokusoh Hospital

1715 Kamagari, Inzai-City, Chiba, 270-1694, Japan

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According to the field data in Japan, the pelvis and the extremities account for about 50% of the proportion by main injury region among those seriously injured in motor vehicle crashes. In this study, based on medical data such as treatment costs and treatment periods, hip joint injuries, resulting in residual disorders were ocused. The goal of this study is to analyze the factors that cause hip injuries under various loading conditions using human body models with improved anatomical structures and material properties around the hip joint. The finding from this study can be summarized as follows.

- (1) Hip joint injury could be evaluated by improving anatomical structures and material properties around the hip joint of human body models.
- (2) Fig. 1 shows the strain distribution on the acetabulum, the load acting on the acetabulum, and the displacement of the femoral head relative to the acetabulum in frontal impact mode. Two types of injuries could be observed in frontal impacts from the knee. One was the acetabular fracture in case of femur abduction, and the other was the hip joint dislocation in case of femur adduction. This is because when the femur is on a adduction condition, the contact area between the acetabulum and the femoral head becomes smaller than in the abduction condition, and the femur is easily detached from the acetabulum by input from the anterior side.
- (3) Fig. 2 shows the strain distribution and the load acting on the acetabulum at impact angles of 45° to 90° in side impacts from the hip joint. In the case of side impacts, the range of the acetabular fracture expanded due to an oblique loading. This is because the input from the diagonal direction enlarges the input in the normal direction of the acetabulum, which makes it easier to fracture. When impacting from the posterior oblique direction, anterior dislocation and acetabular fracture occurred. This is because the contact area between the femoral head and the anterior wall of the acetabulum becomes smaller as the femoral angle becomes more abducted.

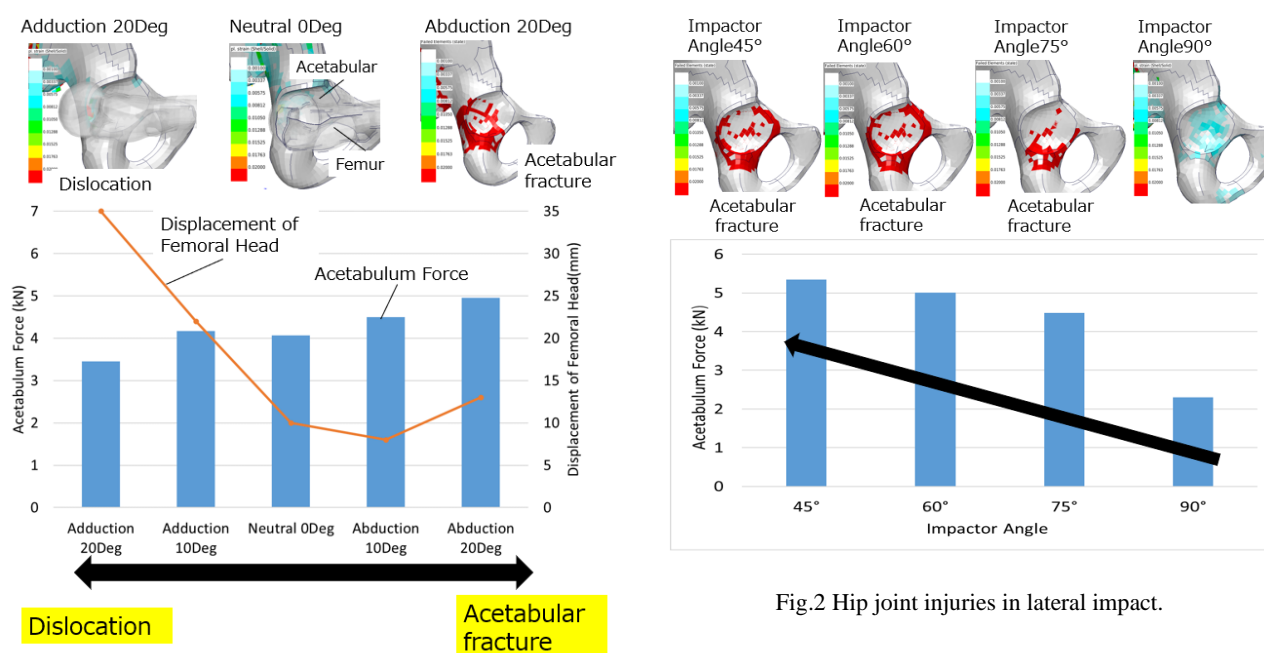


Fig. 1 Hip joint injuries in frontal impact.

Fig.2 Hip joint injuries in lateral impact.