DEVELOPMENT OF HUMAN PELVIC BONE FE MODEL BY CONSIDERING PELVIC ANTHROPOMETRY

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INTRODUCTION

In collisions between pedestrians and road vehicles, the incidence of pelvic injuries resulting in serious wounds or death ranks high, following knee and head injuries. In light of this fact, the development of a human pelvis FE model with high bio-fidelity is required for reliable human injury analysis.

Thus far, several human pelvis models have been developed and modified in order to investigate the pelvic injury mechanism due to impact loadings [1,2,3]. However, detailed studies for pelvic anthropometry have been minimal. Therefore, it is necessary to consider pelvic anthropometry in pelvis FE model construction.

METHODS

In this research, a new human pelvic bone FE model (called the JK-model) was constructed on the basis of the CT image data of a Japanese adult. Anthropometry of the JK-model based on anatomical information was investigated by a comparison of measurement data obtained from cadaver pelvic bones.

Figure 1 depicts the reference coordinate of the human pelvis, defined by Reynolds et al., in order to measure anatomical points of cadaver pelves of Americans [4]. In this research, six representative points from A to F (A:Iliocristale, B:Left Iliospinale, C:Symphsion, D:Ischio-Spinale, E:Inferior Turbersity point, F:Inferior Obturator Foramen Point) were selected, as shown in Figure 2. The length from the origin of the reference coordinate to each selected point was defined as a comparison parameter in order to investigate the pelvic anthropometry of the JK-model. In addition, the result was compared to the pelvic anthropometry of commercial pelvis FE models (for example, THUMS and H-model).

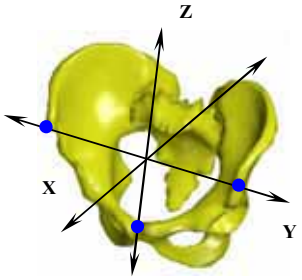

Figure 1: Coordinate System of Pelvis [Reynolds, et al.]

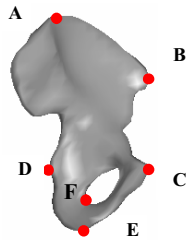

Figure 2: Representative Points

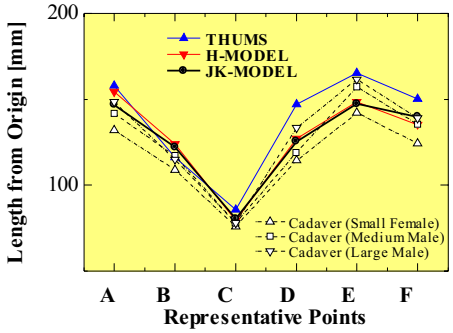

Figure 3: Comparison of Pelvic Anthropometry

RESULTS AND DISCUSSION

The comparison parameters were summarized as presented in Figure 3. It was found that the lengths from the origin to D, E and F points of THUMS are greater than those of the H-model. The overall anthropometrical feature of the JK-model was close to that of the H-model. Also, the comparison parameters of the JK-model lie in the corridor of American measurement data; thus, the JK-model could be used as a standard model for human injury research in the crash safety field.

The appearance of pelvis models is depicted in Figure 4. It was considered that the JK-model has relatively higher bio-fidelity than those of commercial pelvis models with regard to pelvis shape.

CONCLUSIONS

In this research, a new human pelvic bone FE model was constructed on the basis of the CT image data of a Japanese adult. Its pelvic anthropometry was investigated with the use of anatomical information. It is considered that anthropometry study is important and necessary in FE model construction in order to obtain reliable analysis results.

REFERENCES

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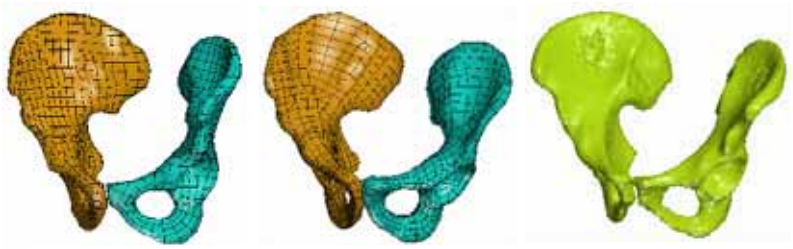

(a) THUMS (b) H-Model (c) JK-Model

Figure 4: Comparison of Human Pelvic Bone FE Model Appearance