

The Mechanical Property Data for Spine Research of Elderly Korean

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Abstract. The mechanical property data for spine research of elderly Korean were made by KISTI and Catholic Institute for Applied Anatomy. We took whole spine CT, X-Ray, BMD scan for making high resolution spine images using donated cadavers (50-85 years). Then we performed the range of motion test of cervical, thoracic and lumbar vertebra. We measured the movement angle of each vertebra when the flexion, extension, lateral bending (left, right), and torsional moment (left, right) was applied. The mechanical property data of elderly Korean could be used for research and development of medical device.

Keywords: Human body information, Korean, Vertebra, Spine

1 Purpose and Need of Mechanical Property Data

People can be distinguished by skin color, pupil, and morphology of each population. The less seemingly difference also comes from the proportions of body parts and shape of intestinal organs. Because of these differences, the results obtained on the basis of population with different characteristics have limits in being applied in some research fields.

At the moment enhancement of life style, and increment in average life span have brought about the progress of an aging society and studies on spondylopathy is being emphasized as an important research field. Of the many researches in spondylopathy, when processing biomedical research, generally computer simulations are utilized. For the research utilizing computer simulations, form data that shows the spinal geometry, and mechanical property data that shows the physical properties are needed. Also test results on spinal exercise nature are needed to verify the effectiveness of the produced simulation model. While obtaining Korean spinal geometry data is relatively easy in Korea due to spread of advanced diagnostic radiology skills, data on mechanical properties and movement properties obtained from experiments are nearly

impossible to get. Thus, the Korea Institute of Science and Technology Information (KISTI), alongside with Catholic Institute for Applied Anatomy (CIAA) is constructing spinal mechanical properties data and movement properties examination results which can be used in spinal simulation models production and verification.

2 Process and means of data construction

2.1 Selection of subject data

Select appropriate subject for use in production of Korean spinal model to utilize in spinal research. Construction subjects are based on body donation between the age over 50 and under 85. Examination subject should have no external injury and specimen with cause of death causes to have influenced their bone structure and physical properties are to be excluded with reference to their death certificates. Table 1 shows subject data in process of construction. The donated body which had been selected was X-rayed both Antero-posterior wise and Lateral wise to check its degenerative status of the spinal joint. The degenerative status was evaluated on disk height loss and osteophyte formation [1][2].

Table 1. List of test subject

| ID | Sex | Age | Stature [mm] | Weight [kg] |
|---------|-----|-----|--------------|-------------|
| ESP_010 | F | 68 | 1650 | 61 |
| ESP_011 | F | 60 | 1590 | 45 |
| ESP_012 | F | 68 | 1580 | 57 |
| ESP_013 | F | 73 | 1500 | 36 |
| ESP_015 | M | 67 | 1600 | 46 |
| ESP_016 | F | 60 | 1580 | 38 |
| ESP_017 | F | 69 | 1630 | 54 |
| ESP_018 | M | 67 | 1560 | 65 |
| ESP_019 | M | 52 | 1650 | 60 |
| ESP_020 | F | 57 | 1670 | 56 |
| ESP_021 | M | 56 | 1750 | 75 |
| ESP_022 | F | 62 | 1540 | 54 |
| ESP_023 | F | 50 | 1560 | 49 |

2.2 Construction of bone density data

Density of the bones can be divided into physical density which expresses the mass per unit volume, and the bone density that is utilized in clinical diagnosis of

osteoporosis. The bone density utilized in diagnosis of osteoporosis is diagnosed by dual energy X-ray absorptiometry (DEXA), and is expressed with intensity value per volume unit. Because they have different measure units and have different uses, both data need establishment. The physical bone density data was calculated by the Hu value of the CT image into density and clinical bone density was established by direct measurement utilizing the DEXA equipment.

2.3 Preparation of the test subject

Spine was extracted by means of only surgical method to avoid influencing the physical properties from the subject body. With the exception of main ligaments maintaining spinal stability (anterior longitudinal ligament, posterior longitudinal ligament, supraspinous ligament, interspinous ligament, ligament of flava), as much soft tissue were removed as possible [3]. For fixation of the specimen, more than three screws were used to fix it and then fixation area was made with sufficiently resin. X ray examination was processed for the specimen which were produced as not to let the fixing of the screws influence the movement of the spine.

2.4 Mechanical properties and range of motion test

For the mechanical property, and range of motion test, various references were reviewed and general test conditions were selected and applied in order to compare with the preceded studies[4][5]. Universal test machine (5567, Instron, MA) was used for the mechanical property test for the compressive force and height deformation was recorded of the vertebra body in reaction to the compressive load. Test device for spinal range of motion test was manufactured with reference to the pure moment examination device suggested by Crawford et al. [6-8]. For the movement of flexion, extension, lateral bending, torsion pure moment was applied in respective directions on the examination table consisted of two nearby vertebrae. Also, the tilt and the rotation angle between the applied moment and the level of each spine was measured by attaching the inclinometer. The measured results were recorded as moment and angle.

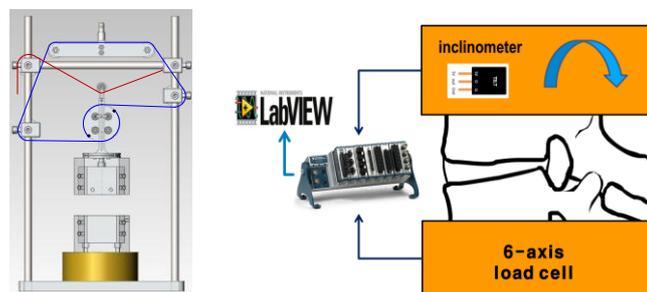


Fig. 1. The range of motion test device

3 Conclusion

The Catholic Institute for Applied Anatomy (CIAA) is carrying out tests on mechanical properties, range of motion and is constructing the results which can be utilized in Korean spinal researches. The constructed results are serviced to actual researchers through the Korea Institute of Science and Technology Information (KISTI). The constructed results can be utilized for Korean spinal related studies such as verification of the spinal biomechanical computer simulation model and development of related medical products.

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