

学 位 論 文 の 要 旨

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| 学位論文題目 | Experimental study of contact stress measurement acting on frequent sites of pressure injury when backrest of nursing care bed is operated (介護用ベッドの背もたれ操作時における褥瘡好発部位に作用する接触応力計測の実験的研究) | | |
| <p>学位論文要旨</p> <p>Japan is aging at an unprecedented rate. There are more bedridden elderly in Japan than in the United States. Pressure injury is a frequent health problem among bedridden elderly people. A pressure injury occurs when the blood flow in an area under pressure from body weight stagnates and worsens, causing destruction and damage to the skin and underlying tissue. Patients who spend a considerable amount of time in bed owing to illness or disability are at high risk of developing pressure injury. When a person lies in bed, the body weight concentrates on the bony prominences of human back. The blood flow of muscle, subcutaneous tissue, and skin owing to compression becomes worse. Severe cases lead to cell necrosis. The measurement of contact stress on the human body has been reported using soft but thick sensors with a large measurement area inserted into the contact surface, pressure-sensitive films, hard sensors. However, most of these are limited to measuring body pressure distribution. As for the sensor, which measured the shear stress of the developed contact surface, there were a hard thing and a soft thing. However, there is only thick sensor. A thick pressure sensitive layer may disturb the contact interface. Furthermore, if the area of measurement point is large, it may be affected by the unevenness of the contact interface. Therefore, the evaluation accuracy is likely to be insufficient. A measurement method to accurately evaluate the shear stress at the contact interface has not yet been established. To measure contact stress that acts locally, such as on bone protrusions, an extremely thin, flexible, and compact sensor is required. The aim of this study is to investigate the contact stress that acts on areas where pressure injury commonly occur when the backrest of a nursing care bed is operated. I also clarify the actual conditions of contact pressure and shear stress that cause pressure injury.</p> <p>A tactile sensing system using a small, thin, and flexible sensor was developed by Sasagawa et al. This is a system that can measure three-dimensional vector information of contact pressure and biaxial shear stress. First, I improved on a tactile sensing system using a small, thin, and flexible sensor developed by Sasagawa et al. I reviewed the manufacturing process of conventional sensors and improving the electrode shape to further decrease the measurement area and achieve higher integration. The revised sensor was calibrated and observed to exhibit appropriate relationships between the output voltage and contact pressure, and between the output voltage and shear stress, even in the low-stress range of less than 1 kPa. The sensor can simultaneously measure contact pressure and biaxial shear stress. Measurements using the sensor are almost unaffected by the thickness of the sensor itself. Additionally, the occurrence of disturbance at the contact interface is absent. It is unaffected</p> | | | |

by the unevenness of the contact interface. Therefore, it is possible to understand the distribution of contact stress acting on the human body. The subject was a healthy adult male. I used a self-made thin 3-axis stress sensor to measure contact stress that acts on areas of the human back where pressure injury are most likely to occur when the backrest of a nursing care bed is operated. Thus, especially in the measurement of shear stress, an upward force was exerted on the sacrum as the backrest was operated. The scapula displayed a tendency to act downward. The effect of shear stress was confirmed even after the subject returned to the lying position on the backrest. Therefore, this indicated the potential occurrence of residual shear stress. Results also suggested that knee lift-up, which is activated when the backrest of the bed is operated, can affect changes in contact stress. Next, measured the contact stress with and without the knee lift-up function activated, and compared the results. Thus, the purpose of the study is to clarify the effect of changes in contact stress due to the activation of the knee-raising function of the nursing bed. Hence, when the knee lift-up function was activated when the bed backrest was reclined, the upward shear stress gradually decreased when the tilt angle decreased. When the knee lift-up function was not activated, the upward shear stress generated when the backrest was raised remained unaffected even as the inclination angle decreased. However, even if the knee raise function was activated, the residual shear stress did not disappear. I focused on the residual shear stress acting on the frequent sites of pressure injury after the subject returned to the supine position, therefore, after the bed backrest operation was completed. Additionally, I clarified the distribution of residual shear stress. The results indicated that the distribution of residual shear stress after the subject returned to the lying position was not uniform at each specific location, and the tendency of shear stress action at each measurement point was not uniform. Residual shear stress was confirmed in the vertical direction and also in the horizontal direction, and it suggested this can act as a factor in the development of pressure injury.

注) 和文 2,000 字以内又は英文 800 語以内

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