Measuring the pressure applied to the skin surrounding pressure ulcers while patients are nursed in the 30° position

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The 30° laterally inclined and 30° head elevated positions (hereafter referred as the 'rule of 30' unless otherwise specified) are widely used as a means of both primary and secondary prevention of pressure ulcers as a result of reductions in localised pressures over bony prominences. However, the authors observed that some some parts of the wound margin were thickened. These thickened edges may be caused by use of the rule of 30 positioning and may also be responsible for a delay in the healing process. This study included five bedbound elderly patients with pressure ulcers located at the sacrum and coccyx. The local pressure was measured at the thickened edges and normal edges of the subjects' wounds by a newly developed sensor while the subjects were positioned according to the rule of 30. The results showed the maximum pressure as well as the average pressure of the thickened edges to be significantly greater than that of the normal edges. Thus, it is suggested that higher pressure on different areas of the wound margin may be responsible for the thickened edges phenomenon, which may consequently delay the healing process. Clinical use of the rule of 30 for patients with pressure ulcers in the sacrum and coccyx regions should be reconsidered.

Key words: 30° laterally inclined position, 30° head elevated position, pressure ulcer, 'thickened edges', local pressure.

Pressure ulcers are areas of localized tissue destruction caused by the compression of soft tissue over a bony prominence[1]. Such compression, when continuously applied for long periods of time, is a concern for bedbound patients. In a clinical setting, since pressure reduction is a key priority, it is important to use the most effective pressure-reduction techniques and select the most appropriate support surfaces. Positioning patients in the 30° laterally inclined position[2] and 30° head elevated position[3], known as the 'rule of 30', has been widely used as a means of prevention to minimise the pressures exerted at bony prominences. The rule of 30 is used to facilitate wound healing by avoiding further compression of sacral pressure ulcers and to prevent a pressure ulcer from developing in the trochanter region.

However, after implementing this pressure reduction, some areas of the periwound or wound margin of a pressure ulcer may become thickened and this may potentially lead to delayed healing. Such thickening and sclerosis of the periwound has often been observed in patients with chronic pressure ulcers at the ischium who sit in a chair for extended periods of time[4]. Since conventional pressure sensors are often too big, may be sensitive to water and difficult to fix to a wound, they are unsuitable for measuring the pressure distribution at the wound margin.

Thus the authors developed a new sensor device to measure the local pressure on the periwound of a pressure ulcer and evaluated its reliability, validity and safety[5]. Using this new device, the pressure on the normal edges and on thickened edges of the periwound was measured while the subjects were positioned according to the rule of 30.

Subjects and methods

Subjects

Enrollment: The subjects of this study were patients who had pressure ulcers and routinely used the rule of 30 positioning. Pressure ulcers were visually inspected for thickened edges, which the examiner assessed as a pressure sore status tool (PSST)[6,7] 'edges' score of 4.

Ethical consideration: In selecting the subjects, the opinions of the nursing staff at the facility where the study was conducted was taken into account. All candidates were informed about the aims of the study, and only those patients who gave informed consent participated in the

study. In cases where a patient was incapable of making this decision, informed assent was received from a family member or guardian. When exposing the pressure ulcer (i.e. buttocks) of the subjects, adequate care was taken to protect their privacy and maintain an acceptable environment. Informed consent was also given before any photographs were taken.

Methods

Method of measurement: Local pressure was measured on the normal and thickened edges of the periwound and compared between subjects in the 30° laterally inclined position and those in the 30° head elevated position. All subjects were tested in both positions.

The device: The new device's (developed by the authors in collaboration with DENSO Co Ltd, Kariya, Japan) reliability and validity was tested. The device is composed of a sensor unit (5 mm in diameter and 0.3 mm in thickness) and a lead (300 mm in length). The electrode of the sensor unit is covered with a waterproof base film to prevent exudate or other liquid from causing damage (*Figure 1*).

The sensor unit, which is disposable for hygiene purposes, is membranous and pressure-sensitive, perceives a load on the base film and detects any changes in resistance between silver electrodes on the basis of the area of contact between the upper electrode and the pressure-sensitive resistant body. The sensor operates by measuring changes in resistance that occur as pressure is applied to a pressure sensitive film mounted within the sensor.

Measuring system: The voltage levels are recorded by the sensor every 0.125 seconds, digitalized and transmitted to a personal computer (using Windows Excel®, operating on Windows 95 or higher) (*Figure 2*).

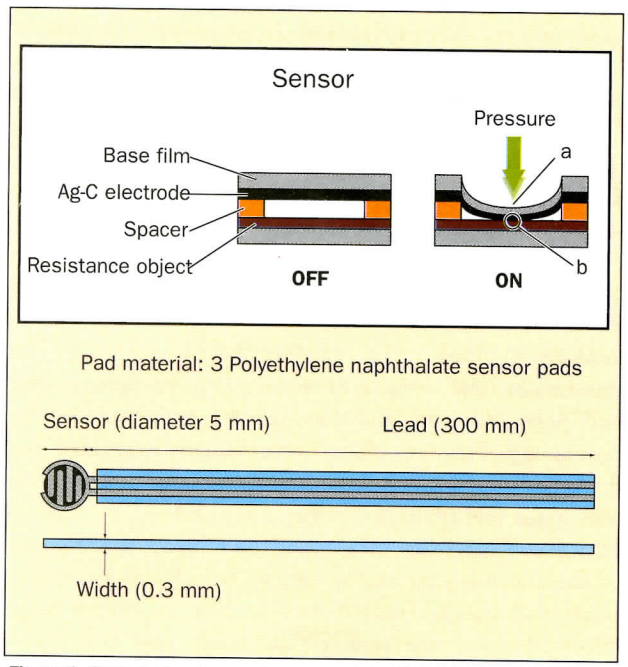

Figure 1. Sensor structure and pressure-detecting principle.

The device's sensor simultaneously measures pressures at three points as independent voltage levels. While the sensors are attached to the skin, any changes in pressure can be observed on a real-time basis on the computer display.

Reliability (hysteresis): For a measured range of 0–350 mmHg and a temperature range of 0–40°C, hysteresis when loading and unloading was approximately linear (±10% variation)(*Figure 3*). A major cause of hysteresis was a delayed response of the sensor film to loading.

Concurrent validity: When tested in a laboratory, the coefficient of correlation with an air-pad type interface pressure-measuring device (Teikoku Hormone Mfg Co. Ltd, Tokyo, Japan) was 0.985 for the sensor plate (hard surface) and 0.959 for the human body (soft surface) (*Figure 4*). The device's clinical validity for measuring periwound pressure was also confirmed[5].

Procedure

Collection of information: Before commencing, information was collected about each subject's daily

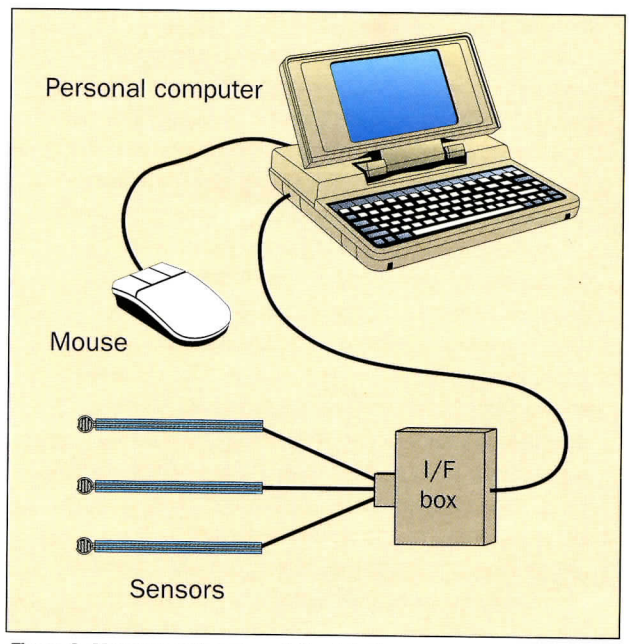

Figure 2. Measurement system. I/F = interface.

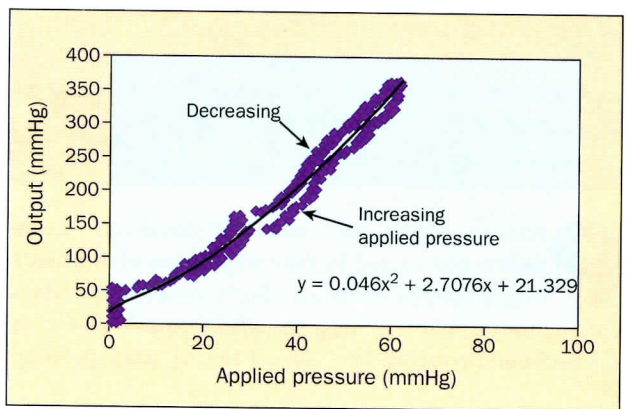

Figure 3. Hysteresis exhibited by pressure sensor.