The 30° tilt position *vs* the 90° lateral and supine positions in reducing the incidence of non-blanching erythema in a hospital inpatient population: a randomised controlled trial

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Manual repositioning of patients by nursing staff is a recognised technique for preventing pressure ulcer formation. The 30° tilt is a method of positioning patients that, in the laboratory setting, reduced the contact pressure between the patient and the support surface.

A randomised controlled trial was used to examine the effects of the 30° tilt position in reducing the incidence of non-blanching erythema (i.e. established pressure damage) in a hospital inpatient population (n=23) when compared to the use of the 90° lateral and supine position (n=23). The primary outcome of the trial was the incidence of pressure damage, defined as non-blanching erythema.

In this study no subject developed pressure damage that presented with visible breaks in the epidermis, but all damage was restricted to areas of non-blanching erythema (five of the 39 subjects who completed the study exhibited such injury).

The main findings of this study were that patient positioning using the 30° tilt method did not reduce the incidence of pressure damage compared with either the 90° lateral or supine positions. This study also investigated the feasibility of using the 30° tilt position with medical inpatients; it found that 78% of subjects experienced difficulty in adopting and maintaining the position. This finding seriously questions the practicality of using the 30° tilt method with a predominantly ill population.

Key words: pressure ulcer, pressure sore, repositioning, 30° tilt, non-blanching erythema, skin damage

Pressure ulcers are areas of localised damage to the skin and underlying tissue caused by pressure, shear and friction, or any combination of these[1].

Pressure ulcers remain a problem for hospital inpatients, with European prevalence rates ranging from 8.3% to 22.9%[2]. Two factors that are thought to influence pressure ulcer formation are the intensity and duration of the applied pressure. Early experimental work on animals attempted to establish if a critical balance could be obtained between the maximum amounts of pressure tissue could withstand and the minimum time period for which it could be tolerated[3,4,5]. This resulted in a pressure–duration curve for swine[6]. Subsequent work identified additional factors that gave rise to pressure ulcer formation: shearing forces[7], capillary autoregulation[8], tissue deformation[9], and protective function of dermal tissue[10]. Nonetheless it was not until 1976 that an allowable pressure–time curve was produced for humans, which confirmed an inverse relationship between pressure and duration[11]. However, this curve was based upon clinical experience with relatively few controlled measurements.

When patients are considered to be vulnerable to developing pressure ulcers interventions to control tissue loading are typically used. Perhaps the most fundamental intervention is for nursing staff to manually change the position of patients at regular intervals. Bergstrom et al[12], in a multicentre observational study (n=843), identified repositioning and the provision of pressure-relieving support surfaces as methods for pressure ulcer prevention. Goodridge et al[13], in a prospective longitudinal cohort study (n=330), found that repositioning was used for 38.6% of subjects who were at risk of pressure ulcer development. The frequency of repositioning varies between patients, but the clinical community has accepted a figure of 2 hours as the optimum time for repositioning. The probable originator of this practice is Guttmann[14] who refers to 2-hourly repositioning of patients both day and night as the cardinal measure of prophylaxis in pressure ulcer prevention. The 2-hourly turn could be described as a ritualistic practice that has become firmly embedded into nursing culture[15]. Clark[16] highlighted the frequent inclusion of regular repositioning in national guidelines and pointed out that this is done despite inadequate investigation of the efficacy of this measure.

Repositioning can take the form of small shifts in the patient's position[17–20]. In recent years there has been growing interest in an alternative form of repositioning known as the 30° tilt[21,22]. To achieve this position the patient is placed in the centre of the bed with sufficient pillows to support the head and neck. A pillow is placed at an angle under one buttock, thereby tilting the pelvis by 30°. A second pillow is placed lengthways under each leg.

Once the patient is placed in the 30° tilt position the sacrum and heels are free from contact with the support surface. This method of positioning is thought to have significant advantages over the usual position of patients lying directly on their side.

The 30° tilt is thought to transfer pressure from bony prominences to areas of larger tissue mass, and thus dissipate the applied pressure. Indirect evidence for the likely effectiveness of the 30° tilt technique has been derived from laboratory studies that report interface pressure measurements and/or tissue oxygenation. These surrogate measures have their limitations, including the practicalities of the measurement technique as well as the depth of tissue they are able to transcend. Seiler et al[23] found elevated skin oxygen levels in eleven volunteers when placed in the 30° tilt position compared to the 90° lateral position. These findings were reiterated by Colin et al[24] in a study on twenty volunteers using the same measurement technique.

Interface pressures were used as a measurement tool by deFloor[25] on 62 volunteers. The interface pressures were measured in ten different positions on two different foam mattresses. The sequences of the postures were randomised. In the lateral positions the lowest interface pressures were achieved with the 30° position. This provides additional laboratory evidence for the value of this method of repositioning, as well as attesting to its ability to reduce the intensity of contact pressure between the skin and the support surface. Such laboratory work appears to have influenced clinical practice, as the 30° tilt is a common recommendation in UK pressure ulcer prevention guidelines. In addition a postal survey of UK clinical nurse specialists in tissue viability identified that 159 had a pressure ulcer prevention policy and 126 of these recommended that the 30° tilt position should be used (T Young, 1999, unpublished data).

However, the 30° tilt has not been investigated to establish whether it is practical and effective for an elderly ill population. This article describes a randomised controlled trial that compares the incidence of pressure damage when subjects were nursed using the 30° tilt with alternative methods of positioning.

Methodology

The sample population was taken from the medical directorate of an acute district general hospital. The subjects were included if they were elderly, were assessed as at risk of developing pressure ulcers (confirmed by a Waterlow risk assessment score of above ten), were able to lie in the 30° tilt position, had given informed consent, had no existing pressure damage, and were of Caucasian origin.

The experimental intervention that was undertaken was the 30° tilt position which has been described by Dealey[26] and summarised earlier in this paper. The control group received standard repositioning, in which the subject was placed in either the trochanter, supine or semi-recumbent position. The subjects were randomised into the experimental and control groups.

First the researcher identified potential subjects and then explained the study methods. This was reinforced by a study information leaflet. Written consent was given by all subjects. Following this the researcher completed a full skin inspection.

The randomisation was based on block allocation with specific intervention being selected by sequential opening of sealed opaque envelopes. The ward staff were then handed the sequentially numbered sealed opaque envelopes containing randomisation code and the researcher left the clinical area. That night the subjects were repositioned using the 30° tilt position (experimental intervention) or the 90° side-lying position (control). Each subject was entered into the study for the period of 1 night. The nursing staff completed a repositioning schedule for each subject after every episode of repositioning. This provided a record of the positions the subjects were placed in, the timing of the repositioning, the use of pillows to achieve the 30° tilt, any problems experienced during the repositioning, and the position's ability to provide initial and sustained pressure relief.

The next morning the researcher returned to the clinical area, where pillows were removed from under the patient, so that the researcher was unaware of which method of repositioning had been used, therefore masking the researcher to the treatment allocation. The researcher then completed a full skin inspection identifying any areas of pressure damage. Non-blanching erythema was used as a definition of pressure damage. This is ascertained by applying light finger pressure to any reddened areas. If the areas do not blanch under exertion then tissue damage is said to have occurred. This is a recognised method of assessing pressure damage and is included in the European Pressure Ulcer Advisory Panel[1] and the National Institute of Clinical Excellence[27] guidelines for pressure ulcer prevention.

It was anticipated that the 30° tilt would make a 35% difference to the incidence of pressure ulcer formation, thus reducing incidence from an average of 3.8% to 2.5%[28]. To arrive at a sample size and then accept an 80% power of detecting a difference, significant at a 5% level, 46 subjects were recruited into the study[29]. The recruitment and retention figures are summarised in *Figure 1*.

Within the data analysis, statistical comparisons were made on an intention-to treat-basis. The primary outcomes were analysed using Fisher's exact test.

Approval for the study was granted from the Hospital Research and Ethics Committee.

Results

Between April and July 1999 46 subjects were recruited with 23 randomised to the experimental group of the study.

Table 1 shows the baseline characteristics of the experimental and control groups. The groups were similar with respect to these variables.

Seven subjects (31%) in total failed to remain in the study overnight: five subjects (22%) in the experimental group were unable to tolerate the intervention, and two subjects (9%) in the control group died overnight. No post-intervention assessment of pressure damage was performed on any of these seven subjects.

Among the subjects who completed the study protocol, five (22%) developed non-blanching erythema, three (13%) of these were from the experimental group and two (9%) from the control group. This difference was not statistically significant (Fisher's exact test, $p>0.05$). The extent of pressure damage in both groups was limited to non-blanching erythema. In the experimental group one subject (4%) developed non-blanching erythema over the sacrum, and the other two (9%) developed two discrete areas of damage (one on the left trochanter and heel, and the other on the right trochanter and heel). In the control group both subjects developed pressure damage at the sacrum.

Among the subjects who completed the study, the experimental intervention was difficult to implement for 20 subjects (87%), whereas only five subjects (22%) in the control group experienced any difficulty with repositioning (Fisher's exact test, $p<0.05$). The reasons for the difficulties that were given by the groups are shown in *Table 2*. The reason eight of the subjects in the experimental group were unable to get into the position was not specified. However, it may be the result of the additional flexibility required in their legs to accommodate the pillows thereby achieving pressure relief under their heels and sacrum.

During the study the subjects were nursed on three types of support surfaces: 31 (67%) on alternating pressure, 12 (26%) on low air loss and three (6%) on static foam or fibre. None of the subjects nursed on static fibre or foam surfaces developed pressure damage, and therefore they were excluded from secondary analyses of any relationships between ulcer development, allocation to treatment groups and support surface provision. While eight subjects (38%) in the experimental arm and four (18%) in the control group were nursed on low-air loss mattresses, the greater use of the devices in the experimental group was not considered to be an important confounder. There is presently no strong evidence demonstrating improved efficacy in preventing pressure ulcers when nursed upon

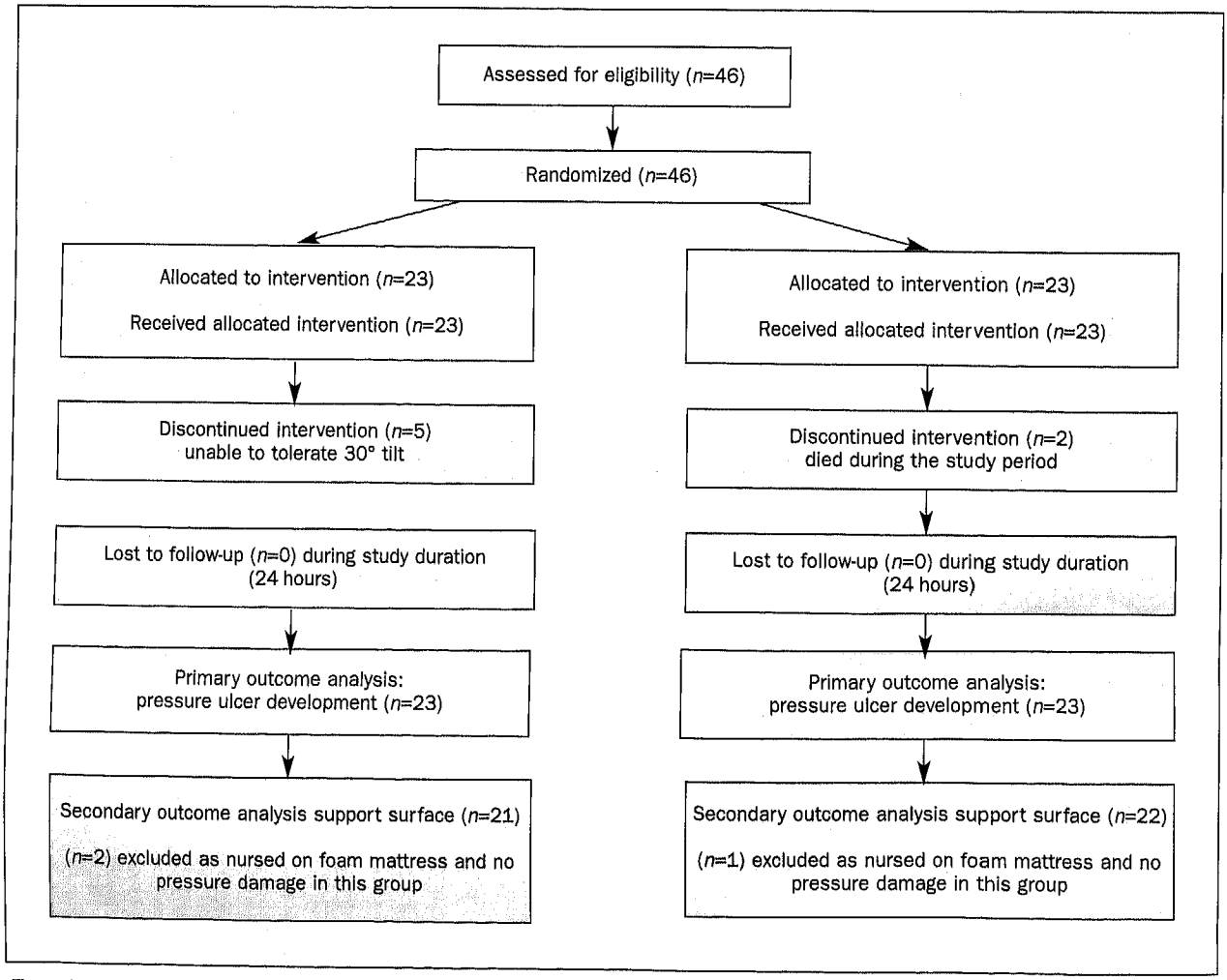

Figure 1. Study flow-chart showing recruitment, randomisation and analysis.

low air loss or alternating pressure systems[27]. The use of alternating pressure mattresses was relatively similar between the two groups, 13 (62%) from the experimental group and 18 (82%) from the control. Two subjects (9%) in the control group developed pressure damage and they were nursed on alternating pressure mattresses. In the experimental group two (9%) subjects developed pressure damage while being nursed on low air loss mattresses, and one (4%) did on an alternating pressure mattress. Pressure ulcer incidence (non-blanching erythema) by mattress type and site is shown in *Table 3*.

Most subjects in both groups were being repositioned to prevent pressure ulcer development, specifically 20 (87%) from the experimental and 21 (91%) from the control group. The other reasons for repositioning subjects are shown in *Table 4*.

Subjects were seen to have altered their own position independently on at least one occasion between repositioning by nurses: in the experimental group this occured in 14 cases (61%) and in the control group in 12 cases (52%). Frequently the pillows used for the positioning of subjects had moved between successive observations: in the experimental group this occured in 12 cases (52%) and in the control group in 10 cases (43%).

Once a subject had been placed in a position the nurse assessed the ability of the position to provide pressure relief (sacrum and heels free from contact with the support surface) at the sacral and heel sites. Neither the experimental nor the control positions consistently provided pressure relief, even sometimes immediately

TABLE 1.
Baseline characteristics of experimental and control groups

Baseline characteristics		Experimental group (*n*=23)	Control group (*n*=23)
Age in years mean (SD)		70.1 (11.1)	70.5 (14.7)
Weight in kilograms mean (SD)		62.6 (13.4)	63.2 (16.5)
Height in centimetres mean (SD)		163.7 (13.4)	168.0 (13.1)
Waterlow score mean (SD) Range 1–>35		20 (3.6)	20 (3.1)
Gender: male		50%	50%
Primary diagnosis	Neurological disease	6 (26%)	8 (35%)
	Cardiac disease	6 (26%)	7 (30%)
	Respiratory disease	5 (22%)	5 (22%)
	Infectious disease	4 (17%)	3 (13%)
	Haematological disease	2 (9%)	0
Support surface	Alternating pressure mattress	13 (62%)	18 (82%)
	Low air loss mattress	8 (38%)	4 (18%)
	Pressure-reducing foam mattress	2 (9%)	1(4.5%)

TABLE 2.
Reported reasons for subjects experiencing difficulty with repositioning

	Experimental group (*n*=23)	Control group (*n*=21)*
Not difficult	3 (13%)	18 (78%)
Inability to get into position	8 (35%)	2 (9%)
Inability to stay in position	6 (26%)	0
Joint stiffness	3 (13%)	1 (4%)
Pain	2 (9%)	0
Anxiety	1 (4%)	1 (4%)
Build	0	1 (4%)

*Data missing for the two subjects that died during the study period

TABLE 3.
Pressure ulcer incidence (non-blanching erythema) by mattress type and site

		Experimental group (*n*=23)	Control group (*n*=23)
Site	Sacrum	1 (4.3%)	2 (8.7%)
	Left trochanter and heel	1 (4.3%)	0
	Right trochanter and heel	1 (4.3%)	0
Mattress type	Alternating pressure mattress	2 (8.7%)	2 (8.7%)
	Low air loss mattress	1 (4.3%)	0

after repositioning. For those subjects who did obtain pressure relief, this was not maintained until the next repositioning.

The frequency with which repositioning took place was similar for both groups with the median and mode falling within the 2–3-hour category.

In the experimental group two members of staff were required to reposition all subjects throughout the study. However, four subjects (17%) in the control group were repositioned by one nurse and one subject (4%) by more than two nurses.

Discussion

This trial found no evidence that the incidence of pressure ulcers differed when elderly ill patients were positioned at 30° or in alternative postures. This may be a consequence of the small sample size and the small number of subjects who developed any signs of pressure damage. However, the trial data are consistent with the 30° tilt being better than standard repositioning, with the 30° tilt being worse than it, and with the two regimens being equally effective. These findings are in contrast with the conclusions drawn from laboratory studies that have provided indirect support for the effectiveness of the 30° tilt[23,24,25]. However, it should be noted that the study sample size was calculated on a basis of a predicted 35% relative difference between the incidence of pressure ulcers among subjects nursed using the two interventions. This difference was not observed in the study and a much larger sample size would have been required to rule out a type II error.

In this study no subject developed pressure damage that presented with visible breaks in the epidermis. Instead all damage was restricted to areas of non-blanching erythema, with five of the 39 subjects who completed the study exhibiting such an injury. The relatively low occurrence and mild severity of pressure damage may have been the result of the following factors: first it could have been the short follow up of each subject (1 night only). The single night follow up was clearly not ideal but the heterogeneous nature of the patient's experience over time while in hospital was considered to be likely to strongly influence their skin status. A second possible explanation lies in the common use of pressure-redistributing mattresses among subjects analysed in this investigation.

TABLE 4.
Reasons for repositioning subjects

	Experimental group (*n*=23)	Control group (*n*=23)
Pressure ulcer prevention	20 (87%)	21 (91%)
Administer medication	1 (4%)	0
Aid breathing	0	1 (4%)
Personal hygiene	1 (4%)	0
Subject's request	1 (4%)	1 (4%)

By adopting an intention-to-treat approach, the study included in its comparison subjects who could not tolerate treatment and therefore did not have the opportunity to receive the potential benefit of the experimental intervention. This has resulted in a dilution of the effects of the 30° tilt by including subjects who never received this method of treatment in the data analysis. This affects the results of the primary outcome but nonetheless the fact that the position could not be tolerated is a valuable outcome in itself.

Ideally any study that investigates the effect of patient repositioning on the incidence of pressure damage should avoid the uncontrolled effects imposed by different types of support surfaces, by nursing all subjects on a standard hospital foam mattress. Patients at risk of developing pressure ulcers are typically nursed on pressure-relieving mattresses, however, there is a lack of evidence relating to their use in pressure ulcer prevention[30]. As a consequence nursing staff may not adhere to a study protocol if they perceive that the support surface does not provide the patient with appropriate pressure relief.

In this study nursing staff regularly repositioned subjects who were being nursed on pressure-relieving mattresses. The principal reason given for the repositioning of subjects, even where pressure-relieving mattresses were used, was that it provided pressure relief. The practice of repositioning patients nursed on pressure-relieving mattresses has been observed by others (including Bergstrom et al[12] and Xakellis et al[31]). Possible explanations for repositioning are that this may either reflect a lack of confidence by nursing staff in the ability of equipment to provide adequate pressure relief or their limited experience with the 30° tilt position.

Alternatively repositioning may be the result of nurses implementing the widely-held belief that 2-hourly turns are fundamental to pressure ulcer prevention. Not surprisingly then in this study the majority of repositioning took place at 2–3-hourly intervals. There was no opportunity to confirm the stated repositioning schedules although it is very encouraging that patients were reported to be repositioned so frequently. It would be ideal for studies that investigate the effects of repositioning to standardise its frequency, nevertheless it is difficult to achieve staff compliance with rigid repositioning schedules. This has long been documented[32]. In the original study design it was hoped to control the variables of the frequency of patient repositioning and the support surfaces. However, this was not achievable and it highlights the problems when transferring an experimental design to a clinical setting. It was not possible to reposition subjects on a 2-hourly basis because of their clinical needs,

associated nursing interventions and staff's clinical judgment. In addition there may have been a learning curve for the staff, resulting in a delay in achieving competence in 30° tilt positioning. The standardisation of support surface was not possible because of the limited availability of pressure-relieving mattresses: in fact patients who were not part of the study were often deemed to have a greater need and therefore received the equipment. It would have thus required a large capital investment to ensure sufficient numbers of pressure-relieving mattresses were available for all subjects in the study.

Patients will probably only benefit from a position such as the 30° tilt if the position is maintained. In this study over half the subjects in both the experimental and control groups independently altered their positions, and the pillows that were used to achieve the pressure relief had moved before the next planned repositioning. Before implementing manual repositioning as a pressure ulcer prevention strategy, it is necessary to identify which patients are unable to move independently, and therefore evaluate the effectiveness of repositioning in this subject group.

In previous studies subjects tended to be either volunteers or spinally injured patients, both groups had no recorded difficulty in adopting or maintaining the 30° tilt position[22,24]. This study investigates the feasibility of using the 30° tilt with medical inpatients and has found that 78% of subjects experienced difficulty in adopting and maintaining the position. This finding seriously questions the practicality of using the 30° tilt with a predominantly ill population.

In this study the primary outcome measure was visible pressure damage, specifically areas of non-blanchable erythema. It was not established whether those subjects who presented with areas of non-blanching erythema had transient or permanent pressure damage. For instance persistent erythema is indicative of permanent pressure damage. However, the short follow-up period in this study did not allow for additional skin inspection to assess the longevity of the non-blanching erythema. A laser Doppler examination of the areas of non-blanching erythema might have discovered the degree of pressure damage at the time of the skin inspection[33].

Repositioning is probably the most expensive component of pressure ulcer prevention and it should therefore be used in the most effective and efficient manner[34]. The 30° tilt has become widely recommended by clinical nurse specialists in tissue viability. However, this study has questioned the benefits of the technique for positioning patients, based upon the frequent inability to adopt and maintain the position, among elderly medical inpatients. In conclusion this study suggests that further controlled trials comparing the 30° tilt and other interventions are now required, in order to identify whether similar problems in maintaining position are encountered with other patient populations.

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