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The effectiveness of lying surfaces in nursing care beds, a comparison of spring element systems versus conventional systems: A post marketing clinical follow-up pilot study

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ABSTRACT

Background: Reduced mobility is a strong risk factor for pressure ulcer development in a nursing home setting. Despite this, there is a surprising lack of data regarding suitable nursing care beds in general and the prevention of pressure ulcers provided by lying surface systems in particular. In this context we aimed to assess the mobility of patients using lying surface systems either with spring elements (SES) and to compare these to conventional systems (CS; wooden slats or steel bars).

Methods: This was a prospective, randomized, controlled study in 29 patients with an age range of 54–95 years. Patients were randomly assigned to SES (n = 15) or CS (n = 14). The primary objective was to show a statistically significant difference in the proportion of patients with normal (up to 4 movements per hour) movements as evaluated by the *Mobility Monitor*[®]. Pressure distribution of the lying body weight was measured by a full body pressure mapping system *XSensor*[®]. Comfort, possibility of movement and recovery of sleep as well as pain at rest were self-rated.

Results: We screened a total of 39 patients of which 29 were eligible to be randomized into the two groups and 27 were finally analysed (SES = 14; CS = 13). The mean age was 81.7 ± 9.5 years, 81.5% were female and the mean Braden Scale Score 22.4 ± 1.3 . We observed no statistically significant difference in the primary evaluation criterion (proportion of patients with a normal number of movements across 14 nights) between the SES group ($81.4 \pm 10.8\%$) and the CS group ($72.9 \pm 16.3\%$; $p = 0.0757$). There was a consistent trend for more movements in the normal range in the SES group however, which was observed when the number of hours with normal movement was plotted per night ($p = 0.0004$). Measured pressure values showed overall higher values for the lateral compared to the dorsal position with the SES but not the CS forming a “shoulder” between 35–55 mmHg in the dorsal position and between 35–45 mmHg in the lateral position. Self-rated comfort was significantly higher with the SES after night 14 ($p = 0.0192$) than with CS.

Conclusions: The study is not aimed at the hard endpoint pressure ulcer, but at the physiological movement profile of patients in bed, which justifies a much smaller number of cases. For elderly nursing home patients it appears that beds with spring elements may be associated with higher normality of body movements and higher self-rated comfort. The presented study could be a contribution to reduce the care dependency of patients regarding mobility.

1. Introduction

Reduced activity and mobility are risk factors for pressure ulcer development in hospitals and the context of care dependency in the nursing home setting [1–3]. The prevalence of pressure ulcers varies by clinical setting and the individual impairment; although estimates of pressure ulcer rates vary considerably they indicate that pressure ulcers are among the most common conditions seen in hospitalized individuals worldwide [4–6]. For Germany estimates point at a

prevalence rate of 10.2% in hospitals and ranges between 12.5 to 5.0% in nursing homes [7,8].

A potential reduction of the effects of impaired mobility on the development of pressure ulcers in the hospital setting was shown to be associated with the use of adequate support surfaces (mattresses and mattress overlays). McInnes et al. demonstrated in a systematic review of 59 trials that foam alternatives (potentially with low- or alternating pressures) in comparison to standard hospital foam mattresses are able to reduce the incidence of pressure ulcers by 60% (RR 0.40; 95%CI

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0.21–0.74). They furthermore demonstrated that pressure-relieving overlays on the operating table reduce postoperative pressure ulcer incidence [9].

Super soft foam mattresses may lead to a better pressure redistribution through immersion but this immersion may also hinder the patient to make movements by him/herself and therefore make the patient more care dependent regarding mobility. This is also the case if the pressure ulcer prevention protocol recommends the use of pillows and other preventive material for positioning of the patient [5]. Therefore, it should be promoted that patients will be supported in regaining mobility by the use of adequate products like special support surfaces and/or bedframe systems.

Surprisingly there is a lack of data on the effectiveness of lying surface systems for preventing pressure ulcers in hospitals or nursing homes. This is of particular interest as, while there is a reduced short-term risk as compared to the hospital setting, people in nursing homes spend extended periods during the night but also during the day in their beds resting or sleeping or are actually bedridden. In this context it has been shown that impaired mobility in bed represents one of the key causal factors in the pressure ulcer pathogenesis [10].

For this reason, we designed a study conducted in nursing homes in Germany to compare lying surface systems either with spring elements or conventional systems (wooden slats or steel bars) (Fig. 1). The aim was to develop and pilot a uniform data collection instrument and to establish a method to evaluate physiological movements and pressure distribution of patients lying in bed.

2. Methods

2.1. Study design

This study was a randomized, controlled, prospective, pilot clinical trial designed to assess the effectiveness of lying surfaces by evaluation of physiological movement profiles and thus to prevent pressure ulcers in nursing care beds. It was approved by the Ethics Committee of the Charité-Universitätsmedizin, Berlin, Germany (EA5/076/16) and was conducted in accordance to the principles of the Declaration of Helsinki. All patients enrolled in the study provided written informed consent.

2.2. Study patients

Patients were eligible for inclusion if they had lived for at least 6 months in one of 7 nursing care homes in Northern Germany (see

acknowledgement). Cognitive capability was defined as conditions where patients were orientated to place and time and not confused. Further selection criteria was a Braden sub sum score for activity and mobility between 5 and 8 [11] as a surrogate of relatively good physical constitution and mobility. Height was limited to < 190 cm and weight to between > 40 and < 130 kg due to technical limitations of measurement devices.

Patients were excluded if they already had pressure ulcers, patients in need of support for their optimal positioning in bed e.g. with pillows, and patients using drugs with an impact on movement, mobility and mental skills. Furthermore, patients with mental impairments (e.g. dementia, Parkinson's and other cognitive diseases) were excluded.

2.3. Investigational subject

Nursing care beds with always the same mattresses (polyurethane foam RG 40 kg/m³, height 12 cm) but different lying surfaces were used. We compared lying systems with spring elements (Scherenbett mit Ripolux neo, Hermann Bock GmbH, Verl, Germany [SES]) to lying surfaces with wooden slats (Burmeier GmbH & Co KG, Lage, Germany) or steel bars (Pflegerbett Alois, Vermeiren Group NV, Antwerpen, The Netherlands) (grouped as CS). All beds were CE certified. Patients were block randomized to either the SES or CS group with a block size of 4.

2.4. Study objectives

The primary objective was to show a statistically significant difference in the proportion of patients with normal (4–0 movements per hour; the latter must always be followed by movements per hour) movements as evaluated by the *Mobility Monitor*[®]. Pressure distribution of the lying body weight was measured by a full body pressure mapping system *XSensor*[®]. Furthermore, patients were asked for a self-assessment.

2.5. Mobility/movement

The *Mobility Monitor*[®] (compliant concept, Fehrltdorf, Switzerland) was used to measure unintentional macro movements. This portable motion sensing mattress (730 × 20 × 160 mm) is used in hospitals or nursing homes [10,12], is placed under the patient's mattress and continuously captures the mobility of the patient lying in bed. Macro movements (defined as posture/large position changes to prevent ischaemia pain) [13], the maximum retention period without movement, as well as micro movements are recorded and documented by the

A. Lying surface with spring elements



B. Lying surface wooden slats or steel bars



Fig. 1. Lying surface systems.

This Figure illustrates the lying surface systems: A. the spring elements (SES) and B. the conventional systems (CS; wooden slats or steel bars).

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