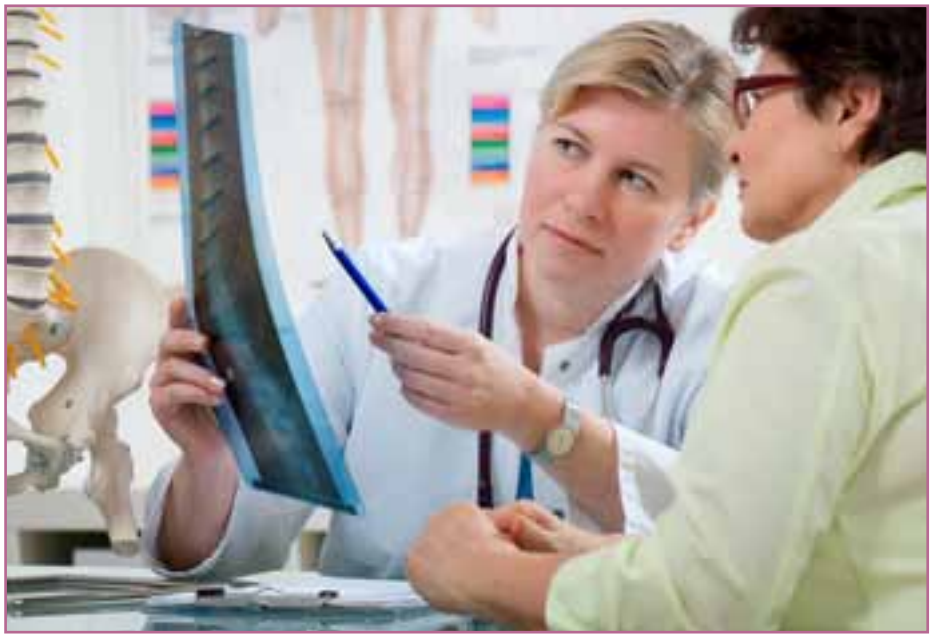
The Squirrel Diamond® low-profile pressure-relieving mattress

With the cost of treating pressure ulceration significant, there has been an onus placed on these wounds by the government. This article examines the pros and cons of traditional mattresses used in healthcare and compares them with the new Squirrel Diamond, which combines alternating air technology with the subtle use of foam.



There has been renewed development in a new generation of pressure-relieving products specifically designed to meet the challenges posed by formal care environments

Pressure ulcers have, in recent times, become the focus of media and government attention. The Quality, Innovation, Productivity and Prevention (QIPP) agenda (Department of Health [DoH], 2010a) and High Impact Actions (DoH, 2009) have emphasised that these largely preventable events deserve increased focus, due to their cost and negative impact on patient outcomes. Certainly, the cost of pressure ulceration is significant. In 2004, it was estimated that the cost to the UK health service was as much as £2.1bn annually (Bennett et al, 2004). This estimate was later increased to between £2.3bn and £3.1bn (Drew et al, 2007). As the

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reporting systems used by clinicians to measure the rates of pressure-related skin damage are refined, it is likely that the true cost is set to rise even further. It is, therefore, unsurprising that there has been a renewed interest in this care field. Pressure ulcers have now become part of the Continuous Quality Improvement Network (CQUIN) data collection (Stephen-Haynes, 2011) and the 'Your Skin Matters' campaign is one of the eight High Impact Actions for Nursing and Midwifery (DoH, 2010b).

These moves are appreciated by those who have strived to reduce the spectre of pressure ulcers in their organisation. However, as with many broad brushstroke government initiatives, those left to manage the day-to-day implications of this policy face a number of dilemmas. One of these is to answer the following question: 'How does the clinician provide safe, effective pressure ulcer prevention, while also minimising the risk of falls, particularly from bed or when transferring from bed to chair?'

Dynamic air mattresses provide an effective tool in the prevention and treatment of patients with pressure ulceration and are widely used in the UK. Through the cyclical inflation and deflation of air cells, an area of the patient's body is lifted clear of the surface of the bed (Bell, 2005). While the scientific evidence for the effectiveness of these devices may be in question (Bell, 2005), those utilising them as part of a managed approach to pressure ulcer prevention see undoubted benefits. However, their use does provide other health-related issues.

For many patients, falls from bed pose a significant risk to well-being. In 2006, there were 44,000 falls from bed reported in England and Wales alone, with at least 11 resulting in the death of a patient (National Patient Safety Agency[NPSA], 2007). Many of these occurred among the frail and vulnerable; the same group that are at increased risk of pressure ulcer development. It is unknown how many of these falls were directly linked to the use of air mattresses, however, it is likely that their use may be an important co-factor.

Certainly, clinicians have reported that the relative patient instability found in many air systems when patients either lay near the mattress edge or attempt to ingress or exit the mattress unaided could lead to incident. The collapse of air cells can destabilise the individual as they attempt to move and may result in them sliding into (or over) the bedrail if fitted or, if they are attempting to stand, fall back onto the bed. Worse still, the individual may fall forward onto the floor.

To overcome these fears, many clinicians use bedrails to ensure patient safety. As O'Keefe (2004) highlighted, these are often regarded as benign, routine and even essential in falls prevention. However, as the 2007 NPSA safety notice identified, bedrails can also pose a threat to patient safety. This threat is increased when deep pressure-relieving air mattresses are used in conjunction with bedrails.

In a night-time audit carried out by Shanahan and Evans (2009), some 21.5% of beds audited had both dynamic air mattresses and bedrails in simultaneous use. Interestingly, the audit did not specify if bed rail height (as measured from the mattress to the top of the bed rail) was assessed. The relevance of this is that the safety standards BS EN1970 specify that the minimum height of a bedrail should be 22cm from the top of the mattress. Concerned at the potential for serious or fatal injury, in 2001, the Medicines and Healthcare products Regulatory Agency (MHRA) issued advice in its publication 'The Safe Use of Bedrails DB 2001(04)'. In 2006, (after the Shanahan and Evans audit) this guidance was amended

Figure 1. Squirrel Diamond Dynamic Hybrid Mattress showing its stable array of air chambers. Clients report that repositioning and transfer is easier. (Pictured on Volker 3080 nursing bed).

when its document 'Safe Use of Bed Rails DB 2006(06)' was published.

The Squirrel Diamond

The team at Squirrel Medical have been designing and manufacturing pressure-relieving equipment for a number of years. To date, most of these products have been intended for use in the domestic and/or care home environment. However, in recent years there has been a rise in demand for these systems within more formal care environments such as NHS hospitals, Loan Stores and larger nursing home facilities. This has led to the development of a new generation of pressure-relieving products specifically designed to meet the challenges these environments pose.

The most recent addition to the product range is the Squirrel Diamond® (*Figure 1*), which is available to NHS environments having been adopted under the NHS listing tender process. This product has been specifically developed to overcome the problems previously experienced by clinicians, chiefly, how to provide effective pressure relief for the bed-bound or highly dependent patient, while ensuring the mattress support surface does not increase the risk of bed falls or entrapment.

The Squirrel Diamond is a hybrid dynamic replacement mattress, which combines alternating air technology with the subtle use of foam. It has been developed to provide all the features of a deep-cell dynamic replacement air mattress in a 12.5cm depth mattress unit. By limiting mattress depth to this size, it is possible to use the device safely on bedframes fitted with standard height bed rails. This eliminates the need for bedrail height extension equipment and ensures that rail height meets the 22cm mattress to rail clearance required by HSE guidance (*Figure 2*).

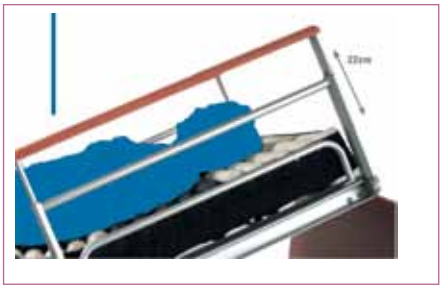

Figure 2. ***With an exceptionally low profile of just 12.5cm (5") the Squirrel Diamond provides an ideal care surface capable of ensuring bed rails (when fitted) reach the regulatory height of 22cm.***

To achieve this thin profile, while continuing to provide pressure redistribution, the company has re-evaluated mattress construction and design and has developed a new (patented) approach. Traditionally, replacement mattresses use single, full-depth air cells to support the patient's weight. Alternatively, in some mattress designs, each cell is divided into two interconnected air pockets. In either instance, when air pressure within the cell is reduced, the cell collapses with the aim of providing pressure relief to the tissues in contact with the cells.

The Squirrel Diamond mattress comprises 58 transverse air cells formed into two independent layers. When connected to the mattresses digital pump, the lower cell tier provides a static, continuous level of support at a pressure range of 30-60mmHg as selected by the clinician. This lower cell layer conforms to the load applied through the upper mattress tier by the patient's body mass, but also prevents the transmission of high points of pressure, which sometimes occurs with other systems if they 'bottom-out.'

The inclusion of a sub-cell foam wafer ensures that the lower cell tier is protected from damage by the bedframe structure and prevents 'pinching' of the cells when the mattress is used on profiling bed systems.

The upper tier of cells provides direct patient support. In all but the five air cells at the head of the mattress, air is delivered to the upper mattress tier in a staggered A:B alternating sequence — each cell deflates and then reinflates before the next cell deflates. In normal operation this sequence is continually repeated every 10 minutes, redistributing pressure and mimicking the micro-movement seen in healthy, sensate and mobile individuals. When body movement is not indicated, for instance, during clinical examinations or procedures, the cell alternation can be halted and all of the cells are inflated by activating the static mode switch found on the mattresses air pump. This provides a firm platform for nursing care. Unless reset, the mattress will return to its alternating mode automatically after a 20-minute delay.

Within the upper tier are zones of specialist air cells positioned in the areas frequently associated with an increased risk of pressure damage formation, such as the heels. These cells have laser-cut perforations, which provide what is referred to as 'micro loss air loss' (MLAL), enabling the cells to collapse more rapidly and so ensure enhanced cell conformability to body contours. Pressure mapping studies that compare the Squirrel Diamond to a conventional 25cm deep dynamic replacement mattress have shown that the patented mattress design is able to offer the same level of pressure redistribution and relief (see *Figure 3*).

The contamination of any mattress with fluid can lead to it acting as a vector for infection, particularly in individuals with existing breaks to skin integrity. Accidental damage to mattress covers can often go unnoticed and this can lead to

contamination of the mattress core. Mattress cover design is, therefore, an important component of any pressure devices construction.

The Squirrel Diamond mattress has been produced with this in mind. The mattress is fitted with a two-tier interchangeable two-way stretch PU mattress cover. This provides a waterproof and vapour-permeable interface, the seams of which are heat-sealed and which is fully zipped to cover the entire mattress body but permit easy inspection and removal when indicated. Between the two tiers is a zipped compartment, which contains a thin layer of white memory foam.

As well as providing additional patient comfort, the foam acts as an indicator of moisture ingress, should damage occur to the primary support surface. The assembly enables care staff to periodically check the internal structure of the mattress and, if necessary, replace individual damaged components without the need for complete mattress replacement. This reduces costs and ensures that there are no significant gaps in equipment availability. External contamination of the cover can be managed by washing the mattress cover in situ with standard cleansing material or, if required, the cover may be removed and laundered.

The Squirrel Diamond pump unit has been designed for ease of operation. The wipe-clean pump casing incorporates several touch-sensitive buttons to activate key functions and is equipped with visual and audible alarm facilities. As with all NHS-approved dynamic air mattresses, the Squirrel Diamond is equipped with an easily identified and operated CPR facility. Activation of this valve permits rapid cell deflation enabling successful cardio-pulmonary resuscitation. This valve is situated on the air hose umbilicus to permit easy access in case of emergency, but far enough away from the mattress itself to prevent it being covered or accidentally entangled in the bed linen or bedframe mechanism, which could result in unscheduled mattress deflation.

Indications

The Squirrel Diamond mattress is designed as a flexible, easy-to-use product to meet the needs of patients at high risk of developing pressure ulcers and for the therapy of all grades of pressure damage. The product is of particular benefit where clinical needs require the use of bedrails and its low profile ensures the safe operation of standard bedrail units.

Where ease of mattress ingress and exit are important, such as during rehabilitation, the Squirrel Diamond offers a safe, firm base for mobilisation and rehabilitation. However, this does not affect the product's effectiveness in terms of pressure relief or comfort. Indeed, the smaller air-cell size reduces the amount of tissue distortion experienced during the inflation/deflation cycle. This makes the mattress ideally suited to situations where patient discomfort (from joint disorders, such as rheumatoid arthritis, and neuro-muscular conditions, such as multiple sclerosis) is adversely affecting their patient experience.

In addition, the relative reduction in gross body movement reduces the risk of mattress-initiated motion sickness and sleep disturbance.

Although the features listed here pertain to the standard Squirrel Diamond mattress, bespoke variants are available on request from the company, including extended mattresses and double bed options.

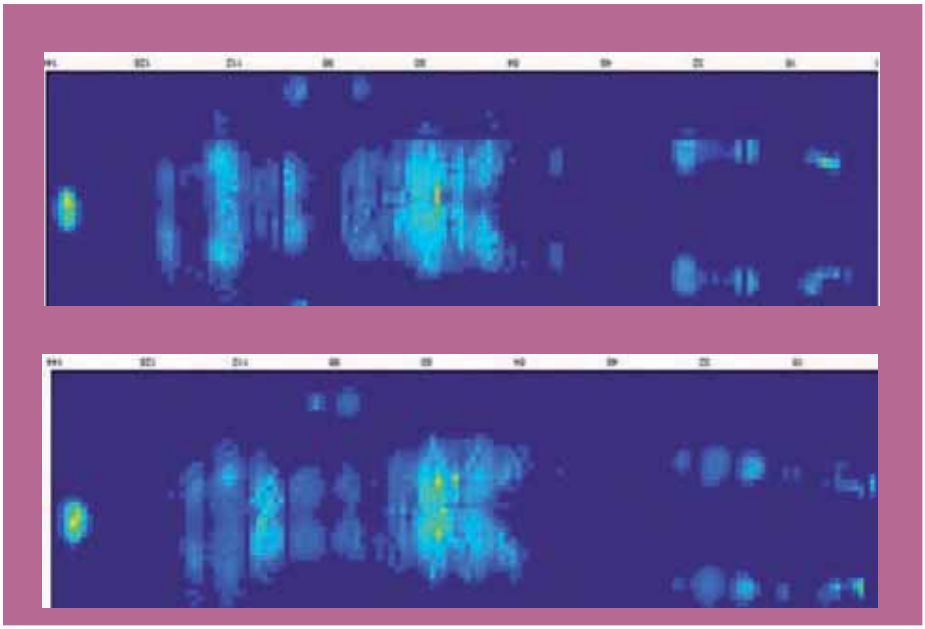

Figure 3. ***Image above shows pressure mapping on a conventional 25cm dynamic replacement mattress, while image below shows pressure mapping on the 12.5cm deep Squirrel Diamond mattress.***

Case study: mattress trial at Peninsula Care Homes

The Peninsula Care Homes in the south west of England began an extended clinical evaluation of the Squirrel Diamond Mattress to assess the product's suitability for use in their five residential care homes. The company wished to develop a strategic approach to dynamic mattress replacement throughout their

care environments, which would ensure the company's compliance with the pending safety standards BSen1970/BSen60601-2-52. The management wanted to ensure patient safety, prevent falls from beds and improve infection control procedures, as well as prevent the development of pressure damage in their vulnerable, high-risk clients.

The evaluation ran until March 2012, and included the experiences and feedback of 107 patients. Consideration was given to the product's ease of use, patient comfort and effectiveness at preventing pressure damage and managing those individuals transferred to the care homes with pre-existing tissue damage. The experiences of one care environment typified what was found.

Mr J was a resident in one of Peninsula Care Homes facilities. He was 76-year-old man and weighed 72kg. He had a history of diabetes and cardiovascular disease, was totally immobile, and had previously had several episodes of grade 1 and 2 pressure ulcer formation (EPUAP, 2009). He was, therefore, considered at high risk of further pressure ulcer formation. Prior to using the Squirrel Diamond, Mr J had been nursed on a leading manufacturers pressure-relieving device on a Volker 2080 nursing bed frame.

Mr J did, however, have the tendency to slide to the right hand side of the bed, while the backrest was in the raised position and carers would sometimes find his upper body resting against the protective padding of the bed rails. This caused him general discomfort.

During the evaluation, Mr J retained his existing Volker 2080 bed base and the mattress was replaced with a Squirrel Diamond mattress unit. His skin was assessed on a weekly basis during the following eight-week period. At no time did his skin show any signs of marking or pressure-related damage. While Mr J would still tend to lean to the right side of the bed, his carers found that he rarely made contact with the protective padding on the bed rails. Both Mr J and his carers expressed satisfaction in terms of the comfort afforded by the mattress.

The care home management extended evaluations trails to a further three patients. The successful outcome of these evaluations led to them procuring a Squirrel Diamond mattress and Volker 3080 nursing bed for each of the 40 residents within the care home.

Since the evaluation, a further 60 patients have been placed upon the Squirrel Diamond systems. These patients were identified as being at a high to very high risk of developing pressure damage.
The care team routinely undertake a comprehensive assessment of pressure ulcer risk and skin condition including photography of all residents' skin and wounds upon admission. This process revealed that a further seven patients were found to have pressure ulcers present on admission. One patient had a grade 4 pressure ulcer (EPUAP, 2009) on the heels, two had grade 3 pressure ulcers (EPUAP, 2009) on the sacrum, one had a grade 2 pressure ulcer (EPUAP, 2009) on the heels, two had grade 1 pressure ulcers (EPUAP, 2009) on sacrum and heels, and one had a grade 1 ulcer on the sacrum (EPUAP, 2009).

The provision of good holistic care, including attention to nutrition, hydration, hygiene and medication, along with the provision of appropriate pressure relief and the use of the Squirrel Diamond resulted in the complete closure of all existing pressure ulceration and the prevention of further tissue damage. Of the 107 patients that have experienced care on the Squirrel Diamond mattress systems within Peninsular Care, none are reported to have experienced a bed fall. The clinicians involved with the delivery and administration of care believe that the stability of the support surface offered by the Squirrel Diamond is an integral factor in the success of their falls prevention strategy.

The matron and clinical manager at the largest of the homes stated that they have been very satisfied with the performance of the Squirrel Diamond in regards to pressure ulcer prevention and regarded it as 'at least equal to any full replacement dynamics that have been used in the past 20 years'.

Squirrel Diamond in the NHS

The Squirrel Diamond is available to NHS care providers via NHS Supplies (NHS code DIA001). Following an evaluation period, the New Forest Hospital (then part of Hampshire Primary Care Trust) took delivery of 20 Squirrel Diamond pressure-reliving mattresses as a means of improving physiotherapy and patient rehabilitation, while also reducing the risk of pressure damage.

The mattresses were also selected as a means to help to reduce the chances of bed falls. The clinicians found that the mattresses fit the existing bed frames well, even better than the traditional deep-cell mattresses. They also felt that 'the modern design of these mattresses prevent the 'pinching effect' underneath patients, which can cause pressure ulcers to those in a seated position for long periods of time.

Also, as the mattresses are only five inches high, patients are able to get in and out of bed more easily and

those with mobility problems will be able to move more freely, especially from a lying to sitting position.

The Diamond mattress, one of two mattress designs supplied to the hospital, was reported to 'have made physiotherapy sessions far easier as the firmness in the mattress allows patients to be treated more effectively; the physiotherapists can move the patient around easier and provide patients with more support. The new mattresses also have the same feel of a high-quality foam mattress, so patients will find the experience far more comfortable.'

'The trial gave us an opportunity to compare different products from various companies. We included both therapy and nursing staff in the trial and the decision-making process for choosing what they felt was the most suitable mattresses for our patients.'

Toni Scammell, Modern Matron at Lymington New Forest Hospital reported: 'Pressure ulcers are a huge discomfort for patients, therefore, we will do anything we can to avoid or relieve them. The added benefits [provided by the Squirrel Diamond] made them the obvious choice. These mattresses are a worthwhile investment to make sure patients get the care they deserve.'

Other care providers that have switched to the Squirrel Diamond dynamic hybrid mattresses include:

- Sue Ryder Care
- The Royal Naval Benevolent Trust
- North London Hospice
- NHS Hampshire
- The Royal Hospital, Chelsea
- The British Home.

Conclusion

The Squirrel Diamond has been developed to complement the existing range of Squirrel medical therapy products by providing a high-specification device designed with both patients and carers in mind. The product offers an effective method of relieving the causes of pressure-induced tissue damage while providing a safe and comfortable support surface, which enables care teams to meet the statutory safety obligations.

As with all products, it is essential to build-up a portfolio of evidence to support its use in the clinical environment. This is an ongoing process to which the manufacturer is committed. However, the positive experiences of many care providers indicate the product's success. WE

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