Medical device protection made easy

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Introduction

The COVID-19 pandemic has increased focus on the consequences of pressure and skin damage, through patients being in bed or immobile for extended periods of time, particularly when nursed in the prone position, or through use of medical devices such as face masks. In protecting patients from ARDS (acute respiratory distress syndrome) and VAP (ventilator-associated pneumonia), there is increased risk of medical device use causing pressure damage (also referred to as pressure ulcers [PUs] or pressure injury [PI]) and leading to potential chronic wounds, particularly in intensive care patients and those suffering from additional complications.

The majority of literature around the prevention of pressure damage focuses on PUs occurring over bony prominences, typically on the sacrum and heels. However, there is less guidance around the problem of pressure damage related to the use of medical devices, which is becoming increasingly prevalent. There is a need for clinicians to recognise the risk and take steps to prevent skin damage, and to be informed about the correct placement and fixation of devices. There has also been a focus on the importance of skin protection for staff using personal protective equipment (PPE).

Overview of pressure and skin damage

In general, PUs can affect patients in every healthcare setting and are seen in all age groups (Wilson, 2012). They are caused by a combination of intrinsic factors (extreme age, limited mobility, comorbidities, malnutrition, dehydration and a previous history of pressure damage), and extrinsic factors (environment, medical equipment being used). Pressure damage can occur at any point where the tissues are subjected to pressure, shearing or frictional forces; this may be high pressure over a short period of time or low pressure applied continually over a long period of time (Fletcher, 2012).

PUs can occur as a result of immobilisation or being bed-bound for extended periods of time (Lindgren et al, 2004). A patient's risk of developing pressure damage can be increased by comorbidities or general poor health (including skin health); prolonged chronic disease and overall frailty can contribute to reduced mobility, and potential weight loss, which in turn can lead to increased risk of pressure damage (Jaul et al, 2018). The most significant risk factors include immobility and reduced perfusion, which are also the features of critically ill COVID-19 patients (Tang et al, 2020).

However, the vast majority of PUs are avoidable, meaning prevention is the main priority, although this still presents a significant challenge in clinical practice (Edsberg et al, 2014; Mervis and Phillips, 2019).

Medical device-related pressure damage

Medical devices, including ventilation masks, are made of rigid materials such as plastic, rubber or silicone, which can cause rubbing and create pressure on the soft tissues (Jaul, 2010). Adhesive tapes used to secure the device may also irritate susceptible skin, especially if oedema then develops around the device (Black et al, 2010).

In a systematic review conducted by Barakat-Johnson et al (2019), they calculated that medical device-related PU incidence rate in ICUs accounts for 0.9-41.2% of PUs, and prevalence rates range from 1.4–121%. A further study by Barakat-Johnson et al (2017) showed a link between the development of medical device-related PUs caused from respiratory equipment (68%) and, of this, BIPAP masks and CPAP masks accounted for 20% of that number.

According to Gefen et al, (2020), the actual cost of medical device-related PUs is difficult to estimate as there are no published costings on them. However, most medical device-related PUs are indeed PUs, and it is reasonable to expect they are costly due to litigation and lawsuits.

Risk factors

There may be a number of predisposing factors relating to comorbidities, mobility, malnutrition or altered levels of consciousness or sensation. Paediatric patients in particular may be at risk of tissue damage, due to their inability to sense devices (Schlüer et al, 2009).

It is also noted that, in addition to these risk factors, patients on mechanical ventilation may be difficult to turn according to usual protocol (Tang et al, 2020). Patients with COVID-19 admitted to intensive care for mechanical ventilation have

been found to benefit from lying in the prone position (face down), particularly patients in the intensive care unit (ICU) with ARDS, to improve their lung mechanics and gas exchange; however, prolonged periods in this position puts them more at risk of pressure damage.

Several studies have shown that patients nursed in the prone position are at a much higher risk of PU development (43–57%), greater than the risk of any other complication related to proning (Sud et al, 2014; Girard et al, 2014). Studies have also noted that patients in the prone position are more at risk of developing facial PUs (Gattinoni et al, 2019).

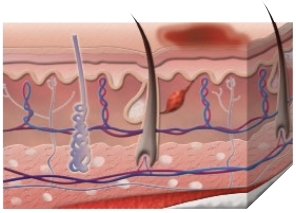
It been estimated that the COVID-19 pandemic has led to an increased incidence of severe facial PUs (Perrillat et al, 2020). Over time, facial PUs can be responsible for scarring, hyperpigmentation or keloid scars, and may require additional procedures; their long-term consequences need to be evaluated (Perrillat et al, 2020).

Pressure ulcer classification

It is important to use a pressure ulcer grading tool to measure the severity of the injury objectively. The European Pressure Ulcer Advisory Panel, National Pressure Injury Advisory Panel and Pan Pacific Pressure Injury Alliance (2019) recommend the use of a basic classification system comprising four categories or stages based on the severity of tissue damage (see Figure 1)

A review (pre-COVID) found that tissue damage related to medical devices was primarily graded as a category 3, 4 or unstageable pressure ulcer, with 74% of lesions not identified until they had become more advanced (Apold and Rydrych, 2012). Conversely, pressure damage to the mucosal area from a medical device – i.e. oral endotracheal tube – cannot be graded per PU classification systems, despite pressure being a main factor (Moore et al, 2020). A detailed prospective study by Black et al (2010) found that the majority of device-related PUs (35%) were category 1, with 32% being category 2, 3% category 3 and 24% unstageable. However, it must be noted that in the head and neck region, for example, the bridge of the nose or on the ears, there is very little tissue and therefore it is more likely that full thickness damage can occur; in these areas, the body's natural ability to redistribute pressure is also impeded. It should also be noted that these studies were conducted pre-COVID. Data regarding pressure damage in patients since the pandemic is currently more anecdotal but this is an area of significant focus.

INTACT skin



Category 1. Non-blanchable redness of intact skin usually over a bony prominence. Discoloration of the skin, warmth, oedema, hardness or pain compared to adjacent tissue may also be present. Darkly pigmented skin may not have visible blanching. May include pain/itching.

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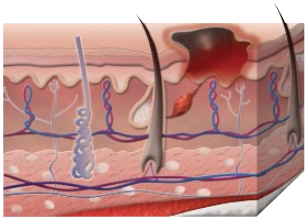
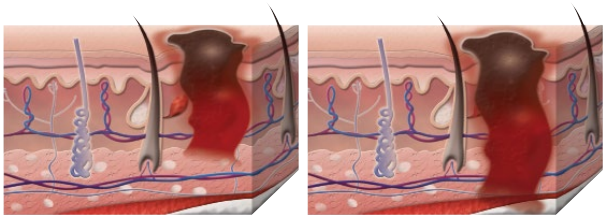


Category 2. Partial thickness skin loss or blister. Presents as a shiny or dry shallow ulcer without slough or bruising (bruising would indicate deep tissue injury). Check for moisture lesion.

DEEP



Category 3. Full-thickness tissue loss. Subcutaneous fat may be visible but bone, tendon or muscle are not exposed. Slough may be present but does not obscure the depth of tissue loss. May include undermining and tunnelling.

Category 4. Full-thickness tissue loss with bone, tendon or muscle visible. Slough or eschar may be present. Often includes undermining and tunnelling.

Note: The depth of a Category 3 or 4 pressure ulcer varies by anatomical location. The bridge of the nose, ear, head and ankle do not have (adipose) subcutaneous tissue and pressure ulcers can be shallow. In contrast, areas of significant adiposity can develop extremely deep pressure ulcers.

Figure 1: Pressure ulcer classification

Medical devices

Medical devices found to be strongly associated with potential pressure damage (although not an exhaustive list), may include:

- Continuous positive airway pressure (CPAP) masks
- Bilevel positive airway pressure (BIPAP) masks
- Endotracheal tubes and tube fixators
- Nasogastric tubes
- Oxygen saturation probes
- Temperature probes
- Electrocardiography (ECG) electrodes
- Arterial lines
- Other intravenous cannulas
- Blood pressure cuffs
- Urinary catheters
- Faecal containment devices
- Identity bands (Gefen, 2020; Gefen and Ousey, 2020).

Crucially, the prevention of device-related pressure damage can be much more complex than preventing pressure ulcers over the usual anatomical sites, because the device causing the damage often forms an essential part of the patient's treatment – for example, the use of a facemask in delivering non-invasive ventilation (Fletcher, 2012).

Medical device protection

Protection of the skin from medical device-related pressure should focus as much as possible on basic prevention strategies. Preventative care should include thorough and regular assessment of the skin underneath and around devices; vulnerable patients with, or at risk of, oedema should be identified as well as patients with sensory deficits and other comorbidities (Black, 2010).

Care should be taken to position and use all devices correctly and follow the manufacturer's recommendations. If it is identified that the device is still likely to cause damage, consideration should be given to the use of protective dressings or skin protection barrier products to reduce the risk of damage wherever possible.

As COVID-19 is highly contagious, especially among medical staff, hygiene is of particular importance in terms of wounds and PU risk (Tang, 2020). Continence may also be an issue in bedbound patients; additionally, diarrhoea is one of the common (2–49.5%) symptoms of COVID-19 (Tian et al, 2020) and, incidentally, could also contribute to the occurrence of sacral PUs in ICU patients (Keller et al, 2002). There has also been some indication that the faeces of COVID-19 patients are potentially infectious (Tang et al, 2020). Hygiene products and skin protection products should be used wherever necessary.

Preventing pressure damage under masks and PPE: guidance for staff (adapted from Black, 2020)

- All masks and PPE must be worn correctly; wash your hands after removing used PPE
- Be fitted for an N95/FFP2 mask prior to patient care and confirm the seal during periods of long wear time; confirming the seal of the mask by blowing out through the mouth and checking for air leaks will help you determine that the mask is still properly fitting
- Preventing spread of infection is the major function of the N95/FFP2 mask and cannot be compromised; the tight fit of masks is intentional
- If a prophylactic dressing is needed, use only thin dressings
- Keep your facial skin clean and moisturised; cleanse the skin with a pH-balanced product and moisturise the skin with a facial moisturiser
- Prep your skin with skin sealants or protectants prior to mask wear; skin sealants or cyanoacrylate can be used (be careful not to get the material near the eyes or mucous membranes). Petrolatum or mineral oil should not be used
- Release pressure from the face by lifting the mask off the face for 15 minutes every 2 hours; this process should be done outside of patient care areas in order to avoid risk for exposure. If that timeframe is not practical, lift the mask by its sides from the face for 5 minutes every 2 hours. If that timeframe is not feasible, lift the mask whenever you can
- Assume facial prophylactic dressings are contaminated and exercise caution with
- removal: Close your eyes and hold your breath in exhalation during dressing removal to avoid transmission of aerosolised COVID-19. Follow infection control practices at the hospital on how to properly dispose of or disinfect the mask
- If facial injury occurs, treat it with a topical moisturiser, a skin sealant, a thin dressing or cyanoacrylate; deep tissue injury or full-thickness pressure injury occurring on the face should be referred for professional wound care

Medical devices and dressing use

Application of prophylactic dressings under medical devices has been recommended, to reduce the risk of pressure

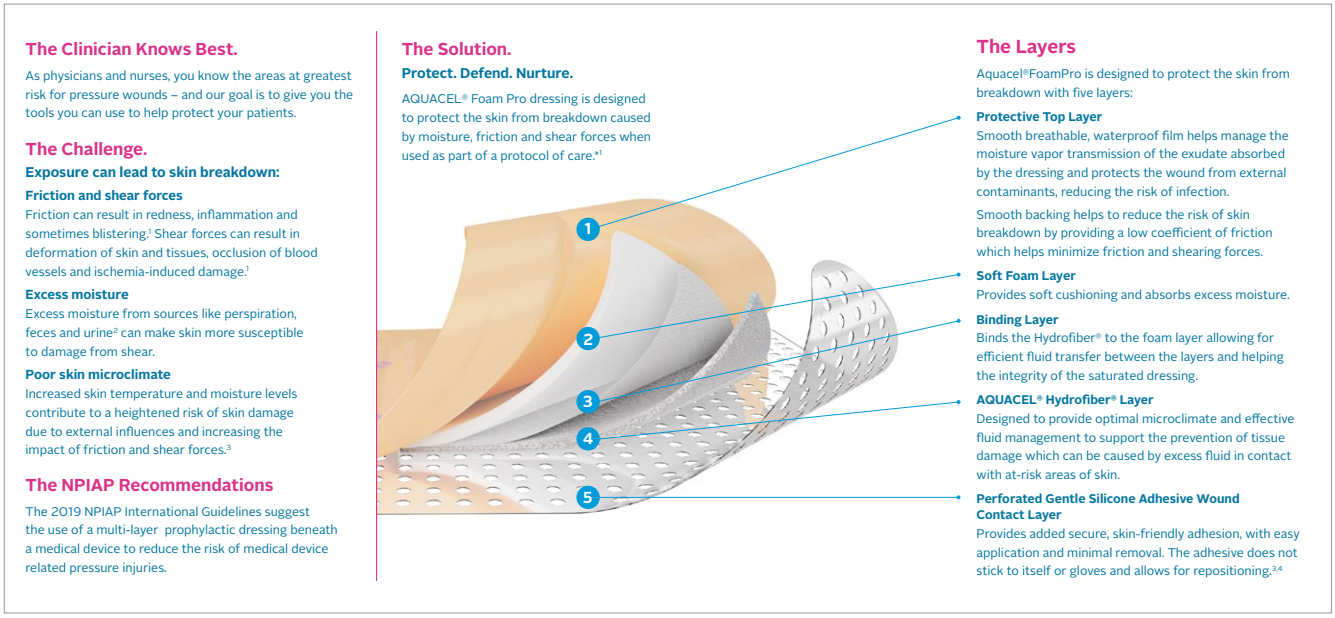


Figure 2: Dressing properties for use with medical devices

damage, as they have been shown to alleviate the sustained pressure in the tissues that is caused by prolonged contact of devices with the skin (Gefen et al, 2020). General advice is to consider applying dressings that demonstrate pressure redistribution and absorb moisture from body areas in contact with medical devices, tubing and fixators (Black et al, 2015).

There is good evidence that thin dressings (such as thin hydrocolloids and thin foams) reduce injury from oxygen delivery masks when used in patients (Black, 2020). The European Pressure Ulcer Advisory Panel, National Pressure Injury Advisory Panel and Pan Pacific Pressure Injury Alliance guidelines advise that thin, multi-layer prophylactic dressings should be used underneath medical devices to reduce the risk of device-related pressure damage (EPUAP, NPIAP, PPIA, 2019).

A timely recent study (Peko et al, 2020) on use of multi-layer prophylactic dressings on the forehead and chin found that the dressings 'remarkably' alleviated the facial soft tissue loads at these sites when the head is prone, by more than 50% (at both sites) compared to cases where no dressings were used. This study provided 'solid biomechanical evidence' to support the practice of nurses in applying multi-layer dressings to protect the face of patients undergoing prone surgeries or ICU treatments. It was noted that this work was now particularly relevant, due to the exponential

Tips for PU prevention and dressing use in practice

- **Skin assessment**
  - On admission to unit/ward, assess pre-turning and post-turning.
  - Pre/post proning, on discharge to wards.
  - Key areas to monitor: bony prominences, coccyx, hips, ischial tuberosities, heels. If proning, face, thorax, chest, shoulders, knees.
- **Skin care and treatment**
  - Keep skin clean and dry.
  - Prevent maceration and dryness.
  - Use pH-neutral skin cleansers (pH 4–7).
  - Protect skin with barriers.
  - Minimise incontinence pad usage on beds.
- **Prevention and management**
  - Use prophylactic dressings on bony prominences and under medical devices to prevent pressure damage.
  - Assess frequently for pressure damage and reposition/offload medical device if medically possible (EPUAP, NPIAP, PPIA, 2019).
- **Document findings**

For more information on dressing selection, see: https://www.convatec.com/

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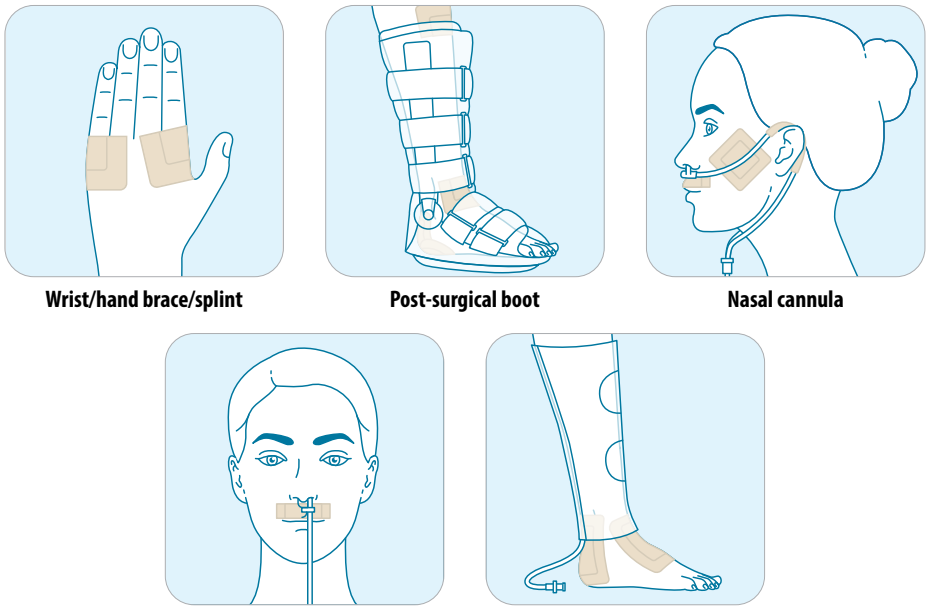
Figure 3: Tips for dressing use



rise in the numbers of mechanically ventilated ARDS COVID-19 patients added to the global healthcare system with the current pandemic.

Dressings should be cut to size to provide localised cushioning. Dressing materials should also be able to remove trapped heat away from the skin surface to reduce perspiration and the associated risk of skin irritation and maceration (Schwartz and Gefen, 2020; Amrani et al, 2020).

In patients spending long periods in the prone position, it is recommended that an occlusive dressing should be applied on each eyelid and checked after prone positioning, to protect the eyes in case of incomplete eyelid closure (Perrillat et al, 2020).

Qualities of the ideal dressing for prevention of medical

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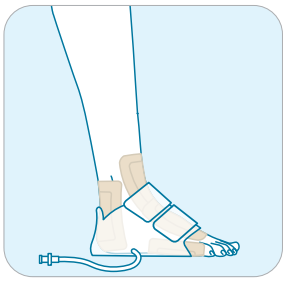
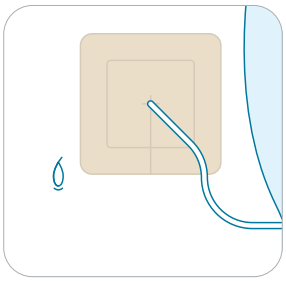
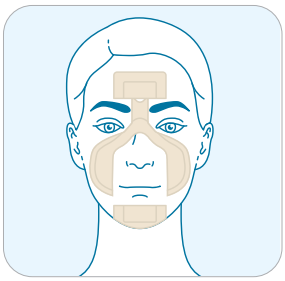


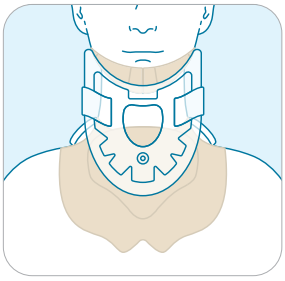
Foot pump



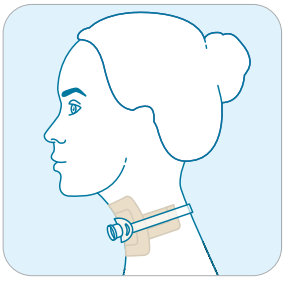
Lines/drains (gastric tubes, feeding tubes)



Non-invasive postive pressure ventilation (NIPPV)/CPAP mask



Cervical collars



Tracheostomy flange and ties

device-related pressure damage:

- Thin, so the dressing can be placed between the device and the skin without causing additional issues
- Able to stay in place
- Comfortable
- Breathable, to optimise microclimate
- Able to be cut to size where necessary.

As well as providing cushioning and physical protection, microclimate is a key issue to be considered around dressing usage. The ideal dressing should be breathable, to control moisture vapour transmission (MVT) and manage fluids, thus avoiding maceration or further damage to the skin. See Figure 2 for more information on the ideal dressing properties for use under medical devices and Figure 3 for how these can be used.

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