

Avoiding pressure damage when using ventilators

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Noninvasive positive pressure ventilators (NIPPV) require the use of nasal or facial masks. Due to the need for these masks to tightly adhere to prevent air leaks, they can cause facial pressure ulcers. The author developed an innovative method to reduce the incidence of ulcers by replacing the hydrocolloid dressings that were used as a barrier between the tube and facial skin, with a modified silicone soft foam dressing.

INTRODUCTION

Noninvasive positive pressure ventilators (NIPPVs) provide improved gaseous exchange without the need for artificial airways such as intratracheal intubation or tracheotomy. NIPPVs reduce the risk of respiratory tract infection and the production of excessive secretions. Nevertheless, long-term use can affect patient comfort and even lead to complications such as gastric distention, pressure necrosis of the facial skin and accidental removal of and leakage from nasal or facial masks.

PRESSURE DAMAGE

Pressure ulcers are caused by excessive long-term pressure on the skin and resultant tissue ischaemia, necrosis and ulceration. The European Pressure Ulcer Advisory Panel [EPUAP][1] defines pressure ulcers as damage to the integument or underlying structures due to pressure, friction or shear. Besides occurring over bony prominences, pressure ulcers can develop at any skin sites that are being directly oppressed by auxiliary tubes.

Pressure is the main cause of these ulcers and is associated with a number of complex interrelated extrinsic factors such as shear, friction and moisture[2].

PATIENT INJURY DUE TO TUBE OPPRESSION

Patients with NIPPVs wear a nasal or facial mask to replace the artificial airway. During ventilation, these masks must fit the face tightly in order to prevent leaks and poor supply. However, prolonged use of these masks can lead to discomfort and even the development of pressure damage on the patient's face.

According to an unpublished 2006 care quality study into acute facial pressure ulcers performed in the authors' medical centre, these ulcers were caused primarily by pressure exerted via fixation devices (53%) and occur mostly in patients undergoing NIPPV using face masks (22%). Further analysis indicated that 47 out of 797 patients (who had NIPPV devices applied via masks) had a facial pressure ulcer (an incidence rate of 5.90%) (Table 1). The cheeks were the most common site of pressure (59%) followed by the bridge of the nose (22%). Most of the wounds were classified as stage 1 ulcers (59%), with two wounds being classified as stage 3 ulcers (Table 2) (according to the National Pressure Ulcer Advisory Panel's [NPUAP] pressure ulcer staging system)[3].

ITEM	MONTH										TOTAL
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	
Number of NIPPV users	89	80	85	73	87	78	79	73	74	79	797
Number of cases of pressure ulcers	5	2	4	6	2	3	5	9	6	5	47
Incidence rate (%)	5.61	2.50	4.71	8.21	2.30	3.85	6.33	12.33	8.11	6.33	5.90

Table 1 – Incidence rates of pressure ulcers in patients on NIPPV using face masks between January and October, 2006.

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SITE	DEGREE OF PRESSURE DAMAGE		
	I	II	III
Forehead	5	4	0
Bridge of nose	13	6	0
Cheeks	29	20	2
Chin	0	3	0
Ears	4	0	0
Total	51	33	2
Percentage (%)	59	38	2

Table 2 – Sites and degrees of facial pressure ulcers in patients on NIPPV using face masks before use of the modified dressings.

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PRESSURE RELIEF USING DRESSINGS

When treating pressure ulcers, patients' skin integrity should be assessed regularly and the skin should be kept clean and moisturised to enhance the tissue's tolerance to pressure and injury[4]. Moreover, dressings may be used to protect against the development of pressure damage. Weng *et al* investigated the protective effect of dressings in 60 patients receiving non-invasive ventilation[5]. The patients were assigned to either the study group or the control group. Patients in the study group had prophylactic hydrocolloid dressings applied to their faces whereas those in the control group were not protected. The results indicate that the incidence of pressure ulcer development was lower in patients who used hydrocolloid dressings compared to those who did not.

According to another survey of premature infants receiving positive pressure ventilation via nasal masks[6] hydrocolloid dressings were used as skin barriers and fixation devices. However, in the authors' experience, removal of the hydrocolloid dressings sometimes caused skin peeling and pain and left sticky, difficult-to-remove remnants of hydrocolloid dressing attached to the face. Some patients also developed pressure ulceration and skin tears on the bridge of the nose and on the skin around the nose. These injuries were caused by an increase in pressure as the face mask rested on the nose, friction caused by excessive patient movement and inconsistencies in the frequency of clinical

skin assessments.

In the authors' unit, silicone soft foam dressings were introduced as an alternative to hydrocolloids in order to protect the skin. These were chosen because of the following qualities[7]:

- Ease of application and removal
- They provide reliable adhesion without skin stripping on removal, thereby minimising pain and discomfort to patients during dressing changes.

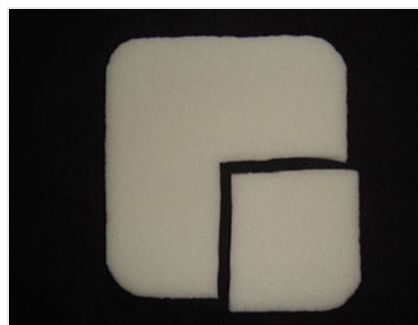
Silicone soft foam dressings are now used routinely and as a result the incidence of pressure ulcers has decreased from 5.90% to 0.90% in the authors' unit.

The authors determined that in order to use silicone soft foam dressings with NIPPVs the clinician requires a piece of soft silicone foam dressing large enough to cover the skin area and a pair of scissors. [Fig 1]. The best method of preparation is as follows:

- Visually divide the soft silicone gel foam dressing into four quadrants
- Cut out and put aside the lower right quadrant (do not discard this, as it will be used to protect the forehead) [Fig 2]
- Make two semi-circular cuts based on the size and position of the patient's eyes [Fig 3]
- Place the soft silicone dressing onto the area that will come in contact with the ventilator equipment [Figs 4 and 5].



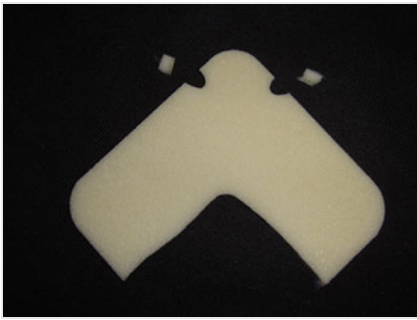
Figure 1 - The procedure requires a piece of soft silicone foam dressing and a pair of scissors.



Figures 2 and 3 - The dressing can be shaped after two cuts and the eye holes have been removed.

Figure 4 - Place the dressing on the area underneath the ventilator equipment.

Figure 5 - The ventilator equipment rests on the dressing, rather than the skin.



The procedure has the following benefits:

- Reduces the incidence of facial pressure ulcers during NIPPV
- Reduces the pain and discomfort associated with pressure ulcers
- Reduces the incidence of infection and complications such as local abscess, septicaemia and osteomyelitis



- Reduces the sense of oppression and increases the level of comfort during NIPPV
- Ensures the surface of dressing in contact with the skin is comprised of low viscosity silicone, which is painless to remove.

The procedure can be used by carers for the following reasons:

- The dressing preparation procedure is simple and does not require extensive clinical background or training
- Even older patients or elderly carers can prepare the dressings on their own.

The procedure also has benefits for clinicians:

- The new dressing system can be prepared in only two steps and is less time-consuming than using hydrocolloid dressings as minimal practical skills are needed to shape and apply it
- Soft silicone foam dressings are cheaper than traditional hydrocolloid dressings



- One piece of soft silicone foam dressing can be used for approximately 5-7 days, making it a cost-effective option
- The position of the soft silicone foam dressing follows the natural contours of the face, preventing sliding. In addition, there is no sticky residue after the dressing has been removed.

CONCLUSION

In this article, the authors have provided an innovative, cost-effective and safe approach to the reduction of NIPPV-related facial pressure ulcers. The modified silicone soft foam dressings not only help to prevent pressure ulceration, but also reduce the side effects associated with hydrocolloid dressings.

Author details

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- *Silicone soft foam dressings reduced the incidence of facial pressure ulcers during NIPPV, reduced the incidence of infection and ensured the dressing in contact with the skin was comprised of low viscosity silicone, which is painless to remove*