PROBLEM-SOLVING:
PREVENTING PRESSURE DAMAGE

Compression bandaging is widely used in the treatment of venous leg ulcers and chronic oedema. However, some patients experience pressure damage as a result of poor bandaging practice. It is important therefore that the clinician can recognise both the patient at-risk of pressure damage, and the signs that indicate it is happening. Finally, the practitioner must be knowledgeable of effective strategies to prevent damage occurring.

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Correct assessment and appropriate application of compression bandaging can eliminate the risk of pressure damage. Currently, many patients experience bandage trauma due to poor practice. To eliminate this problem, it is important to understand which patients are most at risk and to use effective strategies to prevent such damage occurring.

When does pressure damage occur?

- **Peripheral arterial occlusive disease:** if the perfusion to the limb is reduced and the ankle systolic reading from the pedal pulses is below 80 mmHg, the patient is at increased risk of pressure damage, particularly if high compression elastic bandages (35–40 mmHg) are applied. The localised areas of pressure over bony prominences, even with padding applied, may be as high as the peripheral perfusion pressure to the tissues. This causes a lack of blood supply to the tissues and rapid tissue breakdown. *Figure 1* shows pressure damage occurring in a patient with severe peripheral vascular disease (PVD), who received high compression leading to extensive tissue loss within a period of hours.
- **Thin limbs with bony prominence:** thin limbs with a small ankle and calf circumference, and exposed bony or tendonous areas can rapidly develop pressure damage, even when there is no evidence of peripheral arterial occlusive disease *(Figure 2)*. Localised pressure over these areas may exceed 100 mmHg leading to tissue damage.
- **Overtight or uneven bandaging:** poor bandage technique is the commonest cause of tissue damage. When using elastic bandages, particularly single-layer high compression bandages, any increase in the tension of the bandage through extending

Figure 1: Pressure damage in an ischaemic limb.

Figure 2. Thin limb with pressure damage.

its length results in a steep rise in pressure. Ridges of oedema and pressure damage are an indication that this is occurring, and the patient may report general discomfort with the bandage. Particular areas where tight bandaging occurs are the ankle and dorsum of the foot and mid- and high-calf. *Figure 3* shows an example of pressure damage and ridge formation due to poor bandaging technique.

- **Steroid therapy:** systemic conditions that require steroid therapy place certain patients at high risk of pressure damage. These include rheumatoid arthritis, systemic lupus erythematosis and other autoimmune diseases. Many of these conditions involve inflammatory changes in the microcirculation that respond poorly to the application of pressure, causing pressure necrosis even with low levels of compression *(Figure 4)*.
- **Systemic conditions:** such as rheumatoid arthritis are also associated with pressure damage, due to poor mobility causing limb trauma, limb distortion, increased risk of infection and thin, vulnerable skin following long-term steroid therapy.
- **Conditions associated with neuropathy or reduced pain sensation:** a number of conditions are associated with neuropathy including diabetes mellitus. Patients with spina bifida frequently develop dependent oedema and lymphoedema. Any patient who has reduced sensation should be cautiously treated with compression therapy and receive additional padding over vulnerable areas to reduce the level of risk. These patients must be closely monitored and the patient and carer educated on how to inspect the limb.
- **Limb and foot deformities:** foot deformities have been shown to occur in many patients with leg ulceration (Moffatt et al, 2004). Severe deformities that change the normal contours of the limb lead to new areas of pressure risk. Any alteration in the biomechanics of the foot may also lead to callus formation over the areas of sustained high pressure and friction. Callus may act as a source of pressure leading to pressure necrosis. In patients with diabetes, removal of callus has been shown to reduce plantar pressure by up to 70% (Edmonds, 2007). *Figure 5* shows a pressure ulcer occurring from bandaging in a severe foot deformity.
- **Interference with bandaging:** patients are often reported as tampering with their bandages. There may be many reasons for this, including irritation from inadequately treated varicose eczema, irritation or allergy from the external bandage, and pain from the ulcer or bandage. Patients with cognitive impairment, such as Alzheimer's disease, are a particularly high risk group who may be unable to verbalise whether pain or discomfort is occurring, or may be disturbed by the presence of a bandage on their leg. If the bandage is pushed down, it can create a tourniquet effect causing pressure damage. This can be seen when the bandage is removed.

Figure 3. Pressure damage and ridge formation.

Figure 4. Pressure damage associated with rheumatoid arthritis.

Figure 5. Pressure damage associated with a foot deformity.

- **Tourniquet effect from compression hosiery:** circular-knit compression hosiery is prone to cause a tourniquet effect by pulling into the tissues, particularly when there are deep skin folds *(Figure 6)*.
- **Deliberate self-harm:** patients with psychiatric or psychological problems may occasionally resort to using compression therapy to self-harm (Moffatt, 2000). *Figure 7* shows a patient with unilateral swelling and ulceration as a result of a high tourniquet applied at the top of the thigh — this condition has been described as Secretan's syndrome. Such situations are rare, and patients should not be faced with a diagnosis of self-harm unless psychiatric or psychological help is available. Nurses also report that some patients with chronic leg ulceration seem reluctant to allow the ulcer to heal, and appear to deliberately damage the ulcer or surrounding skin when healing is imminent. This situation has been called the 'social ulcer' (Muir Gray, 1983). It is thought to occur in a small group of patients who do not perceive a benefit in allowing the ulcer to heal, possibly due to loneliness, isolation, or a fear of loss of contact with the nurse providing care, who may be their only source of contact. Research has shown that this situation is rare, and that the way in which nurses describe their patient's level of adherence to therapy or interference with bandaging does not correlate with ulcer healing or ulcer recurrence, but reflects difficulties in the relationship between the nurse and patient (Moffatt, 2004). These patients are often emotionally draining and manipulative in their relationships with nursing staff (English and Morse, 1988).

Figure 6. Tourniquet effect caused by circular-knit hosiery.

Figure 7. Self-inflicted oedema and ulceration.

How to recognise pressure damage

Healthcare professionals should consider the following factors to help them detect pressure damage:

- Pain while wearing compression therapy is a useful guide that indicates pressure damage may be occurring. Nurses frequently fail to acknowledge this problem, resorting to blaming the patient for being non-adherent to therapy, rather than accepting their own poor practice.
- On removal of the bandage, inspect the whole limb and note any areas of erythema, bruising, blanching or blister formation, as these indicate that pressure damage is occurring *(Figures 8 and 9)*.
- Deep ulceration with loss of tendon may occur in the peripherally compromised limb.
- Patients with cognitive impairment may be unable to

Figures 8 and 9. Recognising pressure damage.

Figures 10 and 11. Pressure damage in large oedematous limbs.

report pain from bandaging. In these situations, it is important to observe body language for signs of discomfort. The patient may cry when the limb is touched, appear agitated and seek to stop anyone touching the limb or become aggressive to staff. These patients may not understand why a bandage is being applied and seek to remove it, causing further damage. Wet bandages should not be left in contact with the skin as this can cause excoriation. It is also socially unacceptable for patients.

- Pressure damage may occur in large oedematous limbs, not just in those with thin limbs. Bandaging that creates bands of high pressure in one area may result in a collection of oedema above this area and, if continued, can lead to extreme limb distortion. Signs of bruising are often seen in the indented area, as in *Figures 10 and 11*.

Figure 12. Achieving compression treatment in the dysmorphic limb with 3M™ Coban™ 2 Layer Compression System. Reproduced by kind permission of Andy Kerr, Tissue Viability Consultancy Services Ltd.

Methods to prevent pressure damage

A number of methods exist to ensure pressure damage does not occur in any patient receiving compression therapy. Below is a checklist of factors to consider when using compression therapy.

Choosing the correct padding material

A number of different types of padding material are available. Many of the newer products have been designed to be easier to apply and conform better to the shape of the limb, while others have increased exudate handling capacity. Synthetic products give better long-term protection as the loft is maintained. In addition to the more traditional orthopaedic wool-type products, a number of foams are now used as a protective layer. The new 3M™ Coban™ 2 Layer Compression

Figure 13. Examples of ways to add padding for protection.

System has a foam under layer that contours to the precise shape of the patient's limb, even where there is significant distortion of limb shape. As the under and upper layer bond together in application, it stays in position rather like a soft, flexible cast *(Figure 12)*. Soft, flexible foam on a roll is useful and has been used predominantly in lymphoedema management (Asmussen and Strossenreuther, 2003).

Changing the application of padding

For patients with 'at risk' limbs, the padding should be adapted according to the individual and their needs.

Protecting the tibial crest

Many patients have an exposed tibial crest that can easily be damaged. There are several methods of protecting this area. For example, the wool can be pleated over the area, giving four rather than two layers of protection *(Figure 13)*.

Figure 14. Strips of padding applied to the tibial crest for protection.

Alternatively, a strip of two or more layers of padding can be placed along the entire length of the limb and then the normal padding applied over the top *(Figure 14)*.

It is important that the padding extends a little beyond the top of the outer bandage, this will prevent irritation or any friction damage behind the knee.

Protecting the foot and ankle

It is important to remember that the foot has little subcutaneous tissue to protect it from pressure damage. *(Figure 15)* shows the sites at risk of pressure damage. These areas may change in the patient with a severe foot deformity.

Bunions and bunionettes should be well protected with padding, which should cover the entire area. If the padding and compression bandage are applied half-way up the bunion, there is a danger that the bandage will be pushed up the foot when the patient puts their shoes on, creating a ridge of pressure. Padding must extend to the base of the toes and not be rucked up underneath the foot, as this may cause trauma. Callus formation and toe-nail problems are a common occurrence in patients with leg ulceration, partly due to the high prevalence of foot deformities. These can lead to ulceration and secondary infection and regular attention by a podiatrist is required. Prevention and treatment of fungal infections is of paramount importance in avoiding bacterial infection.

If the padding is applied too high up the foot, this encourages the development of forefoot and toe oedema, which, having developed, can be difficult to reverse *(Figure 16)*. In patients with lymphoedema and forefoot bulge, shaped foam is applied to the area and the toes are bandaged *(Figure 17)*. In a long or large foot, an additional two layers of padding may be required around the foot before the ankle turn is applied.

The area over the dorsum of the foot frequently becomes damaged due to the danger of excess pressure. This can be avoided by applying an extra layer of padding around the ankle, or a strip of padding folded over beneath the main padding layer in a similar way to that described for the tibial crest. If there is very pronounced ankle indentation or skin folds, a folded strip of wool padding can be placed in a piece of cotton tubular bandage and laid into the fold *(Figure 18)*. In a similar way a piece of foam can be laid across

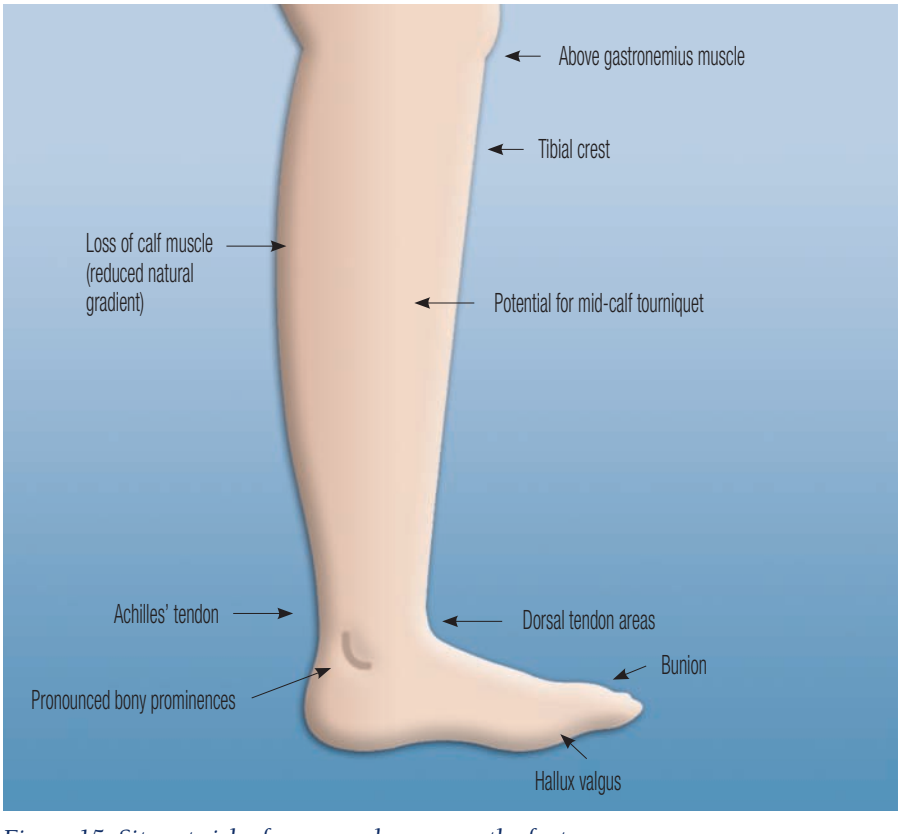

Figure 15. Sites at risk of pressure damage on the foot.

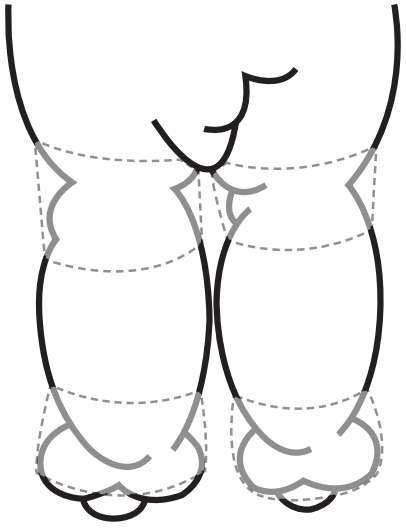

Figure 18. Wool padding placed within a tubular bandage.

this area. In patients with severe lymphoedema, more complex specialist procedures using templates of foam that cover the whole limb may be required (Földi et al, 2003).

Damage to the Achilles' tendon area is a serious complication of bandage trauma *(Figure 19)*. Sloughing of the tendon can occur, that contributes to an equinus deformity with a rigid ankle and severely reduced venous return. Healing is significantly reduced in such situations. Careful use of extra padding and avoidance of slippage of the compression layer should eliminate this problem.

It is important to check patients' shoes to ensure they fit well and do not cause the bandage to ruck. Sensible footwear such as trainers are useful as they support the foot well and can be adjusted to cope with the additional padding, but may not be acceptable to all patients. A number of mail order catalogues offer adapted shoes and slippers. These are well-designed to accommodate bandaging and are easy for the patient to apply and remove with many being washable. In rare cases of protracted ulceration with severe limb deformity, specialist custom-made shoes may be required. It is important that these are made to accommodate the compression bandage and discussion with the prosthetist or orthotist is vital to ensure the correct shoe is made.

Using dressings

It is vital that the most appropriate dressing is used for the treatment of venous ulceration. While research has not shown that one type of dressing is better than another in terms of improved ulcer healing, an inappropriate choice of dressing can delay healing through problems such as trauma to the wound and poor exudate control. Dressings also play an important role in reducing the pain associated with leg ulceration. Some dressing materials have a role in helping to prevent pressure damage in the at-risk foot.

Simple dressing pads

These dressings can be applied over a primary dressing, and will help to prevent pressure damage. They can be applied over the tibial crest, thus redistributing pressure away from the bony prominence. Dressing pads can also be cut and laid over the dorsum of the foot. Care should be taken in applying them around the ankle, as they may be too bulky with space beneath them that reduces the level of compression applied. A similar situation occurs when excessive orthopaedic wool padding is applied.

Ulceration in the post-malleolar area

Ulceration occurring in the post-malleolar area *(Figure 20)* is notoriously difficult to heal. It is thought that this is due to the fact that a negative level of compression is applied to an ulcer in this area. Ulceration is often sloughy with little evidence of granulation tissue. The solution to this problem is to increase the local pressure to this area

Figure 19. Damage to the Achilles' tendon.

Figure 20. Ulceration in the post-malleolar area is difficult to heal.

to a therapeutic level, without increasing the overall compression applied to the ankle. There are a number of ways of achieving this. Dressing pads may be cut to form a pad of pressure that fits neatly into the area and is applied over a thin, flexible, non-adherent dressing. Care must be taken to ensure that the pad does not extend over the bony prominence, as this may lead to pressure damage. Contoured, kidney-shaped foam pads are also available for this purpose, and other dressings such as foams are also useful.

Skin protection

A number of adherent dressings can be applied to localised areas of pressure risk such as the bunion, bunionette or tibial crest. Hydrocolloids are available in varying thickness and flexibility. Those with a bevelled edge are particularly useful as the smooth edge avoids skin indentation. Hydrocolloids are useful if the skin is dry, as the dressing will help to rehydrate the skin as well as adding some resilience against pressure. These types of dressings should not be used when there is significant exudate as maceration may occur leading to tissue breakdown.

Podiatry felt

Podiatry felt is commonly used to protect areas of callus from friction and pressure after debridement. This can be useful for patients with callus on the plantar surface of the foot. However, it should not be seen as a replacement for callus removal, as this is a more effective method of reducing pressure to these areas. Patients with claw or hammer toe deformities may develop calluses on the top of the toes. These may need protection to ensure that the compression bandage does not irritate these areas. Patients with severe toe swelling, recurrent fungal infections and signs of lymphoedema, such as papilloma and fibrosis, may require toe bandaging. This is discussed further in.

Conclusion

Pressure damage resulting from compression therapy can occur in at-risk patients or as a result of bad practice. It is important that the practitioner is mindful of the patients who are vulnerable to such damage when undergoing treatment with compression, and is able to recognise the signs of pressure damage occurring. Correct assessment, along with the use of padding materials when applying compression bandaging, is the most effective way of reducing the risk of damage occurring. **WE**

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Key Points

- **Correct assessment and appropriate application of compression bandaging can reduce the risk of pressure damage.**
- **Pressure damage can occur in at-risk patients and as a result of poor practice.**
- **It is important that the practitioner can identify at-risk patients, recognise the signs of pressure damage and employ effective strategies, such as the use of padding materials, to stop such damage happening.**

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