Bandaging skills for orthopaedic nurses

Christine Love

LEARNING OUTCOMES

On completion of the article the reader should be able to:

• Have an understanding of the various types and functions of bandage
• Recognize where further skill is needed
• Appreciate and apply the concepts of Laplace's Law in the application of safe bandaging
• Appreciate the dangers to skin, circulation and nerve supply
• Conduct appropriate levels of neurovascular assessment and take appropriate remedial action should any impairment be observed.

UKCC CATEGORIES

This article will enable the reader to address PREP requirements through the following UKCC categories for professional development:

• Reducing risk
• Care enhancement
• Practice development
• Education development.

Examples of how this may be achieved, and possible evidence for the reader's professional profile, are given throughout the article. Other ways to demonstrate your professional development may be through:

• Developing and implementing an educational programme to improve bandaging skills
• Conducting a systematic evaluation into the impact of bandaging on patients
• Keeping a copy of this article together with the notes you make whilst completing the reflection items in the text.

TYPES OF BANDAGES

In orthopaedic nursing, bandaging may be used as a treatment or as an adjunct to treatment. The common uses are:

• To secure a dressing, traction extensions or plaster back slab
• Light support
• Compression
• To form a rigid cast.

For bandaging to work effectively, it is essential to apply it with the correct technique. As with all aspects of nursing care, the nurse should not undertake any bandaging without the required amount of instruction and supervised practice. (Box 1.)

Recall the different circumstances in which you have applied bandages. On a scale of 1–10, 1 low skill and 10 high skill, how would you rate your bandage skills?

Box 1 Reflection item

15 min
Bandaging skills

Bandages may be:

• Rigid
• Inextensible
• Minimally extensible
• Compressive
• Tubular.

Inextensible bandages are predominantly cotton weave. In orthopaedics they are often impregnated with adhesive, usually zinc oxide. The most common use is in sports injury (Adams 1985, Austin et al. 1994).

Minimally extensible bandages are used primarily for light support (Love 1989) where the predominant material is elastocrepe. They are also used to keep dressings in place (Orford 1989), and may be used to avoid the skin damage that is known to occur from repeated applications of adhesive tape (Weber & Stone 1988).

Compressive bandages come in four grades of tensile strength: low, medium, high and extra high. They are used primarily for the treatment of chronic venous insufficiency and ulceration (Eagle 1999, Nelson 1997) and lymphoedema (Williams 1998) and are constructed of elastomere. The potential stretch is more than twice the resting length (120%) (Nelson 1997). Stockings used in prophylaxis for deep vein thrombosis have a sub bandage pressure similar to low compression bandages.

**BASIC SCIENTIFIC PRINCIPLES**

Correct bandaging involves the application of three concepts: magnitude of pressure, distribution and duration of pressure (Nelson 1997), and the application of Laplace’s Law (Thomas 1990). Failure to incorporate these into clinical practice will result in unsafe bandaging (Nelson 1995).

Magnitude of pressure refers to the amount of support the bandage gives. This is measured at the skin/bandage interface in mm Hg to define the sub-bandage pressure (Eagle 1999). Nursing staff can check sub-bandage pressure with the same device used to assess pressure sore risk and this may be necessary in some clinical situations or during training (Nelson 1995). Some occupational therapy departments may have access to the device.

The desired level of sub bandage pressure for each class of bandage is usually achieved by stretching the bandage one third of its resting length (Love 1989) and performing a 50% overlap at each turn (Nelson 1997). Nelson (1997) reports that some compression bandages have a rectangle incorporated into the material. When stretched to the correct length, the rectangle becomes a square. Using a 50% overlap and a one-third stretch, the expected sub-bandage pressure at the ankle of an extensible bandage is:

- Dressing retention, 5–8 mm Hg
- Light support 15–20 mm Hg
- Class 3a light compression 14–17 mm Hg
- Class 3b moderate compression 18–24 mm Hg
- Class 3c high compression 25–35 mm Hg
- Class 3d extra high compression. 35–60 mm Hg (Thomas 1990).

The British Standards Institute (1995) for compression hosiery governs the standard of these various types of bandage.

Distribution of pressure refers to the amount of support each area of tissue receives. A safe distribution of pressure is achieved by the application of Laplace’s Law (Eagle 1999, Nelson 1995, Nelson 1997, Thomas 1990). This ensures the pressure gradient conforms to the shape of the limb being bandaged and that the pressure gradient is highest at the ankle and lowest at the thigh with no local high spots (uniform graduated compression).

Laplace’s Law incorporates five pieces of information expressed in the formula. \( P = \frac{NxT}{WxC} \) where:

- \( P = \) sub-bandage pressure
- \( N = \) Number of layers. Each complete overlap doubles the sub-bandage pressure. The expected sub-bandage pressures are calculated according to a 50% overlap
- \( T = \) Tension. This refers to the amount the bandage is stretched. Non extensible bandages cannot be stretched. Minimally extensible bandages can be stretched to 100% of their resting length. Compression bandages can be extended to 120% of their resting length (Nelson 1997). To achieve correct tension, the bandage must be stretched a uniform one third of the resting length (Love 1989). Marking a bandage with ink at 15 cm intervals can check this. When stretched the length will be 20 cm
- \( W = \) Bandage width. Wide bandages produce lower sub-bandage pressure than narrow bandages
- \( C = \) Limb circumference. Wide limbs produce a lower sub-bandage pressure than narrow limbs.

The last component is duration of pressure. This is the length of time therapeutic sub-bandage pressure is achieved.

The aim of all bandaging is to achieve a graduated pressure gradient that conforms to the conical shape of the limb (Love 1989, Thomas 1990). Failure to achieve graduated compression will lead to venous back flow, raised intraveneous pressure, ischaemia and consequent damage to vein tissue, leakage of plasma into the interstitial spaces, disturbance of osmotic balance, venous malfunction leading to congestion and eventually circulatory impairment sufficient to cause compartment syndrome (Love 1998). Nelson (1995) found that the
most common mistake was the production of a tourniquet effect.

Graduated compression is achieved by:
• Selection of the appropriate width of bandage for the limb
• Maintaining a 50% overlap
• Maintaining a constant even tension. When winding the bandage onto the limb, the roll must be held uppermost. The only exception to this is when applying adhesive strapping from a roll. Holding the roll uppermost prevents inadvertent tightening as the bandage roll is lifted clear of the limb on each wrap around.

The length of bandage remaining at the end must never be pulled taught, as this is the most common cause of the tourniquet effect (Nelson 1995). Surplus bandage should be trimmed or folded under and the free end fastened with tape
• Bandaging duration.

The effectiveness of all bandage systems is open to doubt, as it is well known that the sub-bandeage pressure achieved on application is short-lived (Adams 1985, Bodell 1986). Bandages should not get tighter and if they do there is something wrong.

BASIC BANDAGING METHODS

Bandages are applied in three main configurations: spiral, ascending spica and diverging-spica. Another name for spica is the more descriptive ‘figure of eight’.

A diverging spica is designed to cover a joint without restricting movement. It is used to hold a dressing in place and is most useful over the heel, knee and elbow. It may also be used as part of a bandage system that extends from toe to thigh where there is a need for joints to be free to move or on its own for dressing retention. Correct, skilful application of a diverging spica requires a great deal of practice.

Diverging spica

1. If used for dressing retention, apply the wound dressing. Assistance may be required to hold it in place until the first turn of bandage is complete
2. Hold the bandage in the dominant hand with the roll uppermost
3. Take a 20 cm length into the non-dominant hand
4. Start at the opposite side to the point of the joint to be covered. Bandage one wrap covering the point of the joint
5. Direct the roll upwards and at an angle. Wrap once covering the bottom third of the bandage covering the point of the joint
6. Direct the roll downwards and at an angle. Wrap once covering the bottom third of the bandage covering the point of the joint
7. Direct the roll upwards and at an angle. Wrap once covering 50% of the turn of bandage in Step 5.
8. Direct the roll downwards and at an angle. Wrap once covering 50% of the turn of bandage in Step 6
9. Complete and secure the bandage
10. Check comfort and neurovascular status
11. Check the patient can move the joint freely.

Figure of 8

1. If used for skin traction retention, position extensions and supplementary padding as required. Assistance may be needed to hold extensions in place until the 4 wraps are complete
2. Hold the bandage in the dominant hand with the roll uppermost
3. Take a 20 cm length into the non-dominant hand
4. Start distally and at the front of the limb. This could be the palm of the hand, or palmar side of the forearm, dorsum of the foot or front of the leg
5. Direct the first wrap of bandage upwards and at an angle of 45°
6. Wrap around the back of the limb and then direct the next wrap of bandage downwards and at an angle of 45° covering 50% of the previous wrap
7. Repeat Steps 5 and 6
8. In the lower limb check that the crossover lies over the fleshy parts of tibialis anterior and the toe extensors. It must never lie over the tibial crest as this can cause pressure damage. Care must also be taken to avoid compression of the peroneal nerve where it runs around the upper part of the fibula on the lateral aspect of the lower leg
9. In the upper limb check cross over lies over the fleshy part on the radial side formed by the flexors and extensors of the radial side of the hand.

Spiral

1. If used for skin traction retention, position extensions and supplementary padding as required. Assistance may be needed to hold extensions in place until the 4 wraps are complete
2. Hold the bandage in the dominant hand with the roll uppermost
3. Take a 20 cm length into the non-dominant hand
4. Start distally and at the front of the limb. This could be the palm of the hand, or palmar side of the forearm, dorsum of the foot or front of the leg
5. Make one turn
6. Direct the second wrap of bandage upwards and at an angle of 45°
7. Repeat Step 6 covering 50% of the previous wrap at each turn until the limb is bandaged as required. (Box 2.)

**Box 2 Reflection item 2**

Read Bandaging Supplement (Love 1989). Follow the instructions and the diagrams in Figs 1–3 of the article and practice these bandage forms. Repeat practice after 2 weeks and evaluate your skill.  

30 min

**COMMON TYPES AND APPLICATIONS IN ORTHOPAEDICS**

**Tubular**

These are pre-formed into a tube, saving the need for bandage application. They are used to keep dressings in place (Orford 1989), and for light support (Love 1989). Tubular bandages come in a variety of tensile strengths, from cotton conforming that is used for dressing retention, to elastic tubular stockinette that is used for light support of injured painful or weak joints. They are one of the mainstays in the minor accident section of accident and emergency departments where their use extends from affixing a dressing to a finger to providing immediate pain relief and reassurance following non-bony musculoskeletal injury. The comfort and efficiency of the bandage depends on using the correct size and method of application. It is usual for a measuring device to be supplied with the product and this should be used. When applying cotton conforming bandage to a finger, no more than one twist of the applicator should be made at each pass (Orford 1989). With the more elasticized tubular bandages, application may be easier without an applicator. When applying it without the applicator, one third to one half of the bandage should be turned in on itself, applied to the limb and peeled on evenly. A doughnut should never be formed.

**Robert Jones compression**

The Robert Jones bandage is a special form of compression therapy used following injury and surgery of the knee. It is designed to stabilize soft tissues, control the onset of joint effusion, haemarthrosis, or oedema or aid their reduction. Its function is to alter the hydrostatic gradient of local tissues, thereby decreasing the leakage from capillaries that become more permeable as a natural consequence of injury or surgery, capillary swelling or further swelling (Bodell et al. 1986).

To be both safe and effective, it must be applied before swelling has occurred or it will cause the venous congestion it is designed to prevent. In the original design, documented by Charnely (1950), the system consisted of three alternating layers of padding and domette non-extensible bandage extending 15 cm above and below the knee, applied using spiral bandaging. However, crepe bandage is often substituted, as was the case in the evaluation of Bodell et al. (1986). An essential safety aspect is the need for the padding to extend beyond the crepe at thigh and calf level or there is a risk of a constricting band with consequent skin damage. If padding does not extend, beyond the bandage, the bandage can cut into the skin causing local pressure damage or circulatory impairment. If found, the bandage must be regarded as unsafe, removed and reapplied correctly.

The Robert Jones bandage can achieve sub-bandage pressures as high as 70 mm Hg. Initial sub-bandage pressure begins to decline soon after application and in 24 h will be around half its original value (Bodell et al. 1986). It is, therefore, most effective in the first 24–36 h, but after this time sub bandage pressures have declined to such an extent that it should be removed. At times when sub-bandages pressures are above 30 mm Hg, there is a risk of circulatory impairment. Because of the bulkiness, its use may not be practicable for small or obese people. Neurovascular observations need to be continued whilst the bandage is in place. If any impairment is noted, the bandage must be removed promptly. Symptoms should resolve on removal of the bandage. If they do not, the constriction is likely to be coming from skin or muscular tissue. The limb must be elevated to no more than heart level. If used, applications of ice must cease and the doctor informed immediately. (Love 1998b.)

**Taping**

Taping is a specific application of non-extensible light support offering support and protection to injured or weak joints and muscle tissue. Taping requires skill equal to casting and should not be attempted without specific instruction and supervised practice. The complexity of taping can be observed in Austin et al. (1994) where the versatility and variety of applications is demonstrated. Common uses of taping are to support either the medial or the lateral ligament with Gibney strapping (Adams 1985). When applying adhesive strapping from a roll, the roll is held so that it faces the direction of the adhesive. Careful limb preparation is needed, as the skin must be clean and dry. If there is abundant hair covering the area to be taped, open weave bandage can be applied as a base layer. Once the skin has warmed, the adhesive penetrates to form a good bond. The taping can, however, loosen
and dislodge until bonding has occurred. Strapping that has become loose is no longer therapeutic and should be removed.

**Rigid bandages**

Rigid bandages are constructed of plaster of Paris (POP) or a synthetic material. POP is fashioned from lenoweave – open-weave cotton, impregnated with calcium salts. For synthetic materials, the base substance is either knitted polyester cotton or glass fibre impregnated with polyurethane resin (Wytch et al. 1991). They provide protection, support and relief of pain following injury and surgery.

Tests by Wytch et al. (1991) demonstrated that synthetic casts are more advantageous where durability and weight are to be considered. However, synthetic casts shed potentially dangerous dust particles when cut, and can produce sharp edges. They do not mould as well as POP which is more advantageous in early treatment stages. Management of fractures is moving away from the use of a rigid cast for the total period in favour of materials that permit gradual return to movement (Petty & Wardman 1998). (Box 3.)

POP casts may wrap around the full circumference of the limb (a full cast) or be fashioned with slabs of plaster secured by a bandage. It is usual for swelling to occur following injury or surgery, and it is for this reason that application of any rigid or non-extensible form of bandage creates a potential risk. It can either cause local pressure on skin resulting in skin breakdown (Miles & Prior 1999), or constrict circulation leading to compartment syndrome (Love 1998b, Miles & Prior 1999). In order to prevent damage, it is essential that following fracture injury or trauma the following precautions are observed:

- Padding is applied to the whole area to receive POP
- The completed POP is split end-to-end down to the patient’s skin so that the skin is visualized
- POP instructions are given and it is known that these have been understood and the patient is in a position to implement them.

The ability of patients to understand and implement instructions has not been subjected to systematic evaluation. The advice to return immediately may, in practice, be unrealistic, and also people’s interpretation of some of the content could differ and this needs to be appreciated. It is an area where research is needed.

The uses of POP slabs are similar to a full cast, but it provides less support and is not used for a reduced-displaced fracture. The back slab may give the appearance of being less hazardous, but comparisons with a full unsplit cast showed it to be just as unsafe because the retention bandage did not allow for limb swelling (Younger et al. 1990). Younger et al. (1990) found the average swelling following Colles fracture to be 2.5 cms after 14 h. Allowance for the worst level of swelling has to be made for each patient as the level of swelling for each patient is not known until it occurs. In lower limb injury swelling will be proportionately higher according to limb circumference. It could be 5 cm at the ankle and 10 cm at the calf.

The application and removal of a plaster cast is a highly specialized technique and should be carried out only after the appropriate training in casting methods. (Box 4.)

<table>
<thead>
<tr>
<th>Box 3 Reflection item 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Read continuing education article (Prior &amp; Miles 1999) to obtain a more detailed knowledge of POP and safety precautions.</td>
</tr>
<tr>
<td>60 min</td>
</tr>
</tbody>
</table>

**Skin traction**

A common application of retention bandages is to keep skin extensions in place for traction. These are from either foam-backed cotton or non-extensible adhesive tape. Foam-backed skin extensions require daily reapplication and more frequently if they have slipped out of position. Slipping can result in a tight band of material around the ankle that can impair circulation and sensation. The skin beneath the bandage must be carefully inspected for signs of local pressure damage, skin hygiene performed and the traction reapplied. Because of the need for frequent reapplication, foam backed extensions essentially provide a temporary system where the primary aim is improved comfort through the reduction of painful muscle spasm.

A variety of methods for securing skin traction with bandaging has evolved. This has lead to a number of differing opinions on best practice. The common differences of opinion are given in Table 1. (Box 5.)

The most common use for foam backed skin extensions is following fracture of the upper femur in elderly persons prior to internal fixation. There is, however, a growing amount of anecdotal evidence that suggests its use is declining. Amongst the subjective reasons are increased incidence of confusion...
and a greater tendency to pressure damage from the restriction to movement caused. Fractures of elderly people are unlikely to produce the levels of painful muscle spasm usually associated with fracture injury because of age-related reduction of muscle bulk. Thus if pain occurs mostly on movement and can be controlled with analgesia, consideration should be given to removal of the system and application of manual traction during repositioning. However, it is important not to implement blanket withdrawal as age related decline is dependent on pre-injury activity as well as age. Since the primary purpose is pain relief and comfort promotion, there is no reason why traction cannot be applied intermittently according to the wishes of the patient.

Adhesive skin traction is used mainly in children where it is applied for fractures of the femur, using gallows traction, or to reduce hip dislocation, usually congenital, using Bryant’s traction. The main risk of traction in children is compartment syndrome from the combined effects of high elevation, low blood pressure and bandage compression. (Matsen et al. 1980). It is therefore important to be aware that tearfulness may be a symptom of ischaemia. It is essential to conduct regular observations of the toes. They should be warm and of normal skin colour. Tickling the toes to encourage spontaneous movement should not cause pain. If there is any doubt, the traction must be removed and the limbs lowered to no more than heart level.

**Securing dressings and appliances**

A common use of bandaging is to secure intravenous therapy cannulae to avoid skin damage from adhesive tape (Weber & Stone 1988) and to prevent the cannulae from being dislodged. The bandage is often wrapped around the wrist and forearm, providing the potential for circulatory constriction, especially if the forearm swells. A specific hazard occurs if the cannulae penetrates the vein, causing extravasation of fluid, or if there is phlebitis of the vein or cellulitis infection, as each is a known cause of compartment syndrome of the arm (Ouellette & Kelly 1996, Ouellette 1998). The greatest risk is to in-patients who are unable to communicate. If the fingers appear swollen and cold, the bandage must be removed and the arm placed on a supporting pillow at no more than heart level and the doctor informed immediately.

**Bandaging Requirements**

Prior to any bandaging, the nurse must carry out a general patient assessment, noting:

- The reason for the bandaging
- The patient’s understanding of the reason for the bandaging

---

**Box 5 Reflection item 5**

Read continuing education article ‘Principles of Traction’ by Davis & Barr (1999). Evaluate bandaging practices for traction in your clinical area. Evaluate the need for traction in the elderly using unrelieved pain as the criterion.

2 h

---

**Table 1 Differences of opinion in applying skin traction**

<table>
<thead>
<tr>
<th>Difference of opinion</th>
<th>Arguments for</th>
<th>Arguments against</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inclusion of the foot</td>
<td>Gives graduated pressure profile, preventing the tourniquet effect. Keeps the foot warm. Helps protect the heel from friction sores.</td>
<td>Not able to inspect the heel for pressure relief. Can be hot.</td>
</tr>
<tr>
<td>Extension of the bandage above the knee</td>
<td>Helps to prevent bandage slipping down especially if the patient is restless or carrying out an exercise programme.</td>
<td>No real benefit</td>
</tr>
<tr>
<td>Use of padding beneath the skin extension</td>
<td>Protects the skin. Skin extensions fit better if legs are narrow. Keeps the leg warm.</td>
<td>Adds additional bulk that may be uncomfortable and restrict movement. The padding can bunch up, causing local pressure damage.</td>
</tr>
<tr>
<td>Use of spiral or figure of eight.</td>
<td>Spiral is easier to apply. Figure of 8 retains the traction better as it produces a high sub-bandage pressure.</td>
<td>Spiral slips more easily. Figure of 8 more difficult to apply and may become too tight.</td>
</tr>
<tr>
<td>Use of traction for upper femoral fracture.</td>
<td>Aids comfort if muscle spasm painful and unrelieved by analgesia and not controlled through manual traction on movement.</td>
<td>Restricts movement. Being tied down causes confusion and anxiety. Manual traction can be applied if there is only pain on movement. Pain should be controlled.</td>
</tr>
</tbody>
</table>
• The patient’s general health and any deficits to venous or arterial circulation or sensation
• Known allergies
• Pain and comfort levels
• State of skin integrity
• Patient’s ability to maintain a constant position whilst bandage is applied
• Colour warmth, movement and feeling to the limb to be bandaged and the other limb that may be used for comparison
• Patient’s ability to observe and report discomfort, pain and altered sensory or motor function
• Patient’s ability to carry out emergency measures should the bandaging become unsafe
• Patient’s ability to move about and care for self safely whilst the bandage is in place.

The nurse must also:
• Assemble the necessary equipment to include sufficient bandages of the correct width, scissors, and adhesive tape for securing the last bandage turn. Additional equipment will be dictated by the purpose of bandaging and any additional measures such as padding and stockinette
• Check skin hygiene and ensure it is clean and dry and any breaks in skin are protected
• Ensure the patient understands the reason for bandaging and agrees with it
• Provide pain relief if necessary
• Ensure the patient is in a comfortable position with the area to be bandaged accessible
• Ensure that when bandaging the risk of back injury from prolonged static stooping is avoided (Love 1997, Love 1998a).

A bandage system always provides potential for:
• Local pressure damage from interruption of dermal blood supply
• Constriction of circulation and nerve supply.

The early detection of these avoidable complications through focused observations is a nursing responsibility unless otherwise stated.

When checks are made (unless there are documented reasons to state otherwise):
• The skin must be warm and of the patient’s usual skin colour
• The patient should be able to report sensation in all digits and there should be no change from before
• There should be movement of joints distal to the bandage
• Clenching a fist and straightening the fingers or moving the foot up and down and side to side or wiggling the toes should elicit no new source of pain.

It is usual for pain to diminish following injury or surgery. In case of increasing, prolonged or new pain the bandage must be removed and the source investigated.

Loss of pulse is a late and serious sign indicative of impending and unresolvable tissue death. There should be no change in the strength of the pulse. If there is any change in these observations, the bandage needs to be removed and the limb placed at heart level until symptoms resolve or further action taken to relieve the pressure and restore circulation and sensation. Depending on the reasons for the bandage, medical approval may need to be sought. For legal purposes, all events must be documented in the patient’s official records.

When conducting neurovascular observations, following any limb surgery, it is important to be aware that the bandage may not be the primary cause of impairment. Increasing intramuscular pressure sufficient to cause compartment syndrome can arise if haemostasis was incomplete or not adequate at the time of wound closure. Surgery done in a bloodless field (exanguination) presents a particular risk (Bodell et al. 1986) as bleeding points might have been missed. If the bandage is the cause of circulatory constriction, symptoms will resolve immediately it is removed. If not, then the cause will be coming from skin or muscle tissue requiring possible fasciotomy surgery to relieve pressure and restore circulation.

CONCLUSION

With skilful, accurate application that follows the principles of Laplace’s Law, bandages are one of the mainstays of orthopaedic care. They can promote comfort reduce complications and provide a means of affixing dressings, back slabs and traction. Incorrect haphazard or careless application followed by lack of or inadequate routine neurovascular observations renders them a potentially dangerous appliance due to local skin damage and compartment syndrome.

REFERENCES

Adams I 1985 Strapping in sport. Nursing December 5–6
British Standards Institute 1995 Compression hosiery
Thomas S 1990 Bandaging and bandages: the science behind the art. Care Science and Practice 8(2): 56–60
Younger ASE, Curran P, McQueen M 1990 Back slabs and plaster casts which will best accommodate increasing intracompartmental pressures. Injury 21: 179–181