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# Orthopaedic plaster casting: nurse and patient education

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## Summary

Orthopaedic casts are used in the management of fractures and to support and correct deformities. The application and removal of plaster casts is a skill requiring knowledge, judgement and sensitivity. Nurses need to have a good working knowledge of the main principles of plaster casting to ensure safety and provide patients with appropriate advice and information about how to care for casts and how to recognise possible complications.

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## Keywords

### Fractures, health and safety, orthopaedic care, plaster casting

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## Aims and intended learning outcomes

This article aims to provide information for nurses relating to the application, management, removal and care of orthopaedic plaster casts. After reading this article you should be able to:

- ▶ Explain the use of orthopaedic casts, the reasons for their application and how they should be removed safely.
- ▶ Identify the main principles of plaster casting.
- ▶ Outline potential complications that can arise from orthopaedic casts.

- ▶ Discuss the health and safety issues relating to plaster casting.
- ▶ Describe what patients with orthopaedic casts need to be taught.

## Introduction

The application and removal of orthopaedic casts may appear to be straightforward procedures that can be performed without adequate training. However, knowledge, judgement and sensitivity are essential skills in orthopaedic casting if safe patient care is to be delivered and complications are to be avoided (Royal College of Nursing (RCN) 2000).

## Reasons for plaster cast application

Orthopaedic casts are used to treat fractures, provide pain relief and support, and correct deformities (RCN 2000, Larsen 2002, Dandy and Edwards 2003, Nielsen and Ricketts 2005).

Several different types of material are available for orthopaedic casts, including plaster of Paris, semi-rigid non-fibreglass (softcast), and a variety of resin-based synthetic materials such as rigid fibreglass. Plaster of Paris is commonly used post-surgery because of the increased swelling associated with fractures (Dandy and Edwards 2003, Smith *et al* 2005). However, softcast has the ability to accommodate high volumes of fluid compared with plaster of Paris or rigid fibreglass (Deshpande 2005). Instead of a full plaster of Paris cast, a plaster of Paris backslab is often used in the early stages following injury. A plaster of Paris backslab consists of a slab of plaster that does not completely surround the limb, although it protects the injured area and allows the limb to swell.

The two most frequently used materials in orthopaedic plaster casting are plaster of Paris (Figure 1) and fibreglass (Pittner *et al* 2008). Petty and Wardman (1998) carried out a randomised controlled trial comparing adjustable focused rigidity casting techniques with standard plaster of Paris or synthetic casting techniques. A total of 200 patients were treated with either plaster of Paris, synthetic casts or minimal adjustable focus rigidity casts. The study found no difference in fracture healing rates or loss of fracture position.

Plaster of Paris is generally considered to be light, relatively soft and easy to remove (Dandy and Edwards 2003). However, some patients may feel that plaster of Paris is heavy and uncomfortable. It can take up to two days to dry completely, therefore weight-bearing immediately following plaster of Paris application is not recommended (Large 2001, Dandy and Edwards 2003). Synthetic materials (fibreglass and non-fibreglass) are now commonly used. They have been described as lightweight and easy to apply with reported patient preference (Large 2001). However, synthetic casts are not as easy to remove as plaster of Paris (Large 2001, Dandy and Edwards 2003) and are more difficult to mould (Miles *et al* 2000).

A combination of different casting materials, applying a light layer of plaster of Paris covered with synthetic cast material, may be a practical way of achieving an absorbent and easily mouldable cast, with the strength of plaster of Paris and the lightness of a synthetic material (Prior and Miles 1999a). While patients tend to prefer synthetic plaster casting materials, certain circumstances, for example following surgery or

injuries where the limb is likely to swell, may necessitate the use of plaster of Paris casts. The choice of materials to be used should be made by the nurse or technician applying the cast and should be based on the best available evidence. The patient should be kept informed and made aware of the reasons for choosing one particular material over another.

## Time out 1

A patient presents with an open fracture of the tibia and fibula and undergoes open reduction and internal fixation surgery. What type of material should the plaster cast be made of? List your reasons for making this choice.

## Complications

Patients may experience complications from wearing an orthopaedic plaster cast, including pressure ulcers, allergic reactions, infection, deep vein thrombosis (DVT), neurovascular deficit and compartment syndrome (Box 1) (Zenios *et al* 2004). Pressure ulcers are open sores that are often accompanied by the sloughing off of inflamed tissue. These may develop on areas of the body where the blood supply is reduced because of prolonged pressure from, for example, a plaster cast.

Pressure ulcers or infection under the cast can cause burning sensations, local heat and an offensive smell (Prior and Miles 1999b, Terzioğlu *et al* 2002). Patients should be advised to check for any signs of odour. Should this occur, the cast needs to be removed and the pressure ulcer treated. Alternatively, the plaster can be windowed, by cutting a hole in the plaster cast above the ulcer site. This means the pressure ulcer can be accessed while maintaining the position of the fractured limb in the cast (Dandy and Edwards 2003). The windowed section of the cast should be kept and reapplied following inspection and/or treatment

FIGURE 1

### Application of a plaster of Paris cast



## BOX 1

### Complications associated with wearing a plaster cast

- ▶ Allergic reactions.
- ▶ Compartment syndrome.
- ▶ Deep vein thrombosis.
- ▶ Infection.
- ▶ Neurovascular deficit.
- ▶ Pressure ulcers.

(Miles *et al* 2000)

of the skin so that the windowed area does not become oedematous and remains protected from external contamination (Altizer 2004).

Although windowing a plaster cast may be good practice, it may provide an opportunity for some patients to manipulate the cast and have unnecessary contact with the wound. To prevent this from happening, comprehensive information regarding the plaster window needs to be communicated to patients.

Cracking and denting of the plaster may occur as a result of uneven bandaging techniques, insufficient padding and oversized casts (Miles *et al* 2000). These problems need to be recognised and rectified by a plaster casting technician. Allergic reactions can occur following the application of a plaster cast. Severe itchiness, wetness, discharge and heat under the cast may indicate an allergic reaction (Larsen 2002). If the patient develops any of these symptoms, the cast should be removed, the skin thoroughly cleansed and another material used (RCN 2000).

The risk of DVT and pulmonary embolism (PE) in patients following cast immobilisation for injuries of lower limb extremities has been documented (Batra *et al* 2006).

Although the incidence of DVT in patients wearing plaster casts is relatively low compared with other major orthopaedic interventions, such as hip and knee replacement surgery, it should still be treated as a priority, and an effective prophylactic regimen is required (Jørgensen *et al* 2002). Individuals immobilised in plaster casts may benefit from receiving DVT prophylaxis with low molecular weight heparin (Jørgensen *et al* 2002).

In addition, wearing graduated compression stockings on the non-casted limb may be effective in reducing the risk of DVT (Joanna Briggs Institute 2008). Exercises will help to prevent circulation problems and strengthen the muscles in the calf. Alternatively, special foot pumps may also be used for patients having to wear an orthopaedic plaster cast in a hospital setting. These boots are made of soft material and attached to a foot pump – a pocket under each foot systematically inflates and deflates, assisting blood circulation in the legs (Warwick *et al* 2002).

## Time out 2

A patient with a below-the-knee plaster cast presents with severe ischaemic vascular disease. What thromboprophylactic treatments would you recommend to prevent the incidence of DVT and PE?

## Time out 3

List some of the signs and/or symptoms associated with compartment syndrome.

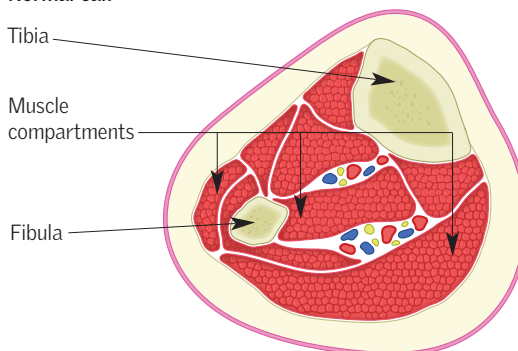
Compartment syndrome may occur as a result of restricted movement when a cast is *in situ* (Solomon *et al* 2005, Judge 2007). Compartment syndrome is a painful condition that is characterised by increased pressure within one or more fascial compartments caused by locally increased pressure, which results in compromised vascular perfusion (Schoen 2000, Court-Brown *et al* 2006) (Figure 2). This prevents nourishment from reaching nerve and muscle cells. Without prompt treatment, the resulting tissue hypoxia can lead to nerve damage and eventually muscle death (Solomon *et al* 2005, Weinstein and Buckwalter 2005).

Tight casts can lead to compartment syndrome (Prior and Miles 1999b). As swelling increases, the pressure within the compartments increases, resulting in compromised blood flow and ischaemic muscles, nerves and tissue (Box 2). If left untreated, compartment syndrome can cause

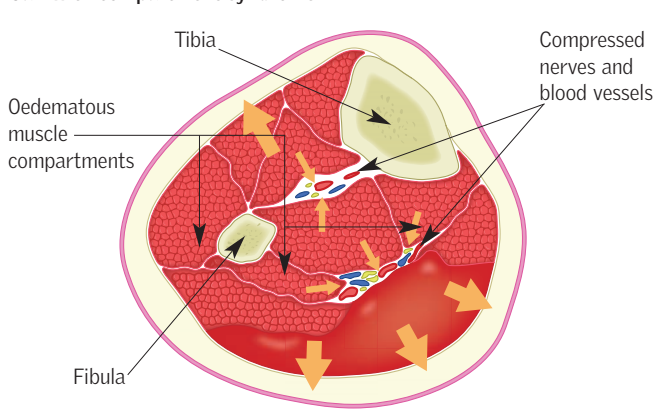
FIGURE 2

### Compartment syndrome

#### Normal calf



#### Calf with compartment syndrome



permanent necrosis and, in some cases, it may result in amputation of the affected limb (Dandy and Edwards 2003). To prevent such complications occurring in high-risk patients, casts should be bivalved, which involves splitting the plaster cast with either plaster shears or an electric plaster saw, to relieve pressure (O'Leary *et al* 2008) (Box 3).

#### BOX 2

##### Signs and symptoms of compartment syndrome

- ▶ Progressive pain.
- ▶ Pain on passive motion.
- ▶ Paraesthesia (altered sensation).
- ▶ Pulselessness or lack of capillary refill.
- ▶ Progressive loss of motion.
- ▶ Pallor.
- ▶ Swelling.

(Hobson *et al* 2004)

#### BOX 3

##### Reasons for altering, splitting and wedging plaster casts

- ▶ To allow swelling of the injured tissue.
- ▶ To enable inspection of the skin underneath the cast.
- ▶ To allow manipulation of the position of the limb.

(Miles *et al* 2000)

#### BOX 4

##### Neurovascular assessment of a lower extremity

- ▶ Date and time of the assessment performed on the extremity.
- ▶ Nerve assessment.
- ▶ Sensation.
- ▶ Movement.
- ▶ Vascular assessment.
- ▶ Temperature.
- ▶ Colour.
- ▶ Capillary refill.
- ▶ Palpation of pulses (dorsalis pedis and posterior tibial).
- ▶ Any other significant observations, such as swelling.

(Bucholz *et al* 2006, Miller and Askew 2007)

Limb elevation is vital following the application of any type of orthopaedic cast (Dandy and Edwards 2003), and is particularly important when there is a concern about the development of compartment syndrome. It has been suggested that the affected limb should be raised higher than the level of the heart (Wardrope and English 1998, Larsen 2002). However, Love (1998) disagreed with high elevation claiming that it is unsafe in certain circumstances, particularly if there is a likelihood of compartment syndrome, as limb elevation above the heart can increase ischaemia. Limb elevation up to 45° is considered safe practice (Dandy and Edwards 2003).

The ability to recognise a compromised limb through careful neurovascular observation is essential in the prevention of compartment syndrome (Altizer 2004, Judge 2007) (Box 4). Regular checking of colour, warmth, movement and sensation of the limb and palpation of pulses are vital following orthopaedic surgery and the application of a plaster cast. A comprehensive advice sheet providing a neurovascular self-assessment checklist may benefit patients and increase their awareness of the early signs and symptoms of possible complications.

Compartment syndrome may result in patients experiencing intense pain, made worse by movement, touch, pressure, stretch and elevation of the limb (Solomon *et al* 2005). Staff in the emergency department should be alert when patients return to the department with any of the above symptoms (Ansari *et al* 1998, Fenn *et al* 2000, Vincent *et al* 2001).

The prognosis for compartment syndrome varies between excellent and poor depending on how quickly the condition is treated (Miller and Askew 2007). It is crucial that nurses caring for patients wearing casts recognise the potential for the development of compartment syndrome and instigate prompt diagnosis and treatment (Box 5). Patients should be made aware of the warning signs of compartment syndrome.

#### Time out 4

A patient under your care has just returned from theatre following internal fixation of a fractured tibia. A few hours after surgery the patient begins to complain of extreme pain and a tight sensation around the injured limb area where the plaster cast has been applied. What may be the cause of the patient's pain? What would you do to alleviate the patient's discomfort?

## Educating patients

Patient education and the provision of information are essential to prevent complications such as compartment syndrome (Prior and Miles 1999a). Effective health promotion proposes to prevent disease and improve individuals' health and wellbeing (World Health Organization (WHO) 1986). Health is the 'state of complete physical, mental and social well-being, not merely the absence of disease or infirmity' (WHO 1946). However, holistic patient care is often neglected and health professionals tend to concentrate on patients' physical symptoms. All patients' needs should be taken into consideration, including their physiological, social, aesthetic and safety needs (Hughes 2004).

### Time out 5

A 75-year-old woman is being discharged from the emergency department following a Colles' fracture to her right wrist. The patient is right-handed and needs to wear the plaster cast for six weeks. Taking into consideration her age and mobility restrictions as a result of the cast, how would you plan this patient's discharge? What services would you arrange to ensure that she has help with her day-to-day activities?

### Time out 6

List at least five different instructions that you should give a patient on discharge following the application of a plaster cast.

According to the *National Service Framework for Older People* (Department of Health (DH) 2001) all older patients should be assessed following a fall and before discharge (Box 6). Other groups of patients may require special attention before discharge from hospital (DH 2001). For example, a single mother who just had a fall and is due to be discharged on crutches, should undergo an assessment to establish whether she will be able to manage at home. Individuals having to wear a plaster cast may experience many daily challenges such as washing, dressing, mobilising, food preparation and home maintenance. Occupational therapy advice should be given to all patients (DH 2001, Miller and Askew 2007). Effective health promotion depends on good communication between the healthcare professional and the patient (Price 2004). Providing patients with written information and fact sheets about how to care

### BOX 5

#### Treatment of compartment syndrome

- ▶ Inform medical staff – the plaster cast should be bivalved.
- ▶ Examine the limb – carry out a neurovascular check.
- ▶ If symptoms continue – fasciotomy should be performed. This is a surgical procedure that cuts away the fascia (thin connective tissue covering and separating the muscles) to relieve pressure.

(Hobson *et al* 2004)

### BOX 6

#### Discharge planning

- ▶ Information leaflet to be given to the patient.
- ▶ Patient to be seen by the physiotherapist or an appointment organised when appropriate.
- ▶ Patient to be referred to the fracture clinic for a follow-up appointment.
- ▶ Contact the GP regarding the patient's injury.

### BOX 7

#### General advice about the care of plaster casts

- ▶ Avoid getting the cast wet.
- ▶ Do not scratch under the cast.
- ▶ Avoid walking on the cast.
- ▶ Do not be tempted to pull or move the cast up, down or around.
- ▶ Do not be tempted to remove the cast.
- ▶ Do not drive while wearing a plaster cast.
- ▶ Do not force anything down the cast.
- ▶ Do not alter the cast by trying to cut or trim it.
- ▶ Do not pull the padding out from the splint or cast.
- ▶ Elevate the limb with the cast.
- ▶ Exercise the limb to improve circulation.
- ▶ Inspect the cast regularly for damage or signs of unexpected staining from blood or discharge.

for plaster casts may help to reinforce verbal instructions (Box 7) (Ryan 2000, Allen 2001).

Patients are often frightened and anxious about the application and removal of plaster casts (Katz *et al* 2001, Larsen 2002) and good communication is vital to allay any concerns (Prior and Miles 1999a, 1999b, Price 2004, Silverman *et al* 2004). Creating a friendly environment is essential to enable patients to identify and acknowledge their fears freely and openly (Silverman *et al* 2004).



Promoting health and encouraging independence can lead to health improvement (Hughes 2004). However, delivering health promotion can be difficult in a busy emergency department where the turnover of patients is high and time pressures exist. Although many nurses feel confident about delivering health promotion advice and believe that they have the ability to modify patients' behaviour, they still view health promotion as an 'extra' to be provided when there is time (Pearson *et al* 2000, Kelley and Abraham 2007). Compounding this are external elements – ecological, cultural, economic and environmental – that can often hinder the effectiveness of health promotion (Whitehead 2004). For health promotion to be implemented routinely in everyday clinical practice, all nursing staff need to believe that it is a worthwhile activity and hospital managers should ensure that it does not conflict with other work priorities.

Cultural awareness is essential for nurses working in the UK. Language barriers can hinder the delivery of information and the provision of health promotion advice (Dunckley *et al* 2003). Where appropriate, it may be helpful to provide translations of questionnaires and handouts (Dunckley *et al* 2003). It may also be possible to request the presence of an interpreter.

#### BOX 8

##### Removal of a plaster cast

Use plaster shears when dealing with:

- ▶ Unpadded cast.
- ▶ Blood-stained cast.
- ▶ Blood-soaked padding.
- ▶ Thick cast material.
- ▶ Wet cast.
- ▶ Delicate skin.
- ▶ Oedema or swelling.
- ▶ Pins and wires present underneath the cast.
- ▶ Large casts.

Use an electric plaster saw when dealing with:

- ▶ Padded cast.
- ▶ Dry cast.
- ▶ Good skin condition.

(Miles *et al* 2000)

#### Time out 7

You are about to remove a plaster cast from a child who is extremely frightened of the electric plaster saw. Identify how you would allay the patient's fears.



#### Removing plaster casts

The removal of a plaster cast can be a frightening experience for patients (Katz *et al* 2001, Larsen 2002). It is recognised that sensitive, effective patient education, and psychological preparation, can be therapeutic for patients (Price 2004) and help to relieve the fear associated with the removal of a plaster cast (Prior and Miles 1999b, Miles 2005). It has been estimated that 425,000 patients experience preventable adverse effects during their hospital stay (Fenn *et al* 2000, Vincent *et al* 2001). Some of these incidents are related to the application and removal of orthopaedic casts (Ansari 1998, Killian *et al* 1999). In a single UK hospital within one year, 28 patients sustained cuts or burns caused by an oscillating plaster saw (Ansari 1998).

Although the application and removal of a plaster cast can appear to be a straightforward task, it requires knowledge, judgement and sensitivity (Prior and Miles 1999b, RCN 2000, Large 2001, Altizer 2004). *The Code* (Nursing and Midwifery Council 2008) aims to enhance patient care by preventing harm and ensuring accurate assessment of the care given.

#### Time out 8

You are about to remove a plaster cast from a patient and you notice that part of the cast is wet from blood. What instrument should you use in these circumstances: a plaster shear or an electric plaster saw?



In cases where patients appear to be extremely anxious and frightened, it may be more appropriate to use shears instead of an electric plaster saw (Box 8). Dry plaster of Paris can be difficult to cut with shears although it is still manageable. Fibreglass casts can be easily bivalved with shears (Prior and Miles 1999b, Miles *et al* 2000, Larsen 2002). Cutting with shears is more time-consuming, especially in a busy environment such as a fracture clinic or the emergency department. However, there may be cases where the only clinically safe method of removing the cast is with the use of shears, for example if it is an unpadded cast or blood-stained plaster of Paris (Miles *et al* 2000, RCN 2000).

## Cast removal technique

### Saw techniques:

- ▶ Always explain the procedure and reassure the patient. Show the saw to the patient and then demonstrate oscillation.
- ▶ Draw the cutting line on the cast.
- ▶ Avoid bony areas.
- ▶ Where possible, avoid blood-stained areas: the saw will cut straight through because blood stained padding or gauze is hard.
- ▶ Use an in-and-out movement with the blade held at 90° to the cast to cut through the plaster.
- ▶ After the plaster has been cut, use the spreaders to separate the cast carefully. Then cut the padding and stockinet with bandage scissors.

### Caution:

The saw can become hot and burn the skin:

- ▶ When in prolonged use.
- ▶ Where the material of the cast is thick.
- ▶ Where the cast is long or large.
- ▶ On recent casts where the resin is still curing (setting).
- ▶ In normal use, if the padding is thin, the patient may be able to feel the heat.

(Adapted from Tippins and Martinez-Tenorio 2005)

### Caution:

If the patient complains of pain or a burning sensation during the procedure, stop and reassess.

### Checking the saw and the vacuum:

- ▶ Ensure a regular annual safety check of the equipment by a clinical engineer.
- ▶ Is it working? Check for damaged wires.
- ▶ Is the bag full? Ensure that both the tube and hood are clear.
- ▶ Is the saw in a good condition?
- ▶ Ensure there is no water nearby when in use.
- ▶ Ensure all screws are tight.

### Patient and cast assessment:

- ▶ Ensure the patient understands the procedure.
- ▶ Is the patient able to and willing to co-operate?
- ▶ Is the patient able to remain still?
- ▶ Is the environment safe?
- ▶ Do you require assistance to hold the limb steady?
- ▶ Is the cast padded?
- ▶ Is there any blood staining?
- ▶ Was the cast applied after an operation?

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The degree of temperature elevation that occurs in a cast-saw blade has been underestimated by clinicians (Killian *et al* 1999). The temperature range of a cast-saw blade is 105-165°C during removal of a cast (Killian *et al* 1999). Electric plaster saws must be regularly inspected to check that the blade is not blunt or damaged and should be used with a vacuum to comply with current health and safety regulations (Health and Safety Commission 1999). Whether an electric saw or shears are used, bony prominences must always be avoided (Prior and Miles 1999c, Miles *et al* 2000, Prior 2001). Factors that should be considered when removing plaster casts are listed in Box 9. Following the removal of a plaster cast, patients need to be educated on skin care and possible complications such as redness and itchiness (Prior and Miles 1999c, Miles *et al* 2000, Larsen 2002).

## Conclusion

Orthopaedic plaster casts are commonly used to treat fractures and correct limb deformities. Nurses need to have a good understanding of the indications for plaster casting and the complications associated with casts to provide effective and safe care for patients. Patient education is essential to optimise care and ensure that patients have the information they need to manage their casts at home and minimise the risk of complications. Providing adequate information and explanations will assist patients to maintain their independence and carry out activities of daily living **NS**

## Time out 9

Now that you have completed the article you might like to write a practice profile. Guidelines to help you are on page 59.

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