

The Newcastle Optima slipper: a new method of casting

Ian Whyte

Introduction

Total contact casting is a proven, effective method of treating diabetic ulcers (Frykberg, 1997). The methods currently employed mean that the manufacture of such casts is very selective and confined to a few skilled operators. This article explores a method that is open to any person with the ability to apply a bandage to the foot. The Newcastle Optima slipper requires little time to manufacture and, because of its user-friendly design, is available to a much wider range of patients than hitherto was the case.

High plantar foot pressures are strongly predictive of subsequent plantar ulceration in diabetic patients with neuropathy (Veves et al, 1992), and once the ulceration has occurred the only way to promote healing is to unload the pressure from the affected site (Frykberg, 1997). Unfortunately, owing to lack of sensation in the feet, patients do not have the protective pain factor, which, under normal circumstances, would result in the ulcerated area being rested. They therefore require a means of offloading the affected area which allows them to walk and does not interfere too severely in their daily lives.

The original solution to the problem was the total contact plaster of Paris cast devised by Pollard and Le Quesne (1983), which was applied for one or more weeks at a time and was windowed over the ulcer to allow dressing changes. This technique was successful, but the heavy plaster cast was cumbersome and initial weight-bearing had to be delayed to allow the plaster to dry.

Mueller et al (1989) modified this technique by reinforcing the plaster of Paris with a roll of fibreglass cast bandage to provide extra durability and to allow weight-bearing sooner than would be allowed by plaster alone. They achieved healing in 90% of foot ulcers in an average of 42 days (range 8–91 days).

The disadvantages of the total contact cast are:

- It requires a skilled plaster technician to apply the cast
- Pressure lesions and/or infections may

develop beneath the plaster and, because of the neuropathy complication, go unnoticed until the cast is removed

- The patient is forced to wear the cast at all times, even while resting or in bed.

Burden et al (1983) proposed an alternative method of casting using Scotchcast, a fibreglass casting tape consisting of a knitted fibreglass substrate that has been impregnated with a polyurethane resin. The Scotchcast boot was manufactured on the foot, and then bivalved to allow the boot to be removed for dressing changes, washing and sleeping. The removable Scotchcast boot was worn with a protective overshoe to hold the cast securely on the foot. This design is very successful and still in common use. Murdoch (1997) reported a combined healing rate of 85% after 40 days in her study.

Other methods of pressure relief have been used by various centres, e.g:

- The Hope removable walking cast (Williams, 1994). This cast is manufactured from ethyl vinyl acetate, plastazote and X-lite on a positive plaster mold of the foot
- The Neofract boot (Page et al, 1996). This boot is manufactured from a rigid polyurethane foam which sets in contact with the skin to ensure a close fit and is removable by means of zips in the stockinet cover around the foam.

However, these orthotics are costly in terms of man-hours (the Hope cast) and materials (the Neofract boot cost £70 per boot in 1995 and lasts only a few weeks).

ARTICLE POINTS

1 The only way to heal neuropathic diabetic ulcers is to unload the pressure from the affected site.

2 Total contact casting is a proven effective method of treating diabetic ulcers.

3 The Newcastle Optima slipper is a new form of casting that overcomes many of the disadvantages of older forms.

4 In combination with a rocker sandal, it is a highly effective treatment for neuropathic ulcers.

5 It is easy, cheap and quick to manufacture.

6 It is applicable to a much wider range of patients than other forms of casting.

KEY WORDS

- Neuropathic ulcer
- Total contact cast
- Newcastle Optima slipper

Ian Whyte is Senior I Podiatrist at Newcastle Diabetes Centre, Newcastle General Hospital, Newcastle.

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1 The Newcastle Optima slipper was developed by researchers at the Newcastle Diabetes Centre.

2 It is a total contact cast comprising a combination of five layers of polypropylene casting tape and open cell foam.

3 This structure gives it sufficient rigidity to equalise pressure over the whole plantar area, while also allowing flexibility.

4 The device is lighter than other forms of total contact cast.

5 It is proving aesthetically pleasing to patients.

The removable Scotchcast boot has several advantages over the other methods:

- The convenience of a removable cast
- The patient can walk on the cast after 30 minutes compared with 24 hours for a plaster of Paris cast
- The cast is light in weight — about 0.5 kg compared with 2.3 kg for a plaster of Paris cast (Gilby, 1991).

However, it does also have some disadvantages:

- A plaster saw is required to bivalve and trim the cast
- The manufacturing process can take over an hour
- Although most of the work can be carried out by one practitioner, an assistant is required at some points in the process
- The fibreglass bandage is rough, with sharp edges, therefore a deep layer of padding is essential. This padding increases the dimensions of the cast, making it bulky and unwieldy, especially when covered by a cast overshoe. Some patients may refuse to comply with the treatment regimen because of the ungainly nature of the device.

A further disadvantage of both Scotchcast and plaster of Paris casting is their need for windowing to allow dressing changes and to relieve pressure on the ulcer. However, windowing may cause further damage to the tissue surrounding the ulcer, causing it to enlarge. As a result the ulcer may be undermined and prolapse into the space provided, which was ostensibly intended to relieve the pressure.

For these reasons, researchers at the Newcastle Diabetes Centre are investigating new materials and a new method of manufacture that will retain all the advantages of the original Scotchcast boot but eliminate some (or all) of the disadvantages.

The manufacture of the Newcastle Optima* slipper goes some way to meeting these objectives:

- It is very easy, cheap and quick to manufacture (typically around 20 minutes — less than a third of the time taken to produce a Scotchcast boot)
- It is lighter (weight approximately 300 g)
- It is proving aesthetically pleasing to patients.

The device can therefore be manufactured within the tight time constraints of a typical podiatrist's clinic. It can also be employed as a first-line orthotic to provide immediate relief in an acute clinical condition, e.g. acute Charcot joint.

The physical properties of the five layers of polypropylene casting tape in combination with an open cell foam closely following the contours of the foot give sufficient rigidity to equalize the pressure over the whole plantar aspect of the foot, while also allowing flexibility. Thus the Newcastle Optima slipper provides some degree of normal foot function. In combination with a rocker-soled sandal, the Optima slipper has proven to be an effective means of healing neuropathic ulcers.

Development of the casting method is continuing. The most recent method, employed by the author in the Newcastle Diabetes Centre, is described below.

Manufacture of the Newcastle Optima slipper using polypropylene casting tape

1. Sit the patient in a comfortable chair with the foot elevated and at a height that allows the operator to work without sustaining undue back strain.
2. Cover the wound or ulcer with a piece of Opsite (Smith and Nephew), Arglaes (Maersk), Primapore (Smith and Nephew), or other film dressing to protect the area while the casting operation is carried out.

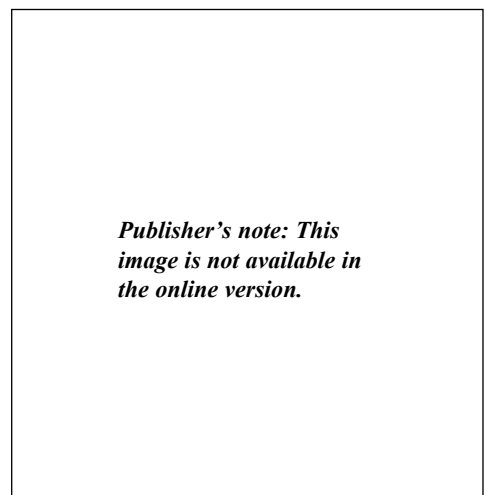


Figure 1. The foot with silicone former taped over the lesion.

*Optima refers to a recently introduced casting material. Dynacast Optima is manufactured by Smith & Nephew Ltd. Other companies are developing similar materials but these are not yet available for general use.

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1 The Optima cast can be applied by anyone with the ability to apply a bandage to the foot.

2 It does not require a skilled plaster technician to apply the cast.

3 The cast can be manufactured within the time constraints of a typical podiatrist's clinic.

4 It can be employed as a first-line orthotic to provide immediate relief in an acute clinical condition such as early Charcot joint.

3. Cut approximately 7.5 cm of 'collar and cuff' foam (Seton).
4. Cut two lengths of stockinet to cover the foot from approximately 5 cm above the ankle to 5 cm beyond the toes.
5. Cut a disc of self-adhesive sponge hypoallergenic foam slightly larger than the lesion or use a suitably sized silicone former* and place it directly over the lesion on top of the protective film dressing (Figure 1).
6. Place both pieces of stockinet on the foot from above the ankle and covering the toes, ensuring that there are no wrinkles.
7. Place the length of collar and cuff foam between the layers of stockinet on the dorsal aspect of the foot, with the long length stretching from the midtarsal area of the foot to where the foot joins the ankle (Figure 2). (This facilitates the safe use of plaster scissors when removing the cast later).
8. Cut a circular piece of 7 mm self-adhesive sponge hypoallergenic foam approximately twice the diameter of the ulcer or 4 cm diameter, whichever is bigger.
9. Stick the foam centrally over the site of the ulcer, on the outside of the outer layer of stockinet. (NB. It is vital to place the foam accurately in this area, in order to produce an area of reduced pressure at the correct site, i.e. over the ulcer.)
10. Cut a piece of 6 mm cushion foam† to fully cover the plantar aspect of the foot and 5–10 mm extra at the heel, so as to form a protected area circumscribing the heel (Figure 3). This also aids retention of the finished device on the foot.

(For the following steps of the process it is essential that the operator wears latex gloves to protect the skin from damage by the uncured materials used in subsequent stages of the process).

11. Take a pack of polypropylene tape 7.5 cm wide, open it, and on a suitable flat dry surface lay out a piece of tape three times the length of the plantar aspect of the patient's foot (Figure 4). (Seal the remainder of the roll in the foil pack for later use.) Fold it twice to produce a triple thickness of tape

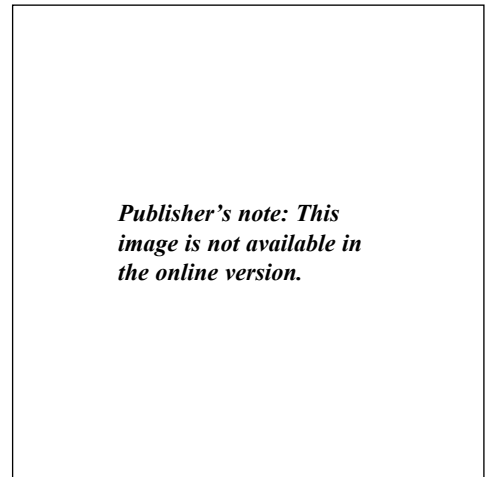


Figure 2. Inserting 'collar and cuff' between layers of stockinet to protect the foot from the plaster shears.

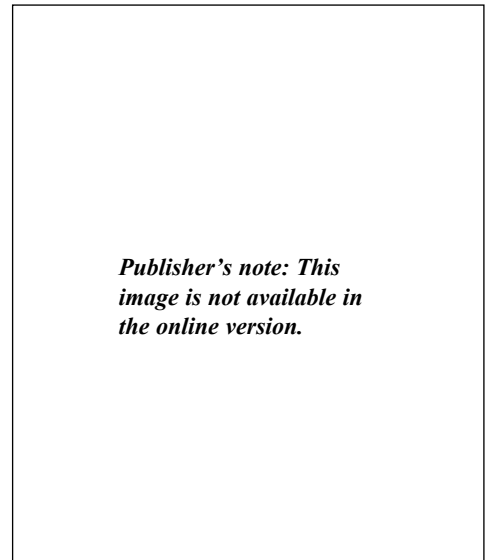


Figure 3. Cutting the foam to shape to cover the weight-bearing area of the foot.

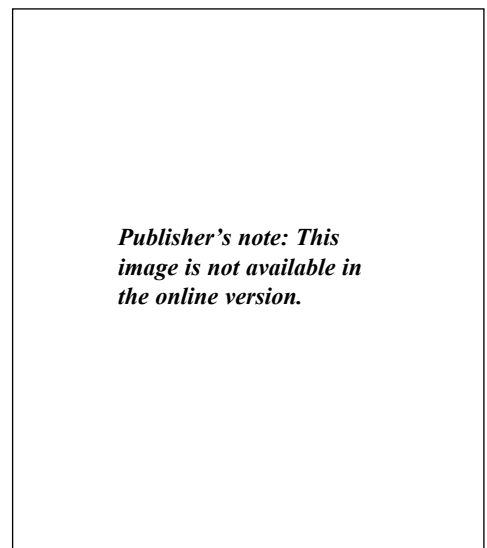


Figure 4. The Optima tape being measured against the foot before being cut to length.

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* Various sizes of silicone rubber formers can be used to create a suitable depression in the finished cast. These can be manufactured by casting Otoform or other silicone casting material. The shapes can be created by pressing fingers, heels etc. into 'Oasis foam' to form a suitable template.

† Ongoing development is taking place to determine the best type and density of foam to be used.

10cm wide and the length of the foot.

12. With a sharp pair of scissors, cut both ends to a semi-circular shape. This will form the reinforcing spine of the device.

(The following part of the procedure is much easier if help from a third party is employed. This could be a nurse, carer or relative.)

13. Take the prepared polypropylene tape and, without wetting it, offer it up to the patient's foot (Figure 5).

(At this stage a third party wearing latex gloves could hold the tape loosely in contact with the patient's foot. This would leave the operator free to take the remaining tape out of its foil wrapper.)

14. Immerse the tape in water, squeezing and releasing pressure on the roll five times. Finally, remove it from the water and squeeze the excess water from the roll.

15. Starting from the toes, bandage the foot up to and just over the ankles, with an overlap of 15 mm. Continue the bandaging back down the foot to the toes again, with an overlap of no more than 15 mm. This should produce a double thickness over the whole of the foot (Figure 6).

16. Place the patient's foot on the ground but do not allow weight-bearing to take place. With both hands, apply minimum pressure to the foot to produce a slight flattening of the cast, allowing the foot to rest loosely as if in mid-stance.

17. Keep the foot in this position for 30 secs, then return the patient to his seat.

18. In handling the cast, the operator will notice a slight warming of the material; at the same time the material will feel harder as curing takes place (Figure 7).

19. With a pair of plaster shears, cut the dorsal aspect of the cast, inserting the

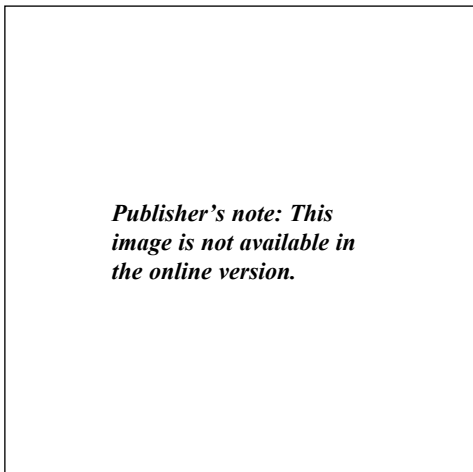
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1 The open cell foam must be placed centrally over the site of the ulcer in order to produce an area of reduced pressure at the correct site.

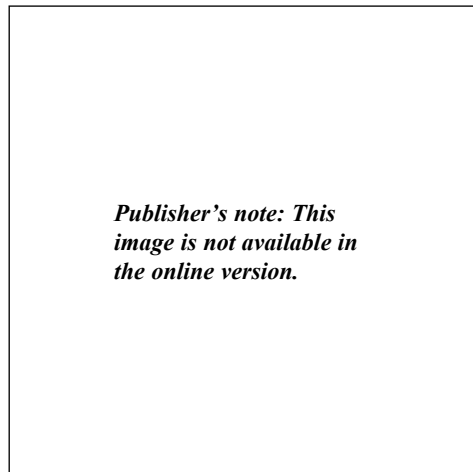
2 Assistance from a third party may be helpful during some parts of the procedure.

3 For example, the helper could hold the polypropylene casting tape loosely in contact with the patient's foot.

4 Latex gloves must be worn when using uncured materials such as casting tape, as these can cause damage to the skin.



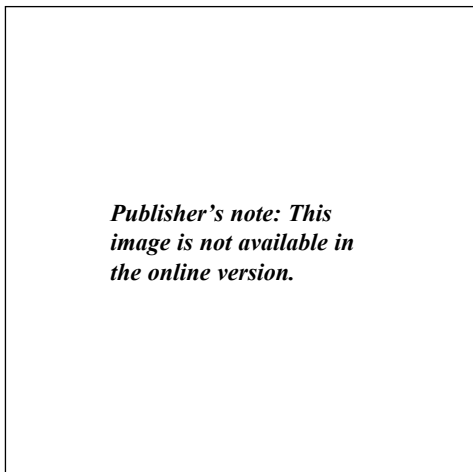
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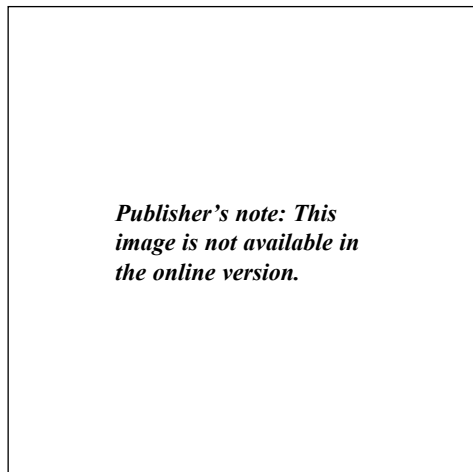
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Figure 5. Triple layer of polypropylene tape being held in position on the foot.

Figure 7. The finished cast curing on the foot.



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Figure 6. Two layers of Optima being applied around the foot.

Figure 8. Beginning the cut to remove the cast from the foot.

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1 As the cast is handled, the operator will feel a slight warming of the material.

2 At the same time, the material will feel harder as curing takes place.

3 After the cast is removed from the foot, it is trimmed closely, following the contours of the underlying foam insert.

4 It is then edged with stretch tape to protect the exposed areas of polypropylene.

5 The ulcer is then dressed, covered with a layer of stockinet, and the sock or stocking replaced.

shears between the layers of stockinet and cutting from the region of the second or third toe, along the centreline of the foot. Make sure that the cut goes over the piece of collar and cuff inserted previously (Figure 8).

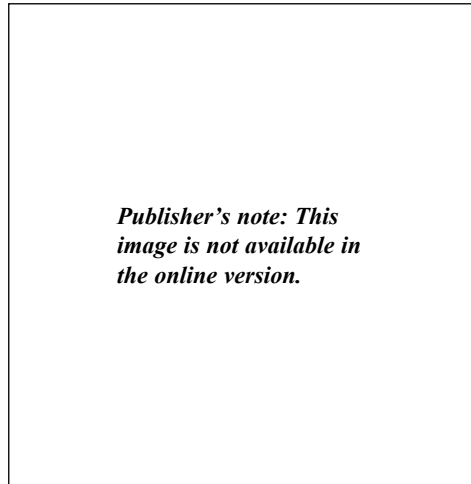


Figure 9. Final cutting of the cast from the foot.

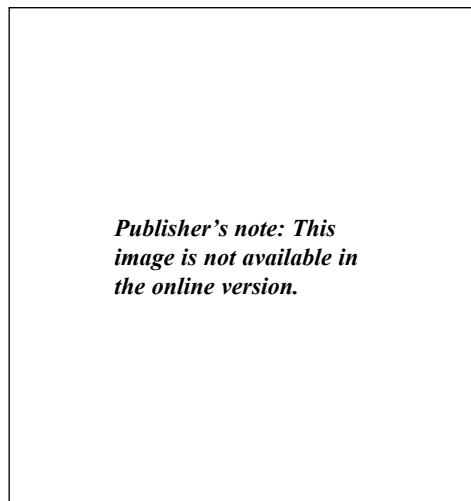


Figure 10. Removing the cast from the foot.

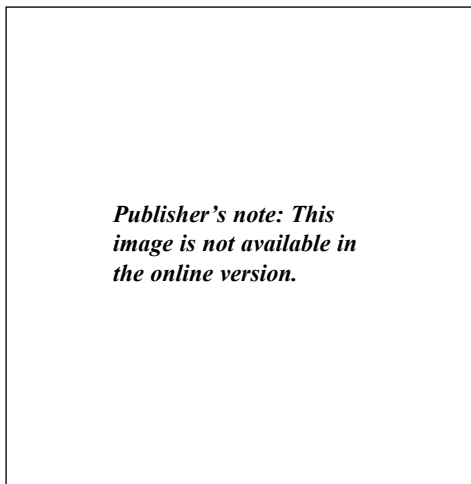


Figure 11. Trimming the cast to size.

20. When the junction between the foot and the leg is reached, recommence cutting from the leg end of the device to meet the cut from the toes (Figure 9).

21. The cast can now be removed from the patient's foot (Figure 10).

22. Trim the cast, closely following the contours of the underlying foam insert (Figure 11).

23. When the cast has been trimmed satisfactorily, ensuring there are no obvious areas of friction, edge it with stretch tape to protect the exposed areas of polypropylene (Figure 12), then offer the cast to the foot to ensure a good fit (Figure 13).

24. The ulcer is then dressed, from a choice of dressings, followed by a layer of stockinet, and the sock or stocking is replaced.

25. Select a suitably sized rocker sandal and fit it to the patient's foot (Figures 14).

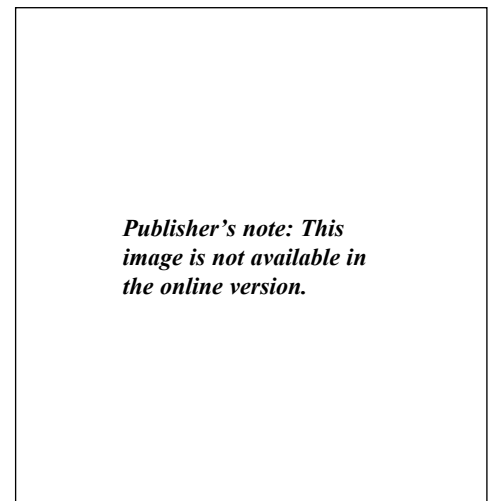


Figure 12. Edging the finished cast with stretch tape.



Figure 13. Checking the finished cast for correct fit.

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1 Development of the Newcastle Optima slipper is continuing, to determine the best type and density of foam to be used.

2 The casting method described here has been used successfully in the Newcastle Diabetes Centre since 1997.

3 Three lesions that did not respond to any other method were controlled successfully by the Newcastle Optima slipper.

4 The successes included an ulcer over a Charcot deformity of over 10 years' duration.

5 Publication of an audit of the results of treatment with the Newcastle Optima slipper is planned for later in the year.

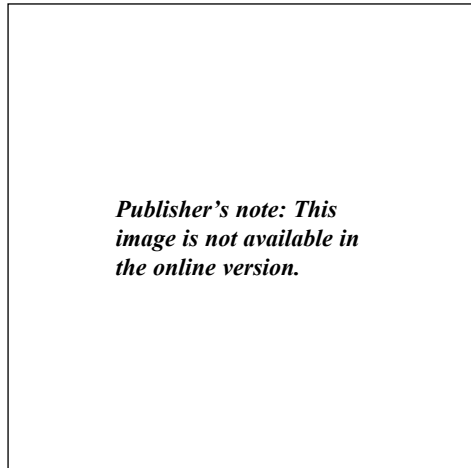


Figure 14. Fitting the rocker sandal.

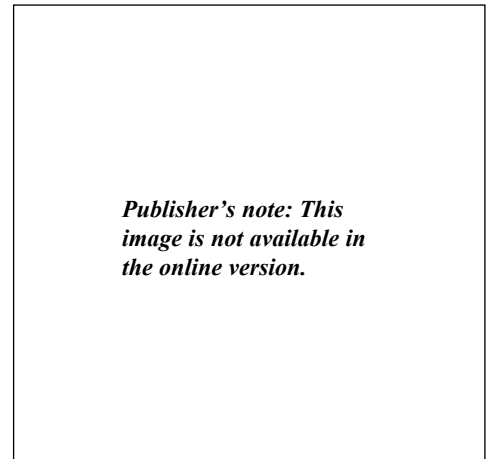


Figure 15. The Newcastle Optima Slipper ready for a test drive.

26. The device is reviewed after 24 hours, and at each subsequent treatment of the patient thereafter.

Conclusion

The casting method outlined has been employed in the Newcastle Diabetes Centre since August 1997, where it has been used successfully in the treatment of various plantar ulcers. These included three lesions that defeated all other methods of control, one of which was an ulcer over a Charcot deformity of over 10 years' duration. Ongoing clinical audit will provide the necessary information to demonstrate the benefits of the cast. ■

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