and he can even make him stand on the outer border of the foot with the sole inverted. But if the patient is allowed to evert the foot even for a moment it at once becomes fixed again in the position of abduction and eversion. Nothing is known about the aetiology of this condition. It is obviously a reflex protective spasm due to pain in the foot. It has been attributed to arthritis of some of the tarsal joints, but there is no clinical, pathological, or radiological evidence of this.

Treatment.—The treatment of spasmodic flat-foot is uncertain and often disappointing. The most common method is manipulation under an anaesthetic and fixation of the foot in plaster in the inverted position for a considerable time. The usual result is that the spasm returns as soon as the plaster is removed and the patient bears weight on the foot. Some cases respond surprisingly well to manipulation followed by radiant heat, massage, and exercises; but it is necessary to keep the patient in bed during the whole of this treatment. Afterwards he should wear an outside steel with a valgus T-strap to prevent passive eversion of the foot. In some very resistant cases arthrodesis of the astragalo-scapoid joint has been done. This abolishes the pain and spasm, but of course it leaves a permanently stiff foot.

A RAPID AND PAINLESS METHOD OF REMOVING PLASTER CASTS

BY

REGINALD G. BICKFORD, M.B., B.Chir.

E.M.S. Staff, St. Pancras Hospital, London

[Work undertaken with aid from the Medical Research Council and the Ministry of Health.]

In most fracture clinics the surgeon relegates the arduous task of removing plasters to the student or nurse and consequently becomes oblivious of the pain and discomfort suffered by his patients during this operation. Watson Jones, having himself been a patient, voices the same opinion in a recent textbook on fractures:

"A professor of surgery retains one vivid childhood memory, the removal of a plaster. The pain of the plaster is forgotten, but not the pain of cutting down the plaster. Even the most gentle of surgeons seem to lose their sympathy on these occasions, to brush aside the victim's protests, and hasten through the work as though time was the only factor."

Clearly, the plaster shears, though well adapted to opening the padded plaster, is a cumbersome instrument when employed on the modern unpadded cast.

Advantages

The method to be described has the following advantages over those at present in use:

- (1) Removal is effected without pain or discomfort.
- (2) It is more rapid—for example, a walking iron and plaster may be removed in two minutes, as compared with ten to twenty minutes by the shears method.
- (3) It renders bivalving of plasters so simple and rapid that the method might be used for treating gunshot wounds requiring frequent redressing.
- (4) It is inexpensive.

Essentials of Method

The method consists in laying a thin steel wire beneath the plaster when it is first applied. One end of the wire is anchored by turning it back and incorporating it between the layers of the plaster, while the other end remains

free. When removal of the plaster is required the free end of the wire is wound round a key lying on the surface of the plaster. The plaster may then be cut cleanly from end to end by manual rotation of the key, so that the steel wire is torn through the plaster.

Materials

Wire.—Best quality steel piano wire is used for cutting the plaster. The thickness of plaster which can be cut without the wire snapping depends on its gauge. Rotation of the key is difficult with wire of greater thickness than 22 gauge, due to the excessive tension developed. A gauge of less than 26 does not possess sufficient strength. Experience has shown that 24 is the most suitable gauge for general purposes. This will cut 30–35 layers of "cellona" plaster bandage, which amounts to half an inch in thickness. Hand-made muslin plaster bandages are cut more easily, as they do not hold so much plaster. Rusting of the wire may be prevented by coating it with a thin layer of shellac or varnish. Piano wire rusts slightly in the plaster, but this is not necessarily a disadvantage, as the thin coating of rust anchors the wire more firmly in the plaster, yet does not seem appreciably to affect the strength. The relatively low tensile strength of stainless steel wire renders it unsuitable for use. The wire may be laid directly on the skin in plasters which are to be bivalved in a few days, and in those in which the limb is not to be used for active movements. In other cases a layer of stockinet is put on the limb, and the wire is then "tacked" on to the stockinet in the required position by threading it through one or two stitches at intervals along the limb. Only a small amount of stockinet should be caught up in this way, as the wire does not cut it cleanly and tends to break at these points. Plastering may then be carried out in the usual way. Permanent plasters without stockinet can be applied if the skin is protected by adhesive tape. A one-inch strip is laid down and the wire is held between it and the plaster. When a fracture is plastered immediately after reduction a specially designed wire* with an adhesive backing may be used. This adheres firmly to the limb and leaves the surgeon's hands free to manipulate the fracture. In the case of children the skin is particularly susceptible to irregularities in the plaster and therefore the wire should never be laid on the bare skin. When these simple precautions were observed, ulceration did not occur in a series of over 100 cases. The extra cost of the wired plaster is practically negligible, as a shilling roll of wire is sufficient for about ninety casts.

Key.—An old six-inch Spencer-Wells forceps may be used as a key to wind out the wire (a sardine tin-opener serves well for thin plasters). The forceps should be rotated in such a direction that their handles are pressed together and the wire should be kept at their broadest part. A few shreds of plaster often lift with the wire. They should be pulled free occasionally from the key if a clean cut is desired. It is important that a strong and even tension should be kept on the wire and sudden jerks avoided, as they tend to snap it. Should this accident occur, the anchored end of the wire is freed and the broken end seized and wound round a Spencer-Wells, thus forming a new anchorage. The freed end is gripped in a second Spencer-Wells and wound along in the direction of the new anchorage. When many plasters have to be removed it is more convenient to use a specially designed key.* The plaster is removed by separating the cut edges by hand. The stockinet tears easily, as it has been weakened by the rusting of the overlying wire.

Slotted Plate.—It has been found that undue lifting of the plaster occurs if cutting is attempted before it has dried. To overcome this difficulty I have employed a steel plate, inserted between the plaster and the key, with a slot through which the wire is pulled. The plate is moved along with the key and prevents lifting of the plaster, thereby ensuring a clean cut. A slot 1/8 inch wide and 3 inches deep cut into a steel plate will be found adequate for most purposes. I have designed a more elaborate device* in which the slot width is adjustable, and which is made of flexible steel and can therefore be

* These instruments are supplied by Allen and Hanburys Ltd.

employed to cut round flexures. It should be emphasized that the use of a slotted device is only necessary on the rare occasions when a wet plaster has to be cut.

Individual Plasters

As already explained, steel piano wire will snap should the plaster exceed a certain thickness. The majority of plasters are below this limit because the wire is placed in the thinnest part on the opposite side to the strengthening slab. As a further safeguard sudden bulges in the plaster caused by uneven spreading should be avoided. In spite of these precautions the thickness of the plaster in certain situations—for example, the ankle—often exceeds the breaking limit. In these cases the main wire is reversed after half the plaster has been applied, and the plastering continued over the reversed part of the wire. Two separate cuts are made, thus halving the amount cut by each wire. In practice, as the wires cannot be exactly superimposed, a sheet of waxed paper is incorporated in the plaster at the level of the outermost wire. This forms a line of separation in the plaster so that after the first layer has been cut it may be torn back, thus

FIG. 1.

FIG. 2.

FIG. 1.—Main part of cast is complete. Waxed paper and wire are in place ready for the reinforcement to be applied over the walking iron.

FIG. 2.—Vertical section of a walking plaster with the wire (W) and the walking iron reinforcement (T) in place. The layer of waxed paper (E) separates the main plaster from the reinforcement in front. Stockinet is shown as a dotted line.

exposing the second layer. The wire is put on the flexor aspect of joints, such as the ankle and the elbow, in order that it does not pull into the flesh during removal.

In all plasters the wire is anchored at the proximal end. This anchorage is effected by bending the last three or four inches to a right angle at the point at which it is proposed to end the cast. The plaster bandages are then laid on up to the bend until the last turn is being made, when the wire is bent more acutely and held beneath it. Thinning out the plaster towards its proximal end should be avoided, as this weakens the anchorage. A properly constructed anchorage will not slip under the tension required to remove the plaster, but should this accident occur further slipping can usually be prevented by clamping a Spencer Wells obliquely over the plaster where the wire is bent.

When a plaster is completed the wire should be cut off, leaving about one to two inches free. This free end can be protected by a short length of adhesive tape applied when the plaster is dry.

Leg Plasters.—The strength of the plaster is concentrated in a thick dorsal slab. The wire is placed ventrally along a line running from the middle toe to the outer border of the patella. When a walking iron or heel is incorporated in the plaster the reinforcement required in the region of the ankle may thicken the plaster sufficiently to snap the wire. In these cases, therefore, the distal end of the wire is bent back acutely as it emerges in front of the toes. The part which has been turned back is held in a central position in front of the ankle and a single layer of waxed paper, about 7 by 4 inches (the cover of a "cellona" bandage serves admirably) is laid lengthwise in front of the ankle and in front of the wire (Fig. 1). The outer edges of the waxed paper should overlap the cross-bars on the walking iron. Plaster bandages are now wound round the limb over the waxed paper so as to bind the walking iron firmly to the cast (Fig. 2). The bandages should not be knotted round the bar of the walking iron as this interferes with the subsequent removal, but a buttress may be inserted between it and the main part of the cast. In removing the plaster the first cut is taken in a distal direction by winding the free end of the wire, thus cutting the reinforcement. The waxed paper forms a line of separation, so that the layer of reinforcement carrying the heel or iron can be gently lifted up with a blunt tool and torn back by hand, thus freeing the walking iron or heel. The rest of the plaster is now cut in a proximal direction in the ordinary way. This type of plaster has proved extremely satisfactory, as it is strong, rapidly removed, and the walking iron is cleanly separated without damage to the cross-bars. After a little practice the application of a wired plaster takes no longer than the ordinary type, and can be managed single-handed.

Arm Plasters.—The plaster is reinforced with a dorsal slab. The wire is placed in a ventral position, and its free end is brought to the surface at the base of either the thumb

FIG. 3.—Vertical section of arm and forearm with plaster cast in position. The wire is being wound on the key (K), and has already cut through the distal part of the plaster from the base of the thumb. The anchored end of the wire is shown incorporated in the plaster at A.

or the index finger (Fig. 3). It is not necessary to reverse the wire in this plaster unless it is greatly strengthened at the wrist.

Plaster Jackets.—The wire is laid at the side of the plaster. It is usually wise to reverse the wire once and put down a strip of waxed paper in the middle of the plaster.

Bivalving Plasters.—The special adhesive-backed wire should be employed. Stockinet is unnecessary and adds to the difficulty of removal, but if it is used it should be cut on one side only when the plaster is opened, the other side remaining as a hinge. The two wires are placed on either side of the limb. The plaster is strengthened by narrow dorsal and ventral slabs laid between the wires. The condition of the plaster is most suitable for removal three to four days after its application.

I wish to thank Dr. E. A. G. Goldie for his help in developing this method. Dr. Norman Jones and the L.C.C. assisted me greatly in its application to patients, as did Miss J. A. Davies in preparing the manuscript.