

is a little raised and this appearance could readily be improved by shaving it level the adjacent skin.

COLOURED SCARS

Many burn scars, particularly those on the face, are reasonably flat but are conspicuous because of their permanent red colour (Fig. 11, A). Other scars, resulting in deep burns, may show patches of dark brown pigmentation (Fig. 12, A).

An attempt is being made to mask the abnormal colour of these scars by the application of a skin graft after the scar surface has been removed by shaving. Results are very promising.

Case Reports.—1. I. L., aged 18 years, had extensive facial scarring following burns of the face. A number of operations had been carried out to relieve contractures of the eyebrows and the patient presented himself with a broad red scar on the left cheek and a depressed, yellow skin graft on his nose (Fig. 11, A).

The red scar on the left cheek was shaved and then covered with a thin skin graft from the arm and Fig. 11, B, shows the result two years later. The colour of the graft, though still not normal, approximates reasonably to that of the adjacent skin. It will be seen from Fig. 11, B, that the depressed skin graft on the nose has also been treated—by the application of a post-auricular Wolfe graft. This has restored the contour of the nose but has remained red in colour. This will be corrected by shaving the nose followed by the application of a thin skin graft from the arm.

2. G. G., aged 42 years, suffered severe burns of the right side of the face and neck in 1951. The right eye and lids were destroyed and the bone exposed over the right orbital and parietal regions. Healing was obtained by skin grafting after excision of the bone from the face and removal of the outer table of the exposed skull. The grafts over the healed scar over the right side of the skull and on the right side of the forehead, however, were extremely thin and unstable and showed a patchy dark brown discoloration due to deposits of melanin (Fig. 12, A). The surface of this area was shaved and then covered with skin grafts taken from the arms and, at the same time, the irregularly scarred skin-grafted area on the right cheek and neck was treated in the same way. Fig. 12, B, shows the condition one year later. The grafts are stable in colour, so far, is excellent.

CONCLUSIONS

The operation of shaving and skin grafting provides a simple and quick method for the treatment of many types of scar for which more complicated procedures are usually carried out.

Excellent results can be expected with thin unstable scars and, in many of these cases, the use of distant flaps can be avoided.

Good results are obtained with mildly contracted and tight scars, with excised scars, and with scars which are difficult or even dangerous to excise.

Matured, hypertrophic scarring can be greatly improved in appearance by the use of this method, which should be considered before embarking on a major excision. Permanently red or brown scars can also be treated in the same way and the results appear very promising.

I wish to thank Professor T. P. Kilner for allowing me to treat one of his patients and for the result.

REFERENCE

HYNES, W. (1954). *Brit. J. Plast. Surg.*, 2, 97.

EXPOSED DELAYED PRIMARY SKIN GRAFTS: A CLINICAL INVESTIGATION

By JAMES CALNAN, F.R.C.S., and F. L. F. INNES, F.R.C.S.

Professorial Unit, Nuffield Department of Plastic Surgery, University of Oxford

DURING the past few years attention has been directed towards improved methods for cutting split-skin grafts: less endeavour has been directed to improving methods of applying these grafts.

This paper is concerned with some aspects of grafting—the use of pressure, the temperature of a graft, delay in applying grafts, and infection. The word “graft” is used here to mean a piece of skin completely detached from its donor site before transfer to a recipient area. The term “split-skin” is used to indicate a skin graft of epidermis and a portion, but not all, of the dermis: it is not used to imply any particular thickness of graft.

I. THE USE OF PRESSURE ON FREE GRAFTS

It has been taught for many years that pressure is essential for the “take” of a skin graft. The exact way in which pressure acts is not readily explained, but an examination of seven well-known textbooks on plastic surgery gives a diverging number of reasons:—

1. Matthews (1946): “It is essential to hold the graft firmly against the raw surface unless a contact adhesive is used. An even pressure must be exerted with a smooth-surfaced support.”
2. Pick (1949): “The split-skin graft should always be sutured in place and adequately splinted by dressings.”
3. Fomon (1939): “Irrespective of the variety, the dressing must be non-adherent, absorptive, protective, capable of exerting firm, even pressure, and of immobilising the graft.”
4. Padgett and Stephenson (1948): “When snugly applied (the thick roller gauze dressing described earlier), sufficient pressure is given to hold the graft in contact with its base.”
5. Brown and McDowell (1949): “The dressing should be regarded as part of the operation and probably has more to do with the “take” of the grafts than any other step except possibly the preparation of the wounds. Pressure is relied on for aseptics, by preventing collection of blood or serum underneath the graft, and by minimising oedema in the area.”
6. May (1947): “Obviously, much of the success of skin grafting depends on the proper dressing. The graft must be kept in close contact with the graft bed. This is done by exercising proper pressure.”
7. Barsky (1950): “I believe that the best method of fixing a skin graft is by careful suturing, followed by a suitable pressure dressing.”

And in the journals pressure has been recommended. Lewis *et al.* (1950) described a combined method for fixation and pressure in skin grafting by plaster-of-Paris splints, but the main emphasis was on pressure. Pickrell (1950) devised a method, based on Pascal's law of fluids, whereby gelatine was used to obtain an even pressure on grafts over irregular surfaces.

Dr J. P. Plast Surg 1957-58

role (1941 *a, b*) did differentiate between primary and secondary skin grafting, feeling that pressure was most important in the former. "The condition is most evasive and most difficult to assure is pressure. Endeavour should be concentrated on improvement in this direction."

It will be noted that although much emphasis is laid on the need for pressure, of these writers says anything about the *amount* of pressure nor do they now precisely this can be attained and maintained. Ferris Smith (1926 *a, b*) the matter much thought and eventually concluded, after trial, that a dressing pressure of 30 mm. Hg was satisfactory and correct for Wolfe grafts, but he said that "this same care is not vital to the success of split-skin grafts." He noted the necessary pressure by using an inflatable bag over the graft and its ing.

Our own observations on "pressure bandages" have led us to believe that ever pressure might have been applied at the time of bandaging over a graft, pressure within a matter of hours must fall to something very small. In ion, we have been impressed by the favourable "take" of patch grafts on alating surfaces where, for one reason or another, no pressure and no dressing been applied in seriously ill burned patients. The question, "Is pressure *vital* for the 'take' of a graft?" seemed worthy of investigation. Perusal of earlier literature on the subject described methods of skin grafting in which ter pressure nor dressings were used—views conflicting with present-day is.

Staige Davis (1919) wrote: "Too much pressure on the dressing over the ed area may cause sloughing of the freshly applied graft, and heavy dressings ing too much heat and sweating are to be avoided." However, he did quote ing (1904), who advocated leaving the grafts exposed because the absence of sings prevented displacement of the grafts, and any collection of serum under grafts could be quickly noticed and pressed out.

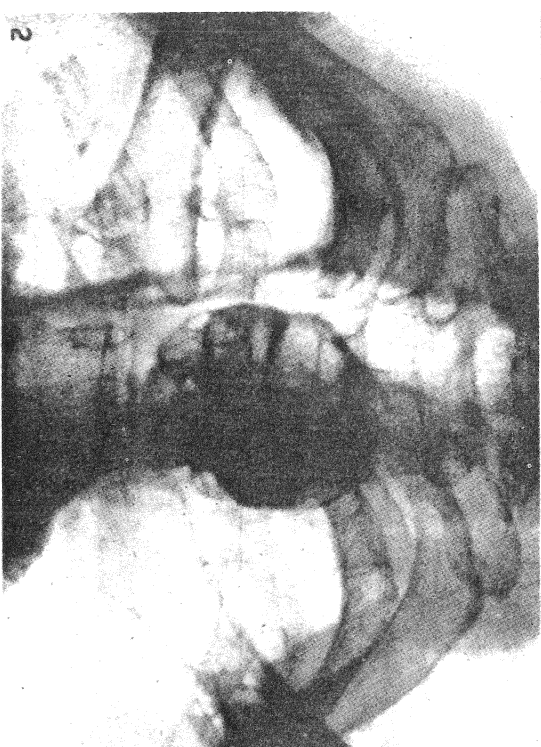
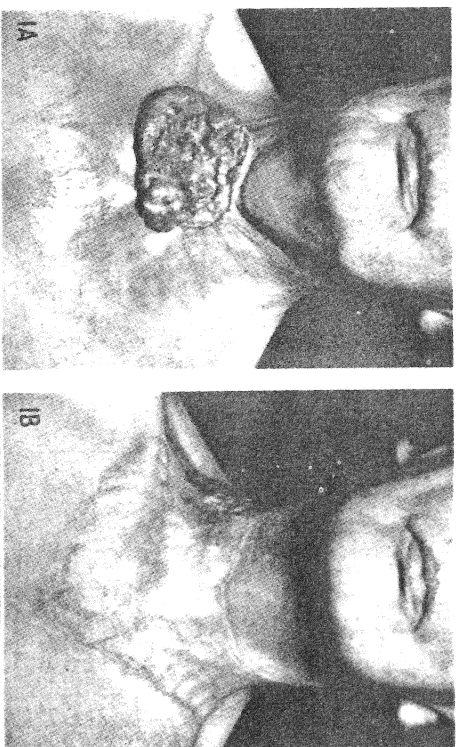
Goldmann (1906) held that since the open method gave secure fixation, h occurred within the first twenty-four hours, exposure to the air allowed ng of the cementing substance. Laplace (1908) followed the exposure method n applying grafts to granulating surfaces. Cole (1941 *b*), in more recent times eared no pressure and no dressings for grafts on granulations and used a wire e and the use of pressure for skin grafts in a letter to the *British Medical Journal*, referred to the use of heavy grey wool covered leaving skin lifts bare whenever possible, so that one can snip any blebs that form.

In order to assess the need or otherwise for pressure dressings to ensure the isfactory "take" of split-skin grafts it was decided to apply grafts on a suitable v surface without any dressing whatever.

Case Report.—Female, M. C., aged 59. Thirty-five years ago X-ray therapy was scribed for a simple goitre. Treatment was given at fourteen-day intervals on nine asions. Three months later another course was started but a reaction, like a scald, curred on the neck and this soon healed. Five years later little hard irritable spots eared in the skin which subsided after application of strapping. For the past two ars there had been a fungating growth on the right side of the neck skin which eadly bled, had a profuse discharge, and slowly increased in size.

Examination showed a large infected fungating carcinoma surrounded by an are radio-dermatitis of the whole neck skin (Fig. 1). X-ray of the neck disclosed a calcified enoma on the right side in the thyroid gland (Fig. 2). On 7th July 1955 the whole of

the affected skin and the fungating growth were excised down to the deep fascia. Two lymph glands were removed and shown to be free from neoplasm. Histologically the fungating area was a poorly differentiated carcinoma, Broder's Grade III.



Figs. 1 and 2

Fig. 1.—Exposed delayed cooled graft to neck. M. C., female, aged 59.
A, Original condition of carcinoma (Broders Grade III) following radiotherapy thirty-five years previously.
B, Result five months later. The ulceration on the right side of the graft followed treatment by radium needles for a recurrence of growth one month previously.

Fig. 2.—Same patient as in Fig. 1. X-ray of chest to show the now calcified thyroid adenoma.

In view of the presence of infection and the irregular oozing surface this large wound was dressed with dry gauze and immobilised by a simple ruffe.

On 12th July 1955 the dressing was removed and the wound thereafter treated with

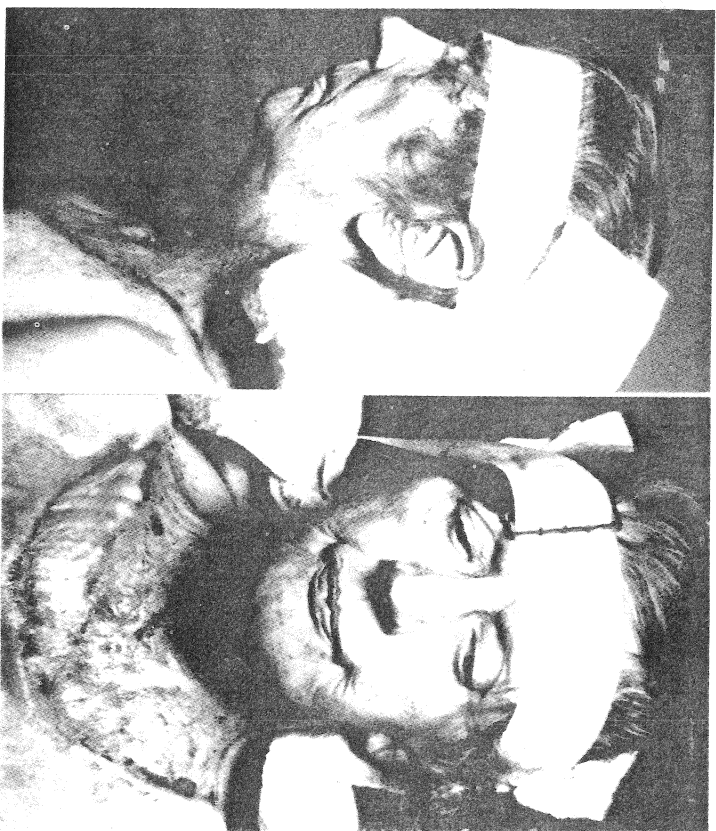
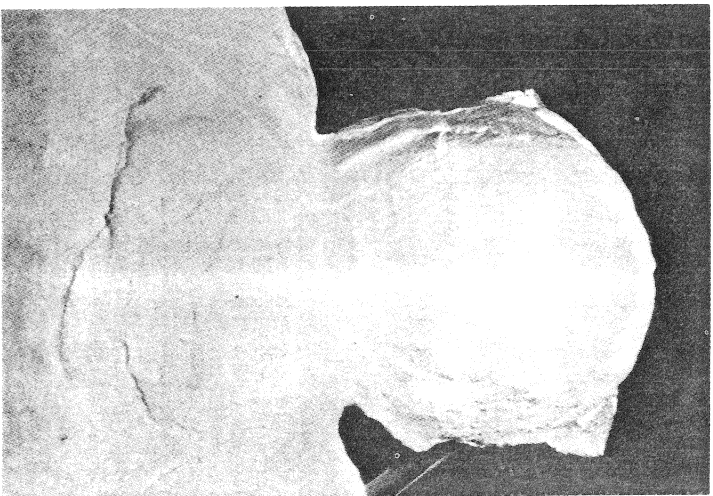


FIG. 3

Same patient as in Fig. 1. To show the simple type of immobilisation splint used; a plaster shell with webbing straps for the head and chest.



5 per cent. Milton on gauze twice a day, and later by Furacin ointment. Smears from the area grew *Staph. aureus* and β haemolytic streptococci at first. Only the *Staph. aureus* persisted, and on 21st July 1955 medium thickness grafts were cut from the left thigh and laid over the raw surface on the neck. No fixation and no dressing was used; Dr Longacre, who was present, suggested that even the tulle gras covering the graft should be removed. The head, neck and shoulders were immobilised in a prefabricated plaster-of-Paris back shell (Fig. 3). A stomach tube was used for feeding for the first three days to reduce the amount of movement from swallowing; by then the grafts were all pinkish and appeared to have taken. Fourteen days after grafting the grafts were well healed without loss, the splint was discarded, and the patient ready for discharge.

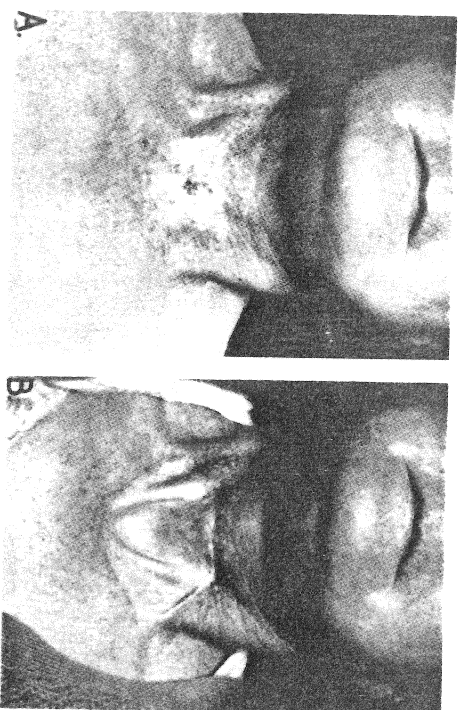


FIG. 4

Delayed primary exposed graft to neck.

D., W., female, aged 56. Thirty-five years ago had X-ray treatment for thyrotoxicosis. Area of radiodermatitis over the neck had a central scab, suspected to be malignant. Excision and delayed (forty-eight hours) application of a very thick split-skin graft. No dressings. The head was immobilised in a plaster shell similar to that in Fig. 3. Healing without loss.

A, Original condition.

B, Result ten months later.

(Mr Eric Peet's case.)

Since these grafts did so well, this method was tried in twenty-five other patients, particularly for skin grafting in those situations where dressings were difficult to apply satisfactorily. The later results were equally encouraging (Figs. 4, 5, and 6), and they make it clear that pressure on grafts is not necessary for their successful take.

In addition, the dressings needed to produce adequate pressure have several disadvantages which cannot be lightly dismissed. Among these are:—

1. The danger of necrosis if pressure is too great where the recipient area overlies a rigid structure such as bone.
2. The frequent failure of well-applied pressure dressings to prevent hematoma formation below a graft.
3. The inability to see collections of blood or serum below a graft in the early stages when prompt evacuation of the collection may yet prevent loss of the graft.

4. The time needed to apply effective dressings at operation.
5. The expense of such dressings.
6. The danger of leaving suture marks where stitches are used to immobilise the graft or dressing.

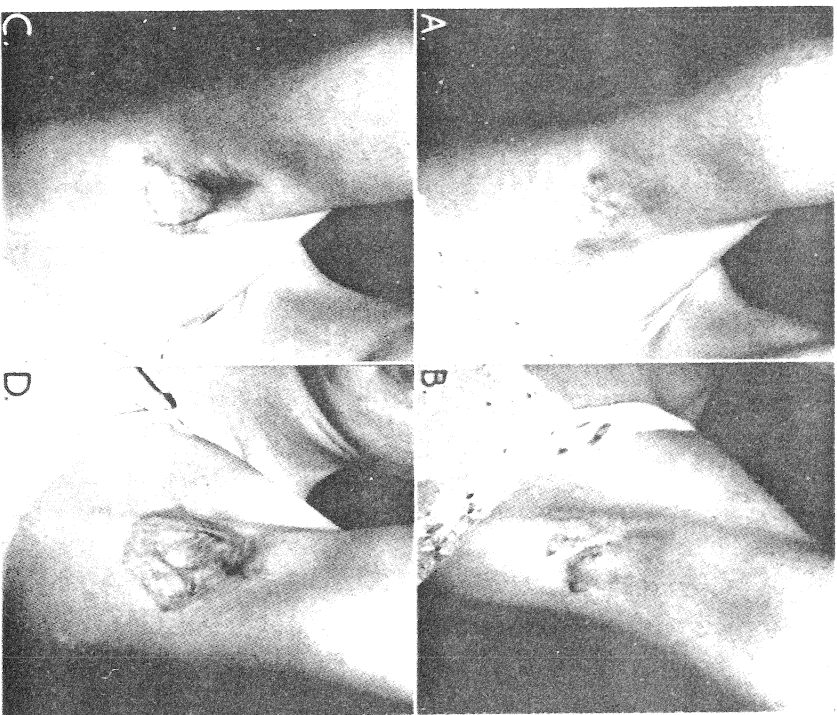


FIG. 5

Delayed exposed grafts to axilla.

Y. S., female, aged 28. Ten years' history of hydradenitis suppurativa of both axillae. Areas of affected skin excised and covered by medium thickness grafts four months later. Healing without loss. Arms immobilised on a double abduction frame.

A and B, Original condition. There is some contracture of the marginal scars, evident only in this position of full extension.

The chief disadvantage of dressings over grafts is, however, seen in those situations where *immobilisation* of the part being grafted is impossible, e.g., chest wall or front of neck. In such situations dressings are likely to do more harm than good because the moving base may cause the graft to be rubbed against a rigid dressing, so shearing it off, or causing bleeding from the raw surface beneath the graft.

II. THE COOLING OF GRAFTS

There is one other important consideration to be taken into account. Dressings cause the graft to become warmed to the temperature of the recipient area. The higher the temperature of the graft, the greater will be the metabolic activity of its cells. This increased metabolism may be of paramount importance during the critical time when the graft has as yet no intravascular circulation. If dressings are not used, the important principle of keeping the graft cool can be put into practice, thus ensuring more complete survival of the graft.

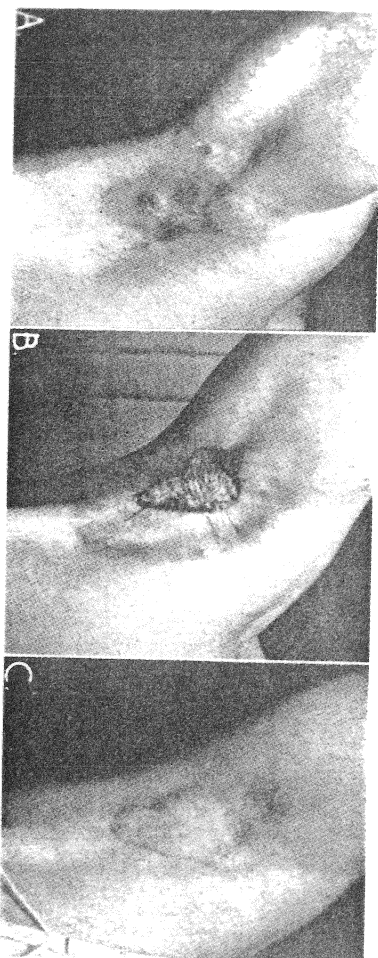


FIG. 6

M. F., female, aged 51. Six months' history of hydradenitis suppurativa. Treated by excision and delayed exposed thick graft to right axilla.

A, Original condition.
B, Graft on thirteenth day, two days after the arm had been taken down from the abduction frame. Note the wrinkling of the graft. When the arm was abducted the axillary defect was nearly twice the size.
C, Result six months later.

Medawar (1945), in discussing the experimental study of skin grafts, noted: "The length of time which skin can survive in the absence of food and oxygen is a function of its temperature—at least within the physiological range 0° to 37° C. The higher the temperature, the shorter the time of survival.

"A free skin graft spends a preparatory period of its life *in situ* in an ischemic condition, deprived of a free circulation of blood or of any supply of oxygen. It remains in this condition until an effective blood supply reaches the underlying dermis—i.e., for a length of time which is roughly proportional to its thickness.

These remarks clarify what has been known clinically for a long time—that thin grafts take better than thick ones. The period of ischemia, during which the graft must survive by absorption of the serous exudate from its bed—the so-called "plasmatic circulation"—was investigated by Davis and Traut in 1925 by experiments on eight dogs. These writers concluded that after twenty-two hours a vascular circulation was established in one graft, but that an "adequate circulation which can determine the survival of a graft is not established until the eighth day." They concluded that "any technique which tends to occlude the vessels of the graft is disadvantageous."

More recently Conway *et al.* (1951) have estimated the duration of the

"plasmatic circulation" as five days, basing their conclusions on observations made on mice and using a tissue chamber technique.

It is during this early period of one to eight days that the survival of a skin graft is in the balance. Any method which prolongs the viability of skin beyond this critical time is worthy of notice.

Medawar (1945) suggested "cooling" skin grafts by exposing their surfaces to air at room temperature, thereby lowering metabolism and so postponing any autolysis due to ischaemia.

Pepper (1954) in a carefully controlled experiment showed how the survival time of stored skin grafts varied inversely with the temperature of storage. Skin grafts were cut, stored at a constant temperature for a certain length of time, and then reappplied to a large raw surface on the same rabbit. The viability of a graft was determined by its "take"—in the same way that one estimates it clinically. Pepper's conclusions are given below :—

Storage Temperature.	Survival of Graft in Days.
0° C.	35
13° C.	21
22° C.	11
30° C.	7
37° C.	3 to 5

Unfortunately the thickness of the grafts cut is not recorded, but the suggestion was that if thick autografts were maintained at 30° C. at the recipient site the "take" might be facilitated. This hypothesis was tested on guinea-pigs, but owing to technical difficulties was inconclusive.

The idea of "cooling" is not new. Martin (1873) noted that preservation of skin in cold was favourable, whereas heat was unfavourable and resulted in shortened viability. He also found that moisture hastened decomposition. Even so, in the past, little notice has been taken of the value of "cooling" grafts in order to ensure their "take."

Medawar (1954 *a, b*) restated his opinion in support of Pepper's work. The idea of cooling skin grafts is based on sound biological principles, and since it has been established that pressure is unnecessary for the take of a graft, a technique which dispenses with dressings would be advantageous.

Results of Cooled Grafts.—In twenty-five patients grafts without dressings have been applied to the following areas :—

Axillae	7
Neck	2
Pubis and groins	2
Abdominal wall	2
Leg	9
Forehead and scalp	4
Perineum	2
Back	1

For the axillae the arms were splinted in abduction on an "aeroplane" type of removable splint; the neck was immobilised by a plaster shell covering the back of the head and shoulders (see Fig. 1); and the leg cases had plaster back slabs. All others were not immobilised except for a wire protective cage strapped over the grafted area (Figs. 7, 8, 10, and 11).

Healing in all cases was as rapid as for grafts applied in the normal manner. No graft was lost by haematoma formation, but in two infected legs small portions

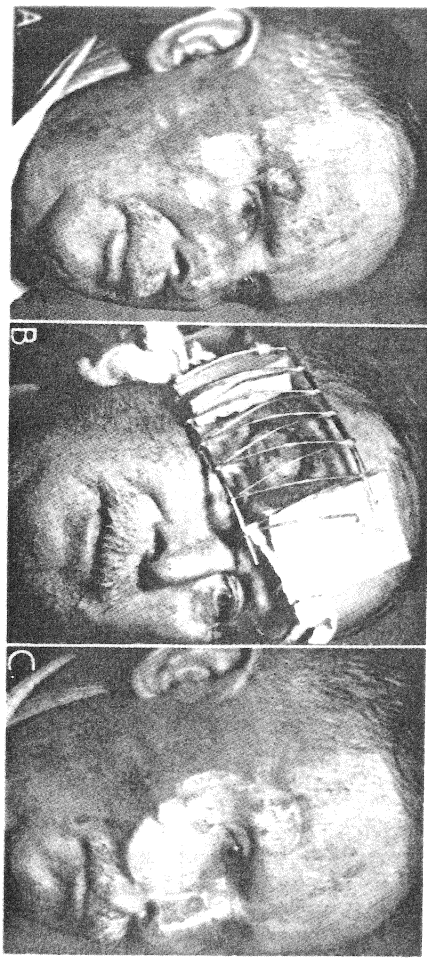


Fig. 7 To show protective splint for forehead.

F. B, male, aged 82. Squamous-cell carcinoma on right cheek excised and grafted in 1951. Three years later recurrence above right eyebrow treated by radiotherapy (radium needles: 5,000 rads.). Subsequent ulceration due to radionecrosis. Treated by excision and delayed exposed thin graft applied six days later.

A, Original condition. B, Nine days after grafting. There is a small area of loss in the centre—an avascular necrosis. C, Result seven months later. The wool swab on the right cheek covers a biopsy wound (hyperkeratosis).

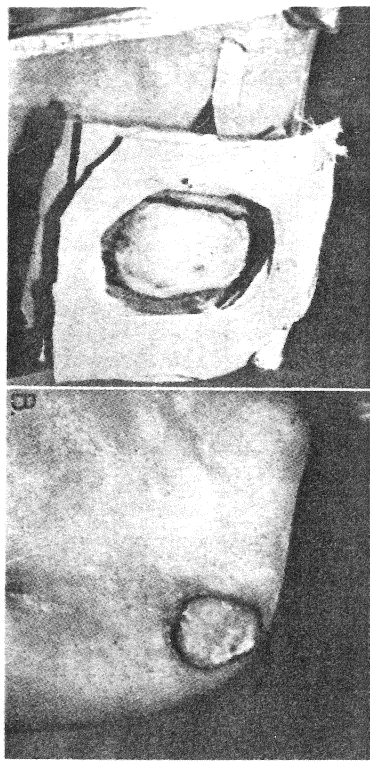


Fig. 8 To show use of cut-out pad for protection of grafts.

H. W., male, aged 69. Basal-cell carcinoma on left shoulder treated by excision and delayed exposed cooled graft. The protective pad was several layers of orthopaedic felt stuck to the skin: arm immobilised by a collar-and-cuff sling. No dressings.

A, Appearance of graft on fourth day. B, Result on twelfth day.

were lost from infection at the margins. One scalp graft acquired a β haemolytic streptococcus on the fifth day which devoured nearly half the graft before being brought under control. The defect remaining was prepared by local antiseptics

and more skin applied from store (refrigeration at 3° to 6° C.) with complete "take" one week later (Fig. 9).

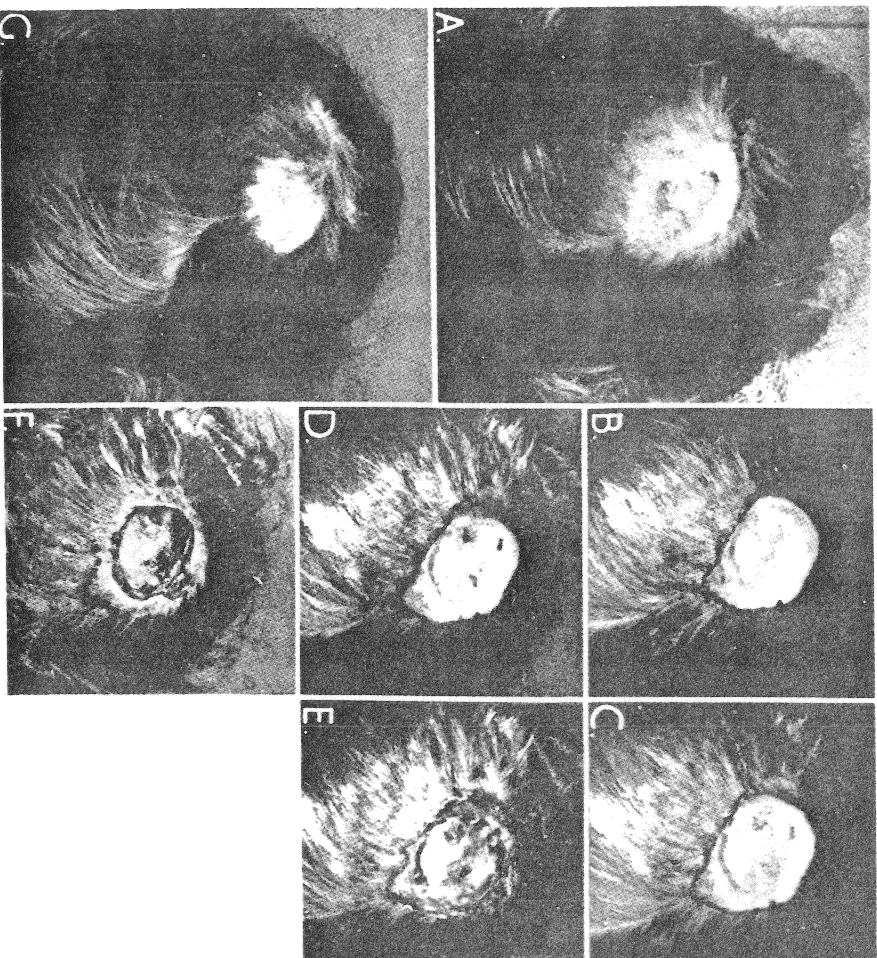


Fig. 9

Streptococcal infection in an exposed graft.

- E. P., female, aged 45. Basal-cell carcinoma of scalp treated as alopecia for five years and associated with generalised psoriasis. Excision and medium thickness graft applied on fifth day.
- A. Original condition in centre of the shaved area.
- B. Graft three days after application is thick, pale, and firmly adherent.
- C. Fifth day : three blisters snipped.
- D. Sixth day : little change.
- E. Seventh day : dramatic deterioration overnight in the appearance of the graft when most of it became dry and crusted. Small bead of thin pus at one edge grew a β hemolytic streptococcus and *Staph. aureus*.
- F. Two days later following treatment by local antiseptics it was clear that less than half the graft had been lost. Skin from store was applied to the raw area one week later.
- G. Final result six months later.

In six cases the grafts were very thick and amounted almost to full-thickness (Wolfe) grafts : all took without loss.

The donor sites, usually the thigh, were treated by exposure according to

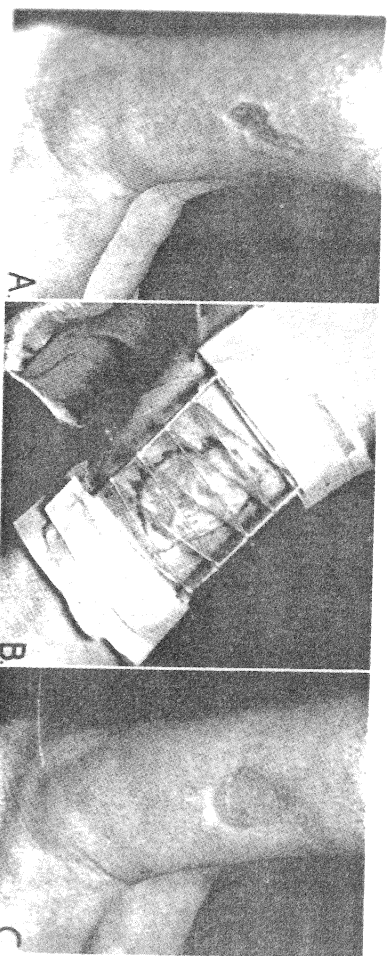


Fig. 10

D. F., female, aged 39. Indolent ulcer of right leg following mild trauma two months previously. Treated by excision and delayed exposed graft.

- A. Original condition.
- B. Graft on third day to show protective wire cage. No other splinting was used.
- C. Result six months later.

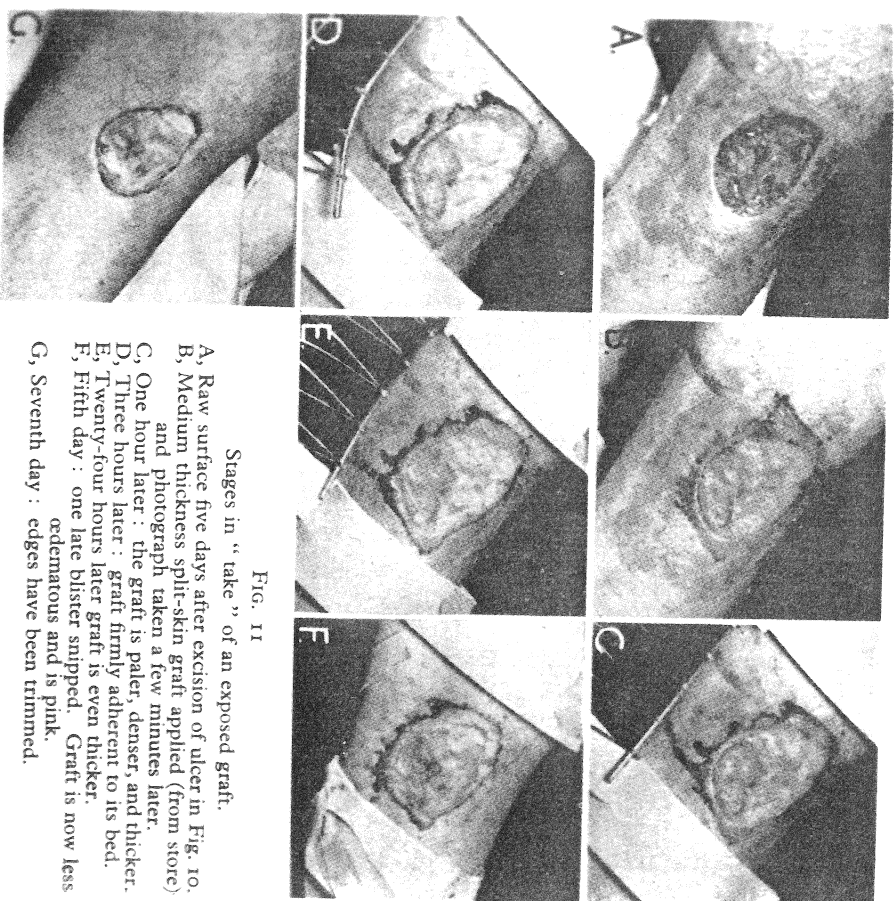


Fig. 11

Stages in "take" of an exposed graft.

- A. Raw surface five days after excision of ulcer in Fig. 10.
- B. Medium thickness split-skin graft applied (from store) and photograph taken a few minutes later.
- C. One hour later : the graft is paler, denser, and thicker.
- D. Three hours later : graft firmly adherent to its bed.
- E. Twenty-four hours later graft is even thicker.
- F. Fifth day : one late blister snipped. Graft is now less oedematous and is pink.
- G. Seventh day : edges have been trimmed.

the technique of Artz *et al.* (1955) with satisfactory results. Donor areas were usually covered by a thin dry crust within forty-eight hours (in much the same way that burns treated by exposure are), but in two cases where grafts had been cut under local anaesthesia drying was not complete until seventy-two hours. Two patients complained of intense pain in the donor site for the first twenty-four hours, but the remainder found these exposed dry crusts to be very comfortable and usually were up and about by the fifth day.

III. DELAYED GRAFTS

Two other factors must be considered in connection with the successful "take" of skin grafts. The first is the nature of the recipient area, and the second is the perennial problem of control of infection. As regards the recipient area a short delay after its surgical preparation is thought at present to offer certain advantages:—

1. If sepsis is present then the open wound permits free drainage to the surface and gives an opportunity for control of the infection before the graft is applied. There are many ways of doing this, but the main principles of wound dressing are followed, that is, if no slough is present surface infection is minimised by attempting to keep the surface as dry as possible by well-applied absorbent dressings, and if fragments of dermal slough remain moist dressings are used to clear this first. Furacin ointment on gauze has been the main antiseptic preparation used; but 1 per cent. streptomycin soaks applied twice daily have also been used.
2. Bleeding from the recipient surface cannot in all cases be effectively prevented in the early period after the raw area is created. We believe that haematoma formation below a graft is by far the commonest cause of failure. Delay in applying the graft almost eliminates this complication.

3. Delay in applying the graft allows time for the elaboration of granulation tissue on the raw surface. The granulation tissue is the guarantee of adequate vascularity of the surface to be grafted. This is of especial value in relatively avascular areas.

The control of infection in the grafted area must be mentioned here. It has been established without question that if a surface is kept cool and dry, infection does not become a problem provided some skin elements either living or dead remain on the surface; exudates dry and form crusts. On a completely denuded surface, however, the exposure method does not work. The exudates do dry but become heaped up in hypertrophic crusts below which pus soon forms. Therefore when grafted areas are left exposed without any dressings it is necessary to cover *all* the raw surface with the graft or grafts. Widely spaced patches allow exudates to escape, but unpleasant hypertrophic crusts form and pus collects below them. These necessitate the application of moist dressings within two to three days; and although such a short period of exposure is of value in some cases, it is generally better, where the graft is inadequate to cover all the raw surface, to use dressing from the beginning.

Technique used in Delayed Primary Grafting.—In all except two of the twenty-five cases where no pressure was used, skin grafts have been applied some five to twelve days after creation of the recipient area. The technique followed has been to cut the skin graft, to place it folded on tulle gras in a dry sterile jar, and to store this in a refrigerator at 4° C. At the same operation the recipient area,

created by excision of some offending lesion, after careful haemostasis is covered by a bulky occlusive dressing of dry sterile gauze. After five days the occlusive dressing is gently removed, the stored skin applied to the now granulating wound, and the covering of tulle gras removed. The graft is teased out to fit any irregularities in its bed and air bubbles are removed—if large by "milking" them towards the margin, if small and localised, by snipping the skin graft over them. The essential splinting of the recipient area, usually by a prefabricated plaster-of-Paris cast, is then completed.

We have called this "delayed primary grafting."

Observations on Exposed Grafts.—Delayed primary cooled grafts behave in a uniform manner. The following changes were noted in thick split-skin grafts applied to both axillae five days after excision of an area of hydradenitis suppurativa (see Fig. 11):—

First Day.—The graft when applied was white (and usually is unless it has been allowed to come into contact with blood at the time of cutting) and looked lifeless. Within an hour it had begun to swell up, by absorption of serum from the recipient area, and within two to three hours moved with the part as though firmly glued to its bed.

Second Day.—The graft was still white and probably two to three times its original thickness. There was a little serous discharge from one edge where there was no graft overlapping the normal surrounding skin. Both graft and surrounding skin were curiously quiescent and showed no reaction.

Third Day.—The graft still looked white and lifeless, much as it did on the first day. There was no discharge and it moved easily with the underlying deep tissue.

Fourth Day.—The centre of the graft showed bluish streaks and spots, the remainder being yellowish-white.

Fifth Day.—The central streaks were purplish or reddish blue. There was no collection or discharge.

Sixth Day.—The central area was almost puce and more diffuse.

Light Day.—The graft was purplish-pink with a few mottled white areas. It was curiously quiescent with no marginal reaction. The graft looked very thick and could be moved with the deep tissue by a palpating finger. It appeared to be a complete "take." The margins overlapping normal skin, which were thick and white, were cut away and in several places the cut edge bled freely.

Tenth Day.—The margin of the graft and the surrounding skin still looked pale and quiescent. In the past three days there had been little change in the graft, which appeared to be "hanging fire." There was no suggestion that the cuticle was going to be shed. It has been noted that exposed grafts often do not shed their cuticle—a usual event in grafts which have been covered with dressings. This may be explained by the survival of the complete thickness of the grafts which are cooled, whereas in covered grafts some or even all of the epidermal part of the graft may perish, possibly because the limited fluid circulation is unable to meet the demands of the increased metabolic processes (due to the higher temperature) of the graft before vascularisation occurs.

If the skin graft is thin and more translucent, then on the first day it looks pink (due to the colour of granulation tissue beneath), but by the second day has become quite pale. By the fourth day a dusky pinkish-blue colour returns, which gradually becomes more pink as the days pass.

CONCLUSION

1. Pressure is not necessary for the "take" of a free skin graft.
2. Cooling of grafts allows them to survive *in vitro* for a length of time that is roughly inversely proportional to the temperature, within physiological limits, i.e., the lower the temperature, the longer the time of survival.
3. Exposure of skin grafts applied to the body so that they are at room temperature appears to prolong their survival during the time of the "plasmatic circulation."
4. The exposure of grafts is practicable and appears to offer certain advantages clinically.
5. In some areas where the application of dressings is difficult, or where movement cannot be completely controlled, delayed primary application with exposure of the graft is a satisfactory method for obtaining skin cover. It avoids the necessity for bulky dressings and complicated splinting.
6. Exposed grafts can be examined daily during the period of "take" so that blisters and areas of failure may be recognised early and appropriate treatment instituted.
7. The delay in applying skin grafts does not seem to affect the final result, in that the thin layer of granulations between recipient site and graft does not produce measurable fibrosis.

We wish to acknowledge indebtedness to our colleagues who have allowed us to treat and investigate some of their patients.

REFERENCES

- ARIZ, C. P., BROWNELL, A. W., and SAKO, Y. (1955). *Ann. Surg.*, **142**, 248.
 BARKSY, J. (1950). "Principles and Practice of Plastic Surgery." London: Baillière, Tindall & Cox.
 BROWN, J. B., and McDOWELL, F. (1949). "Skin Grafting." London: Lippincott.
 COLE, P. P. (1941 a). *Lancet*, **2**, 143.
 — (1941 b). *Brit. J. Surg.*, **28**, 585.
 COLT, G. M. (1942). *Brit. med. J.*, **2**, 619.
 CONWAY, H., STARK, R. B., and JOSTIN, D. (1951). *Plast. reconstruct. Surg.*, **8**, 312.
 DAVIS, J. S. (1919). "Plastic Surgery: Its Principles and Practice." London: Kimpton.
 DAVIS, J. S., and TRAUT, H. F. (1925). *Ann. Surg.*, **82**, 871.
 Editorial (1946). *Lancet*, **2**, 350.
 FOMON, S. (1939). "Surgery of Injury and Plastic Repair." Baltimore: Williams & Wilkins.
 GOLDMANN, E. (1906). *Zbl. Chir.*, **33**, 793.
 LAPLACE, E. (1908). *Med. Bull., Philad.*, **30**, 83.
 LEWIS, E., EDWARDS, J. R. G., and PHILLIPS, A. J. B. (1950). *Brit. J. plast. Surg.*, **3**, 77.
 MARTIN (1873). "Vitality of Grafts." Paris These. Quoted by H. Neuhof (1923).
 "Transplantation of Tissues." London: Appleton.
 MATTHEWS, D. N. (1946). "Surgery of Repair." Oxford: Blackwell.
 MAY, H. (1947). "Reconstructive and Reparatve Surgery." Philadelphia: Davis.
 MEDAWAR, P. B. (1945). *Brit. med. Bull.*, **3**, 79.
 — (1954 a). *Proc. XVII Congr. Soc. Int. Surg.*, p. 269.
 — (1954 b). *Proc. Soc. Med.*, **47**, 57.
 PADGETT, E. C., and STEPHENSON, K. L. (1948). "Plastic and Reconstructive Surgery." Springfield, Ill.: Thomas.
 PEPPER, J. F. (1954). *Brit. J. plast. Surg.*, **6**, 250.
 PICK, J. F. (1949). "Surgery of Repair." London: Lippincott.
 PICKRELL, H. P. (1950). *Brit. J. plast. Surg.*, **2**, 274.
 SMITH, F. (1926 a). *Surg. Gynec. Obstet.*, **42**, 556.
 — (1926 b). *Surg. Gynec. Obstet.*, **43**, 99.

COMPLETE AVULSION OF SKIN OF PENIS AND SCROTUM

By VOJTECH KUBACEK, M.D.

Department of Plastic Surgery, Masaryk University, Brno, Czechoslovakia

Loss of the skin of the external male genital organ, due to an accident rarely in time of peace. The first mention of this type of injury was Diefenbach and in medical literature a description of the first case is presented by Gibbs in 1855. With the constant development of increasing use of machinery in varying branches of work this injury has become more common, particularly in the course of the last ten years, and about sixty cases have been recorded.

MECHANISM AND EXTENT OF INJURY

The mechanism of the injury is for the most part the same. Cloth often trousers, are caught by the unprotected, rapidly rotating shaft of the drive wheel and the twisting clothes catch the easily pliable skin of the external genital organs and strip it off. The skin of the penis is with the deeper layers by means of a delicate and loose connective tissue very easily movable, and therefore in the majority of cases the body of the penis and the content of the scrotum are kept intact. This fact sets the injury external genital organ apart from those occurring in war-time in which in to avulsion of the skin covering, destruction and partial or complete loss of corpus of the penis or the content of the scrotum is found. Therefore injuries of the external genital organ are considered to be a particular in surgery, often requiring a much more complicated and complex treatment which we do not intend to deal with in the present communication.

In most cases only the skin is stripped from the penis. The loss may be complete, including total avulsion of the whole prepuce at the sulcus of the penis, or partial, in which the whole prepuce may be left intact, as was the case with one of our patients. Occasionally, denudation of the penis occurs even in combination with a partial loss of the scrotal skin at the root of the penis.

Less frequent is denudation of the penis in combination with a complete loss of the scrotal skin, occasionally even with the avulsion of amounts or of the complete covering of the testicles. A thorough search of literature at our disposal revealed twenty-two discussions on combined loss of the skin of the genitalia.

SURGICAL CONSIDERATIONS

Denudation of the external genital organ is an extremely painful injury, which in most cases is followed by neurogenic shock. Therefore as possible morphine should be administered when first aid is given. The loss of skin avulsions blood loss is negligible and first aid is on the whole simple and consists fundamentally in aseptic emergency dressings. It is advisable