

## Designs of Splints for Preventing Skin Graft Contraction and Study of their effectiveness

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**T**HE contraction of skin grafts is an important factor in the recurrence of post burn contractures. Attempts have been made to modify this behaviour of skin grafts. It has been shown that maintenance of (i) proper corrected position of the joints after skin grafting (Keopke, 1967; Evans, 1968) and or (ii) constant mild pressure on the graft e. g. in neck (Cronin, 1961; Gibbon, 1965; Dingman, 1961; Cramer, 1964; Tanzer, 1964; Ousterhout, 1969, and Evans, 1968, 70) minimizes or prevents contractions of skin grafts, and recurrence of contractures.

In our attempts to inhibit contraction of skin grafts we have largely depended on the principles, but certain modifications had to be incorporated in the design of our splints because of (i) the peculiarities in anatomy of the parts to be splinted and/or (ii) the functional importance of the affected parts, precluding application of constant and prolonged pressure and consequently we have taken into consideration following points while designing the splints :

(a) The corrected position of the affected part is maintained.

(b) The pressure is selectively applied over the grafts leaving the adjoining skin free.

(c) The free mobility of the affected joints is permitted for the sake of convenience to the patient and maintainence of function.

(d) Any residual deformity persisting after release of contractures due to unyielding contracture of muscles, blood vessels, nerves and capsular ligaments is also simultaneously corrected by employing gradual traction,

The splints designed for achieving this have varied depending upon the requirements in the different areas. For this purpose the different regions of the body have been divided into four broad groups having similar features.

Group 1. Areas which conform to the shape of cylinders or cones e. g. (i) extending from wrist upto axilla and (ii) from ankle upto inguinal region.

Group 2. Comprising axilla, neck, inguinal region and breast with adjoining chest wall.

Group 3. Comprising face.

Group 4. Includes small joints of hands which perform intricate functions and are prone to become stiff by prolonged immobilization.

**Group 1.** Areas conforming to the shape of

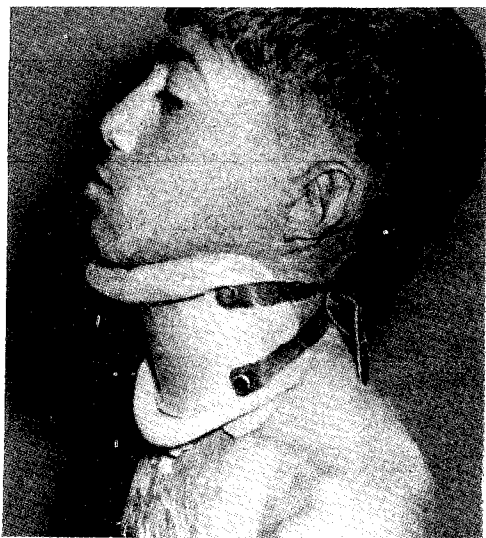
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cylinders or cones :

At these sites the application of constant mild pressure on the grafts and maintenance of corrected position is easy and is achieved by an elastic crepe bandage tied over half to one inch thick sponge rubber placed over the graft. This selectively exerts greater pressure over the graft as compared to the rest of the adjoining areas.

**Group 2.** Comprising neck, axilla, inguinal region and breast with adjacent chest wall.

(i) Neck—whereas maintenance of corrected position and constant pressure over the graft is best obtained by a moulded splint covering the grafted area in the neck, it has been our experience that patients do not wear such a splint constantly because of the inconvenience in performing daily activities due to restriction of the movements of the neck. We have therefore relied on a simple collar splint made with aluminium sheet cut



*Fig. 1—Showing the mode of application of a collar splint for grafts on neck.*

to a proper size and lined with an inch thick sponge rubber, which extends beyond its edges to cover most of the grafted area. The metallic sheet extends from cervico-mandibular angle to cervico thoracic angle in front, to the mid lateral lines of neck on either side. The splint is tied with leather straps at the back of neck so as to exert mild pressure over the graft. (Fig. 1). This splint allows complete freedom of all neck movements and so can be worn constantly for long periods without inconvenience.

(ii) Axilla—when extensive contractures of axilla are released the skin grafts generally extend from axilla to the side wall of chest and arm. Maintenance of axilla in full abduction i. e. corrected position, is difficult as it is inconvenient, cumbersome and interferes with daily activities. Prolonged application of pressure over the whole of the grafted area i. e. from arm across axilla to and over the chest wall, without restriction of movements may be technically difficult if hollow of the axilla is to remain expanded without causing wrinkling of the graft. It has been our experience that if pressure is maintained on apex of the axilla, anterior and posterior axillary folds and adjoining chest, the graft in axilla does not contract significantly and contractures do not recur. This is accomplished by application of a moulded plastic or thin metallic sheet, conforming to the contour of the side of the chest and extending upwards as far up as anterior and posterior axillary fold 0.5" below apex of axilla. It is lined by 1" thick sponge rubber which extends beyond the metallic sheet all round except in axilla, where it extends 2" above its upper edge, covering the graft on medial side of arm or lateral wall of axilla, and is strapped

to the chest by elastic/leather straps. When in place with arm resting on the sides of chest it exerts mild constant pressure on the graft. The sponge rubber which extends upwards into the hollow of the axilla maintains pressure and prevents wrinkling of graft in axilla. The splint is convenient to wear under clothes and permits full range of movements of shoulder and thus does not interfere in daily activities (Fig. 2).



Fig. 2—Showing the mode of application of axillary splint, and freedom of movements permitted by it.

(iii) Groin—The splint designed for groin is of the nature of a wide sheet of elastic lined by a sponge rubber applied to the inguinal region and strapped to abdomen and thigh with elastic/leather straps in the manner of a figure of eight. It maintains constant pressure over the graft and at the same time permits free movements (Fig. 3).

(iv) Breast and Adjoining Chest—In extensive contractures of the chest obliterating breast projection and profile, after relea-

sing the contracture and restoring the normal position and contour of the breast and resurfacing it with grafts, it is important to maintain the normal shape of the breast. This involves preventing contraction and maintaining position of the skin graft carried from front of chest to under surface of breast. This is achieved by a moulded plastic/metallic sheet lined by a sponge rubber and fitted over the graft and strapped to the chest.

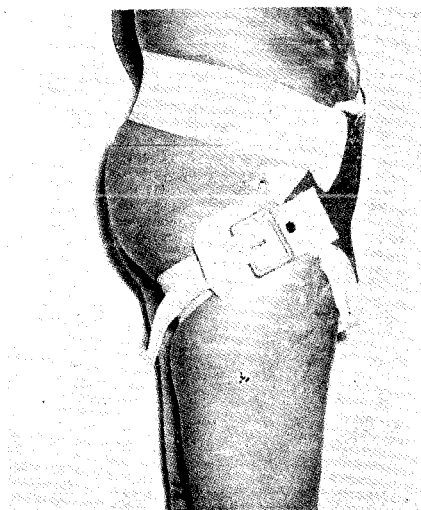


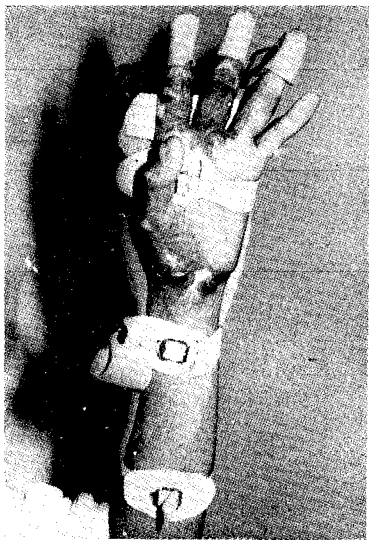
Fig. 3—Illustrating an elastic splint exerting compression on the grafts in inguinal region.

### Group 3 Comprising face :

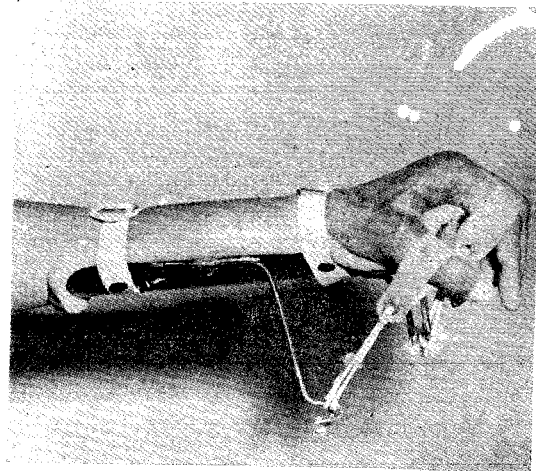
Grafts placed on forehead, cheek and chin are amenable to compression but splints have to be tailored to the needs. The compression is exerted by an aluminium sheet moulded to conform to chin, cheek contour and lined by a sponge rubber and maintained by elastic or leather straps. Forehead grafts are compressed by elastic bands supplemented by sponge rubber and strapped at the back. Grafts on upper lip, nose and eyelids are difficult to manage with such splints.

**Group 4** Comprising area of small joints of hands and fingers :

Whereas application of mild pressure on the grafts is necessary it is not possible over flexor/extensor surface of metacarpophalangeal and interphalangeal joints without immobilizing them and consequently producing stiffness. The splints therefore are so designed as to keep the grafts under constant tension or stretch while simultaneously allowing active as well as passive movements i. e. using dynamic splints. Gradual traction not only prevents graft contraction but also aids in further correction of the residual deformity remaining after inadequate release of contracture, due to contracted musculotendinous units, digital vessels, nerves, capsular and collateral ligaments, by gradually stretching the soft tissues (Fig. 4, 5). Traction principle is not effective in counteracting contraction of grafts in the palm or finger webs, so that splints for such areas are so

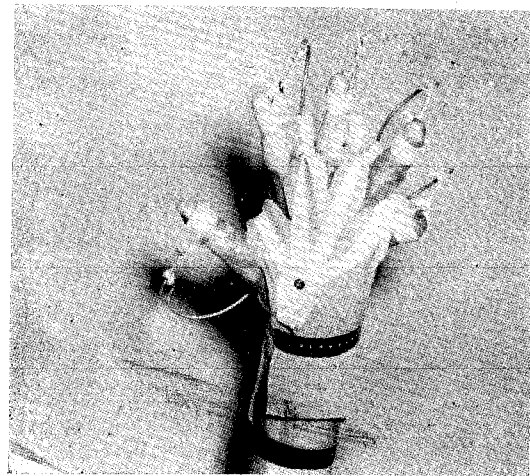


*Fig. 4—A dynamic traction splint for grafts on flexor aspect of fingers.*



*Fig. 5—A dynamic traction splint for grafts on extensor surface of hand.*

designed that while traction is maintained on the fingers, compression applied on the graft in the palm and finger webs and at the same time active movements of fingers are permitted (Fig. 6).



*Fig. 6—A dynamic traction cum compression splint for grafts on flexor aspect of fingers, palm and finger webs.*

#### **Time and Duration of Application of Splints**

The maximum contraction of the skin grafts is known to occur during the first two

weeks after take of grafts. During this period the graft has not consolidated and cannot withstand, compression, pressure or traction or shearing strain. Therefore during first two weeks we maintain the position of joints by applying Plaster of Paris splints closely fitting the grafts. After three weeks when the grafts have consolidated, the suitable splints are applied. The duration for which the splints are maintained depends on the behaviour of grafts under the splints of various kinds. It has been seen that skin grafts on which pressure is maintained settle early and no further contraction occurs if compression splints are worn for about 6 months. In the traction splints, the tendency of the grafts to contract persists for periods longer than 6 months so that such splints have to be worn for periods longer than that, until the tendency of grafts to contract disappears. To be effective the splints must be worn constantly during day and night, because grafts left exposed without splints contract rapidly, however, short the period of exposure.

#### Effect of Splints on Behaviour of Skin Grafts

The grafts on flexor surfaces of joints normally contract rapidly, and maximum

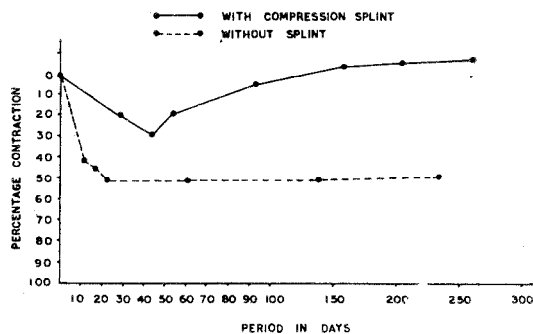


Fig. 7.—Graph illustrating the behaviour of split skin grafts on front of elbow with and without application of compression splint.

contraction occurs in first two weeks. There is generally insignificant relaxation in grafts in such areas and grafts settle in that state (Sawhney, 71, 75). When constant mild pressure is exerted the contraction is significantly reduced and it occurs slowly extending over a period of 6 to 8 weeks. This is followed by gradual stretching so that graft may assume its original dimensions or even stretch beyond it (Fig. 7). The grafts settle early and become soft and pliable developing crease lines. On the other hand the skin grafts behave differently under the effect of traction splints. They continue to contract for 4 weeks after application of splints. The reduction in contraction is not as significant as in grafts under compression splints. However, contraction is minimized to an extent that ultimate functional results are not compromised. The grafts under traction do not stretch to a comparable extent and also take a longer time to settle (Fig. 8). The power to contract lasts longer than 6 months. This suggests that compression splints are more effective than traction splints in preventing contraction of grafts or recurrence of contractures.

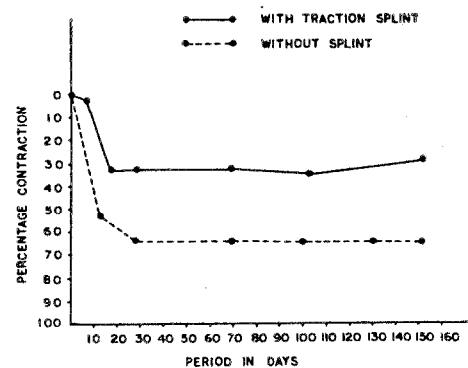


Fig. 8.—Graph illustrating the behaviour of split skin grafts on flexor aspect of fingers with and without application of traction splint.

**Summary and Conclusions**

The rationale and design of splints to be worn after release of contractures has been presented. Whereas compression splints need to be worn for 6 months, the traction splints

have to be maintained for longer periods. The compression splints are more effective than traction splints in preventing contraction of skin grafts.

**REFERENCES**

1. Cramer, L. M. : Cervical splinting for burn contractures. *Plast. and Reconst. Surg.* 34 : 293-295, 1964.
2. Cronin, T. D. : Successful correction of extensive scar contractures of the neck using split skin grafts. *Transactions of the International Society of Plastic Surgery. First Congress 1955.* The Williams Wilkins Co. Baltimore 1957, p. 123.
3. Dingman, R. O. : The surgical correction of burn scar contractures of neck. *Surg. Clinics North America*, 41 : 1169-1176, 1961.
4. Evans, E. B., Larson, D. L. and Yates, S. : Preservation and restoration of joint function in patients with severe burn injury. *J.A.M.A.*, 204 : 843-848, 1968.
5. Evans, E. B., Larson D. L., Abston, S. and Willis, B. : Prevention and correction of deformity after severe burns. *Surg. Clinics North America*, 50 : 1361-1375, 1970.
6. Gibson, V. P. : Innovation of skin grafting as applied to chin chest contractures. *Plast and Reconst. Surg.*, 35 : 322-326, 1965,
7. Koepke, G. H. and Feller, I. : Physical measures for the prevention and treatment of deformities following burns. *J. A. M. A.*, 199 : 791-793, 1967.
8. Ousterhout, D. K., Yeakel, M. A., Lau, B. M. and Thumbusch, W. T. : Inflatable splint. An adjunct to prevention and treatment of cervical scar contractures. *Brit. J. Plast. Surg.*, 22, 185-189, 1969.
9. Sawhney, C. P. : Contracture of skin grafts and its relation to cleavage lines of skin. *Brit. J. Plast. Surg.*, 24, 233-237, 1971.
10. Sawhney, C. P. : Behaviour of skin grafts as regards changes in its linear dimension. *Indian J. Plast., Surg.*, 8: 68-71, 1964.
11. Tanzer, R. C. : Burn contracture of neck. *Plast. and Reconst. Surg.*, 23: 207-212, 1975.