Flexible Elastomer Molds in Burn Scar Control
(burns, pressure application, silicon molds)

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Burn scar hypertrophies and contractures have responded well to pressure techniques with pressure gradient burn garments except over soft tissue areas and concave body areas such as the axilla, hand, clavicle, neck, and face. Although these areas represent only 20 percent of the body area, when scarred from burns they pose perplexing functional and esthetic problems. Rigid splints and face masks have been used but their rigidity makes them uncomfortable for long-term wear. Silastic® Medical Elastomer molds have proved highly successful in these areas when worn under pressure garments. They are flexible and of definite shape. The elastomer molds fill the concave gapping so that consistent definitive pressure can be maintained and scar hypertrophies prevented.

Occupational therapists working as members of burn teams have played an increasing role in carefully maintaining and monitoring the pressure techniques used in the treatment of burn scars and contractures. Definitive splinting and the judicious use of pressure techniques have consistently proved their worth when these two methods have been properly timed, applied, and maintained during the wound healing process. Larson and others stated,

Scar contractures and hypertrophic scar formation following thermal injury can be markedly lessened by proper positioning of the patient, utilization of splints to maintain good position of all joints, the use of skeletal traction to expose skin grafts and maintain proper joint position, and long-term use of splints and pressure dressings following healing. (1, p 653)

Clinicians have benefited from the pathophysiological studies done at the Shriner's Burn Institute and the University of Texas Medical Branch at Galveston. Kischer, Shetler, and Shetler reported that moderate and continuous pressure for a minimal period of nine months reduces the erythema, elevation, and firmness of grafted area or scar without recurrence once pressure has been removed (2). In September 1978, in a paper delivered at a symposium on Burns in Children, in Galveston, Texas, Larson presented statistics to substantiate the use of splints and pressure. He found that when splints and pressure were not applied, 93 percent of his patients required surgical intervention to improve functional joint range. These statistics improved to only 26.3 percent when splints and pressure techniques were used consistently.

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Etiology of Scar Formation

The dermis layer is of primary importance in scar formation because collagen bundles, the major concern in the contractures, are found there. Scar formation is the result of the following factors. An increase in the prolonged inflammatory response causes an increase in the vascularity to affected areas. This increase in vascularity brings about greater collagen formation with a decrease in collagen breakdown together with increasing adhesive-ness of the collagen fibers and bundles. Collagen bundles consist of numerous ropelike strands that float or are suspended mucopolysaccharides (3, pp 466-467).

The fibroblasts make excessive collagen in early scar healing that disrupts the plasmic reticulum. This freshly laid down collagen is "sticky." When the collagen bundles come together they fuse, forming thickened nodules that push outward and cause hypertrophic scarring and contractures (3, p 467). If increased vascularity or redness in the newly formed scar tissue is gone or blanched in three months, the likelihood of scar hypertrophies is negligible. However, in the majority of patients, the increased vascularity persists indicating the potential for hypertrophic scarring and resultant contractures.

Methods of Applying Pressure

Applying pressure to newly formed scar tissue to prevent rigid, deforming scars and contractures has been tried in different ways with varying degrees of success. Initially, bandages and Ace wraps were used in an attempt to apply early pressure. These bandages slipped or constricted and an even pressure could not be maintained. Foam or sponge pads were applied over joints (4), but these are difficult areas to secure and treat with constant pressure, especially when patients are encouraged to move and perform activities of daily living.

Splints are successful in maintaining gross functional positioning of the extremities and neck but must be carefully monitored. Splints can be used as a part of a sustained protocol to stretch out existing contractures as they appear. They are particularly useful at the elbow, wrist, hand, and knee joints. A balance between the use of splints and an exercise program must be maintained for the successful management of the burn patient (5; also 3, p 469).
Pressure gradient garments have proved highly successful in controlling hypertrophic scarring when the wearing protocol is strictly adhered to. Early accurate measurement and application are imperative, with a constant monthly follow-up program maintained for up to 18 months post-burn or until full scar maturation. These customized garments have solved 80 percent of the problems of pressure to the burn scar areas because of their unique design in which zippers with a tri-dimensional dacron fabric are used. To be successful, these garments must fit like a second skin on the patient, while allowing full functional use of the body. The garments are designed to apply 25 to 32 mm Hg pressure to the scar area in order to prevent collagen buildup and subsequent scarring (3, pp 470-477).

Direct contact pressure is most effective on convex and flat surfaces, but less effective on concave surfaces. Since most individuals sit in a semiflexed position, many concave areas result primarily over the clavicle areas, anterior chest, axilla, hands, and neck. The soft tissue areas of the body also pose special problems: around the mouth and nose, under the mandible, the axilla, the neck, and the cleavage of the breasts.

Silastic® Mold Technique
In recent years, Silastic® Medical Elastomer has been used as an interface between the skin and pressure garments. This interface can be made by pouring or spatulating the material directly on the body part to form a definite contoured mold. The molds are placed in the hollows created by normal flexed positioning such as in the axilla, clavicle, and hands. They are worn under the pressure garments and require no bandaging.

Material. Elastomer is a two-component silicone material that vulcanizes at room temperature without exotherming. When catalyzed, it solidifies into a strong, solid "rubber" that is inherently nontoxic, nonirritating, and nonsensitizing. It resists oxidation and does not become hard with age. Elastomer is white, opaque, and viscous. It is composed of polydimethylsiloxane #200 that requires a catalyst of specially tested stannous octate. A special fluid may be used as an extender if necessary.

Making the Mold. An elastomer mold is made by first applying a silicone-base baby powder over the
scarred area. A sufficient amount of elastomer to adequately cover the area is then poured into a Styrofoam cup or similar container. Since the mold material does not expand, it is easy to estimate the amount needed.

The patient must be comfortably seated and positioned before the catalyst is added to the elastomer. The setup time can be controlled by the amount of catalyst used. A tongue depressor is used to thoroughly and rapidly mix the elastomer and catalyst. As soon as the mixture begins to drag on the depressor, it must be quickly poured over the scarred area. It will have the consistency of a thick butter frosting and can be spread like an icing on a cake. The mold should not be more than \( \frac{1}{4} \) inch \((1.25\text{-cm})\) thick over the scar and should slope to about \( \frac{1}{4} \) inch \((.3\text{ cm})\) at the sides to conform to the skin surrounding the scar.

The mold can be impregnated with a piece of gauze to give additional strength and to prevent larger molds from cracking. The elastomer should be spread to give a wide margin outside the perimeter of the scar to ensure adequate pressure and prevent the mold from slipping. The mold usually sets within a few minutes. Once it is firm and dry, carefully lift up an edge of the mold to break the seal and peel it off. Patients often prefer to remove the mold themselves. Once removed, the mold and the scar surface areas should be washed and dried.

**Protocol for Use**

The soft rubberlike molds are easily tolerated by the patient because they permit normal mobility of the affected area. Since they are occlusive, corn starch or baby powder can be used on the scar site to reduce sweating. The mold should be washed and dried daily. Immersing the finished mold in boiling water for 15 minutes will significantly reduce the odor if any is present.

Because the mold pressure reduces the scar so noticeably in the early weeks, the molds should be changed weekly to take advantage of the gains made. Often a series of three to four molds are needed until the scar hypertrophies are flat, soft, and elastic. The molds should be worn continuously under the garments until the scarred areas are completely blanched white and mature. The elastomer mold technique will be successful if it is initiated no later than six months post-burn when the scar is still red.

**Case Example**

A typical application of the elastomer mold technique was used on a young boy who was scalded by a
cup of hot coffee, which resulted in second-degree burns of the shoulder and clavicle. He was treated in an emergency room and sent home. When the patient was first seen three months post-burn as an outpatient, a well-developed red hypertrophic scar was present (Figure 1). The child was measured for a pressure garment short-sleeved vest, and a mold was fabricated (Figures 2, 3). Figure 1 shows the child three months post-burn; Figure 4 shows him eight months post-burn. The mold was changed four times during the six-month scar management program until the scar was completely flat and soft.

**Other Uses**

This same technique has been used successfully for inserts under face masks. Smaller molds can be fabricated to fit in the hollows around the nose and mouth and behind the ears.

Feldman of the Shriners' Burn Institute, Cincinnati Unit, has done extensive work with boots lined with silicone (elastomer) contour molds of the foot. The boots have been very successful for the prevention of dorsal skin contractures involving the ankle and toes. Since the material can be easily cut and rejoined, it has proved excellent in maintaining definitive pressure in the growing child.

Burned hands have always presented unique problems because uniform pressure application to a highly mobile body part is difficult. Because the functional position of the hand always involves flexion, the benefits of pressure in Jobst gloves are greater over the dorsum of the hand than over the palmar surface. The palmar surface is more difficult to treat, especially in cases of electrical burns.

Probably one of the most frustrating hand contractures seen repeatedly is the fifth finger volar contracture. Even when pressure garment gloves are worn, the patient will develop the “crawling” type of contracture that shortens and tightens very quickly (Figure 5). Since these contractures are very rigid, a static splint is required to form the base of the mold. A static Orthoplast splint is fitted with the finger in as full an extended position as possible, but allowing room for the mold. The mixed Silastic® Medical Elastomer should be quickly poured into the splint, making sure to cover and
support the full length of the contracture (Figure 6). This often requires extending the splint just distal to the wrist. The splint and mold are then snapped to the finger. The molds are changed weekly until the contracture softens and stretches and full extension is reached. Figure 7 shows splints with elastomer mold liners; Figure 8 shows the result after one month. Once full extension has been reached, it must be maintained by using pressure gloves and extension splints worn at night over the gloves.

Palmar and thenar web space contractures respond well to this protocol by maintaining the contracture at its maximum stretch position while the mold is used.

These applications can be used on any part of the body where pressure garments will not supply adequate pressure to potential hypertrophies. The scar, however, must be red and the elastomer molds started no later than six months post-burn. The pressure techniques must be used 24 hours a day and molds removed only for bathing and short exercise periods, to prevent reoccurrence of the hypertrophies. All too often these techniques are discontinued when the scars are smooth and elastic but not mature. Monitoring the scar should continue for at least one week after pressure has been discontinued to check for any recurring hypertrophy.

Conclusions
Kischer, Shetlar, and Shetlar reported that "Hypertrophic scars and contractures may be rapidly resolved through application of pressure and forced extension. Examination of pressure-treated scars by scanning and transmission electron microscopy demonstrates a reduction in intercollagen cohesiveness and increasing numbers of vestibular fibroblasts." (2, p 62)

When these techniques are properly used, the scars can be controlled by reducing the collagen buildup. An increase in pliability and excursion of the scar tissue will result, with a decrease in joint restriction, and, ultimately, better active range of motion. Often, surgical scar revisions can be eliminated, and the resulting mature scar will have a smooth, elastic, cosmetic appearance.

The elastomer molds should be considered for late application of pressure (up to six months post-burn) in conjunction with pressure-gradient garments for difficult-to-reach areas. They also should be considered as an aid in the reduction of contractures and webbing, particularly in the fifth finger with the flexion contracture primarily spanning the interphalangeal joint resulting in webbing of the volar surface of the digits. By applying an elastomer mitt over the dorsum of the hand, including the wrist, increased excursion and softening of the dorsal scar will result. The softened and extended dorsal scar will prevent dislocation and subluxation of the metacarpophalangeal joints and the interphalangeal joints, which, in turn, will maintain good joint integrity and proper tendon balance. The extent of surgery can be reduced or procedures delayed. This can be of particular importance when working with joint contractures in growing children, since restricted joints will prevent proper bone growth.

Work is currently being done at the Shriners’ Hospital, Galveston, Texas, on elastomer face masks to be worn under pressure face masks. They are softer and allow more mobility without affecting the pressure (3, p 473).

All of these techniques have been in use at the Western Pennsylvania Hospital Burn Unit for three years with a high rate of success. They are only successful, however, when the patient and family thoroughly understand and cooperate with the instructions for wearing the molds.

REFERENCES
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Note: Silastic® Medical Elastomer (formerly Silastic® Medical Grade Elastomer #382), Dow Corning/Wright, P.O. Box 100, Arlington, Tennessee 38002

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