

Skoog

AMERICAN COLLEGE OF SURGEONS
 52nd Annual Clinical Congress
 October 9-14, 1966
 San Francisco, California
 Press Room: Mark Hopkins Hotel

FOR RELEASE WEDNESDAY A.M.
 October 12, 1966

"TISSUE REPAIR IN BURNS"
 by Prof. Tord Skoog, M.D., Uppsala, Sweden
 The Scudder Oration on Trauma

SAN FRANCISCO--I wish to express my gratitude for the great honor of being invited to give this Scudder Oration. The subject on trauma I have chosen, is related to the repair of burns. The magnitude of this type of injury is illustrated by the fact that in this country only, 70,000 burns occur annually with a working rate of 10%. Every week thousands of patients in the world die from burns or are crippled for life. The cost in care must be astronomical. The suffering and tragedies beyond comprehension.

Like no other injury, the burn represents a graded trauma affecting primarily a single organ of the body, an organ serving many functions essential to life. The systemic effects in severe cases are dramatic and were characterized as a catastrophic surgical illness by Truman G. Blocker, Jr. in the Scudder Oration of two years ago. These general aspects of the burn have for many years caught the interest of scientists and promoted clinical research in this field. Though we may still not fully realize the complexity of the pathophysiological reactions involved, we are now at least able to better understand why progress has been moderate in combating the burn syndrome (Arturson).

Too little emphasis has, in my opinion, been placed upon the principles and surgical techniques necessary for tissue repair in burns. Despite the fact that these principles and techniques are not only essential for cure, they also determine the healing time and the quality of the final results so important to the patient. Fortunately, the skin demonstrates a regenerative capacity, which offers exceptional possibilities for its recovery by grafting. Numerous factors have, however, to be considered if we are to achieve the best possible results in restoring the various functions of skin (Ponten). Today, reconstructive surgery offers a variety of methods which allow us to reduce to very low figures the former inevitable disability caused by full thickness skin loss in burns.

The review I am going to present to you is based on observations on some 3,000 burns, about 900 of these were of such severity that they required admittance to the hospital. The distribution, type and courses of these burns closely resembled your experience in the United States.

HOSPITALIZATION TIME - It is of great interest that full thickness burns admitted to our unit for primary treatment have had an average stay in the hospital of 51 days, irrespective of whether they were admitted within 48 hours or referred to us up to 180 days after injury or even later. These findings confirm similar observations at the burn unit in Galveston and are ample proof that full thickness burns need specialized surgical treatment.

These figures also reflect the fact that with present methods of treatment, deep burns require on an average at least three weeks preparation prior to grafting.

LOCAL TREATMENT - Time will not permit me to discuss the early local care of burns with regard to the use of antibiotics, chemicals and various immersion solutions. Their role in the successful clinical course leading to skin grafting remains a controversial topic. All our fresh cases have been treated by the exposure method as described by Wallace. An evaluation of this treatment made at our unit by Korloff demonstrated that it entails less danger of infection than the occlusive dressing method.

Although the pharmaceutical industry offers an increasing variety of remedies to control infection, it was obvious to us, as to anyone working in this field, that skill and patience in the local care of the burn are of basic importance in obtaining good healing conditions. When suppuration occurs during the sloughing stage, good drainage is obtained by daily baths and wet dressings.

The indications for skin grafting in burns are mainly depending on the depth of the injury. In deep dermal burns and patchy full thickness burns, spontaneous healing may take from one to two months. The regenerated epithelium is thin and vulnerable, so that slight trauma causes blisters, avulsions and ulceration; contracture from deep scarring may also occur. These hands illustrate that kind of healing, showing the result two years after burn injury. The wide extent of skin replacement necessary to restore function of these hands is shown by the indicated borderlines of the grafted area. Therefore, burns, which extend down to the level of the deep dermal layer, should preferably be grafted. That will save time and give better functional cosmetic result.

When the full thickness of thickness of the skin is lost, regardless of the type of injury, it must be replaced if function is to be restored. This basic principle has its most common application in burns: the result of ignoring that is shown in this patient where skin loss on the dorsum of the foot and the leg has bound the foot to the shin and dislocated the ankle. The severe atrophy and deformity of this leg is entirely the result of scar contracture and disuse. This woman was crippled in childhood by simple skin loss due to burn of the neck and the chin. Scar contracture during growth has caused this hideous secondary deformity of the face.

Skin grafting should be accomplished as quickly as possible to reduce healing time, to prevent pain and to minimize the dangers of infection and other complications. Like in no other injury the pain, persistent over a long period of time, affects the personality of the patient. Particularly children become frightened and bewildered. In this situation, sedatives are of little value and there is no relief until the wounds have been completely covered by skin grafts. We are forever indebted to some of the greatest men in reconstructive surgery for pioneering and teaching this principle which marks the most important step so far in the advancement of burn treatment. I am referring to Vilroy Blair and Barrett Brown from this country, to Sir Harold Gillies and Sir Archibald McAindoe from England.

GENERAL CARE OF THE PATIENT

Let me briefly consider a few aspects of the treatment prior to

grafting. It was often confirmed in our burns that the degree of success in skin grafting is related to the general condition of the patient. This rarely presents a problem if skin grafting can be carried out within a month after the injury, as demonstrated in this farmer who was admitted four weeks after the burn. The eschar was removed and replaced 48 hours later with split skin grafts. The take was complete and the patient discharged after three weeks. Five years later, skin cover is functionally normal.

Patients referred at a late stage, with their wounds still open, regularly presented marked hypoproteinemia and secondary anemia. For example, in this case, with full thickness circumferential burns of both legs in a boy aged 6, no attempt had been made to graft this patient when he was admitted four months after injury. The granulations are pale and gelatinous, some idea of his cachectic condition can be gained from the stick-like appearance of these legs. He would not gain weight until the legs were healed; five grafting operations were required and nine blood transfusions to improve and maintain his general condition. Here he is six years later. He has a full range of movement and takes part in all normal activities of a boy that age, but due to improper or rather neglect of treatment, he had to suffer at least six months of unnecessary pain in hospitals during which period his life was in danger due to infection.

The negative nitrogen balance in these patients due to the protein loss from the wound over a long period cannot be overcome by an increased intake of protein and calories or medication with iron and vitamins. Repeated large transfusions of whole blood, plasma and albumin daily, or with an interval of two to three days, are needed to bring the erythrocyte volume and the plasma protein level close to normal at the time of operation. Neglected cases needed on the average more than twice as many grafting procedures for healing compared with patients admitted at an earlier date.

EXCISION PRIOR TO GRAFTING

An evaluation of the late results of skin grafting revealed that the general function of the graft did not only depend on the thickness of the graft, but also on the depth of the original burn, as well as the extent of surgical debridement prior to grafting.

In those cases in which the skin graft replaces the cutaneous layer only function is completely restored as you will see in this petrol burn. On admission, there was a definite full thickness loss but margins were not clear. Here, after twelve days the area of full thickness loss is well demarcated. It was then excised and a split thickness skin graft applied. The result after ten years, note the subcutaneous veins under the graft showing that the subcutaneous tissue with the cutaneous nerves has been left, which explains why the sensation within the grafted area is normal.

Contrary to this, when the excision has been taken down to the deep fascia, the sensation within the graft is considerably decreased but still enough for protection. This estimated 25% fire burn extended deep to the fascia. Three years after injury, the grafted skin was functionally quite satisfactory though sensation was poor.

When the original burn involved the deep fascia or perosteum, protective sensation was not always adequate. This is found to be of importance in some areas, for instance, on the back of the hand and on the leg, where unnoticed trauma causes repeated ulceration.

Supported by these findings I feel, that as a general rule, tissue undamaged by injury should not be sacrificed. In the majority of burns, one should wait for clear demarcation of the dead tissue and then perform very conservative debridement, being careful not to remove any viable tissue. Another advantage with this technique is that the patient will at the time of surgery have developed a granulating barrier against invasive infection. The extra time in the hospital which this principle may entail will be found to have been well worth while when the final result is considered.

This principle gives a very limited scope for immediate excision and grafting of the burn. This is because it is rarely possible in the fresh burn to determine exactly the extent of tissue damage. Exceptions are small burns with clearly demarcated edges. This is a full thickness burn due to prolonged contact with a hot stove during an epileptic fit. The area of full thickness skin loss was well demarcated and immediately excised and replaced by full thickness grafts from the groin. More skin was added over the proximal phalanx of the middle finger later on and this shows the final result after six years.

Skin GRAFTING

The long term results demonstrate no visible difference between grafts applied on granulating surfaces and those applied on freshly created wounds. Neither are attempts at the more or less complete removal of fresh granulations successful in preventing scar formation or contracture. To minimize blood loss and to reduce the danger of spreading infection, the granulation tissue should be removed only to the extent, necessary to obtain a good vascular bed for the graft. It is obvious that undermining an advancement of skin edges, in an attempt to reduce the size of the skin defects should not be done, as it causes tension along the borders of the graft and results in wide marginal scars with marked tendency towards keloid and scar bands formation. On the contrary, if contraction has already the surrounding skin should be freed and allowed to retract. Observations in growing individuals for periods of up to twelve years clearly demonstrate that split skin grafts grow with the child provided that the original defect is completely covered with skin under normal tension, that the margins of the graft are placed correctly. In this case, the right hand was grafted because of a deep burn when the patient was two years old. Soon afterwards, scar contractures had to be corrected but this demonstrates the normal development of that hand during the following ten years.

When the margins of a skin defect are so placed that contraction along its line would cause limitation of movement, use is made of cross-cuts or local flaps, secondary defects being covered with free grafts. This can be done at the time of primary grafting but it is generally left for a secondary procedure. This shows the eschar of a third degree burn two weeks after injury, treated by exposure. At this stage, the burned tissue was excised and replaced by skin grafts. The result ten years later, note the cross-cut extending into normal skin and preventing contracture in the longitudinal scar line of the popliteal fossa.

The raw surface should as far as possible be completely covered with skin,

using large sheets. In many centers the view seems to be held that the use of 'postage stamps' or narrow strips of skin provides for drainage and improves the take of the graft. In our experience, complete coverage reduces infection, speeds up healing and minimizes scarring. Naturally, in extensive burns, the possibility of total coverage depends upon the amount of skin available, if this is inadequate, we prefer to cover completely a part of the area and leave the remainder for one or more subsequent grafting procedures.

IN THE FIXATION OF SPLIT SKIN GRAFTS - one technical point may be mentioned. In the case of thin skin grafts suturing is often traumatic and occasionally part of the graft is ruined by the sutures. Further, if the graft is anchored with sutures to a granulating wound, the stitches sometimes cause bleeding underneath the graft which prevents a good take. To overcome these disadvantages, we have now for several years been utilizing porous tape for the fixation of the graft. In this manner, they are quickly and simply attached to each other and to the surrounding skin. There has been a complete take within the granulating arch. Granulating wounds following deep burns are often surrounded by recently healed dermal burns as in this case where the regenerated epithelium on the cheeks is very easily traumatized and adhesives applied over such areas are liable to cause epithelial evulsion upon removal and to increase the incidence of local infections. None of these complications were encountered when the porous tape was used for fixation of the grafts and likewise in dressings. The ectropions of this patient were corrected by full thickness skin grafts and the dressing held in place by porous tape. The tape was then placed on such vulnerable skin as is here present. At the first dressing five days after the operation, the absence of folliculitis, maceration or other skin reactions within this area is evident.

HOMOGRAFTS

The use of skin homografts in the treatment of extensively burned patients is a most valuable procedure to reduce pain and to prevent fluid loss. I will report just one case to you. A girl of 4 with a severe infected burn five weeks after injury. With regard to her poor general condition, it was considered too dangerous to perform the major operation of cleaning the wound and coverage with autografts. Fresh homografts from the mother were used instead. They had a complete take and there was marked improvement of the child's general condition in the next two weeks. When the homografts liquified permanent healing was achieved by autografting in stages. The result after five years is shown here.

SPECIAL SECTION

In extensive deep burns, or burns affecting certain areas, healing rarely means complete rehabilitation. Several reconstructive procedures may be needed to restore function and appearance. In girls it is important that skin loss of the front of the chest and the axilla is fully replaced to bring forth the growing breast. This patient suffered a full thickness burn on the right upper arm, the entire axilla and part of the pectoral region when she was one year old. This resulted in a deformity that is here shown at the age of 16. By scar excision, the original skin defect was reproduced and grafted

with split skin. The breast then came into normal position and developed symmetrically with the other side.

This patient suffered a deep burn of the same region at the age of three when the nipple area was also destroyed. A full range of movement returned following grafting to the arm and axilla. A flap from the lower abdomen carrying a massive subcutaneous fat layer was then transferred in two stages to form the breast that was missing.

In the two cases just shown, free grafts were used to overcome contracture of the axilla. Though we give preference to this method, repeated contractures of this area may require flap repair. In this case, a flap was shifted from the upper arm to the left axilla and on the other side, a flap was rotated from the back; secondary defects being covered with free grafts.

Burns localized to the front of the neck present surgical problems similar to those of the axilla. In this third degree petrol burn, recurrent contractures occurred following grafting. They were not completely released until a third set of free skin grafts had been inserted. This is after 10 years.

Burns of the face involve only a small percentage of the total body surface and are of little significance with regard to the general effect of thermal injury on the victim. Left to heal spontaneously, facial burns reveal, however, their serious nature. The horrifying deformities which develop, and the functional disturbances which result due to scar contracture or actual loss of tissue, present difficult problems in reconstructive surgery.

This is the result following healing of a deep burn of the lower lip and chin. Complete scar excision restored the position of the lip and post-auricular skin grafts were used for skin replacement. This also made it possible to correct protrusion of the ear at the same time.

In facial burns, the thin skin of the eye lids is frequently affected with the obvious dangers of ectropion and inadequate protection of the eyes. In a conspicuous place like this where the arch to be grafted is limited, it is an advantage to carry out the immediate repair with graft. A full thickness skin graft taken either from the supra-clavicular or the post-auricular region is preferable. This shows the rather pale supra-clavicular graft after eight years. In more extensive burns, particularly those encircling the eye, repeated grafting is required for correction as in this boy burned by sulphuric acid. Secondary scar bands at the inner and outer canthi had also to be corrected by local flap procedures before this result was obtained.

Electrical injuries caused the most severe permanent disability in our series, that because the nerves proved to be the most vulnerable of deep structures. In hand injuries, I have found a typical lesion to occur when the victim grasps a high tension wire. The hand is thrown into spastic flexion contraction and the current in taking the shortest distance arcs across and enters at the wrist. This patient has that typical injury, all fingers were without sensation and immobile. On exploration, it was found that both the ulnar and the median nerve had been burned through. After resecting

about 6 cm., each nerve was re-sutured, tendon repair was accomplished and soft tissue cover obtained with a skin flap. Mobility and sensation returned gradually to an extent that he can now earn his living as a mechanic. The current also caused a deep burn of his forehead. After removal of the outer table of the bone, flap cover was required. This was provided by a scalp flap which, however, brought the hairline too much forward. Therefore, the superficial hair-bearing layer was later returned and on the remaining base, there was a good take of a full thickness skin graft. In this slide, you can also see the degree of flexion his fingers have. After this picture was taken, he also got some opposition of his thumb by tendon transfer.

In areas in which appearance is a prime consideration, split grafts sometimes have to be replaced by local flaps or tissue from a distance. In this electric flash burn, deep coagulation necrosis was present over the right side of the face and neck. Necrotic tissue was excised after three weeks and this is a result of split skin grafting. Note the contraction and the unpleasant appearance of the grafts of the right eye lid, cheek, nose and upper lip and the destruction of the eyebrow and nasal ala. This picture shows six months after injury the first stage in reconstruction with an acromipectoral tube pedicle, the lower end is used to release the neck contracture. This is the next stage in the transfer of the tube to the face. The nose was reconstructed by means of a forehead flap, based on the right temporal artery, The eyebrow was simultaneously rebuilt by placing a bit of the hairy scalp pedicle across the supra-orbital ridge. *Three years after injury showing the tube pedicle replacing the right half of the upper lip, most of the cheek and part of the lower eye lid. The eyelids themselves have been resurfaced with full thickness skin. The entire nose has new cover from the forehead flap which also forms the eyebrow.

In this short review, I have only been able to deal with some basic principles for tissue repair in burns and to indicate methods of a more general application. To make this treatment available in developing countries where in many places burns dominate the panorama of trauma, we need international cooperation for a world-wide teaching program. I am aware of the great international contributions of your College to the peoples of the world who suffer. In a humble way, I would like to use this opportunity to bring to your notice the efforts of a group of surgeons who would like to help those suffering from burns and to reduce the problem of burning accidents. Last year, at an international congress for research in burns, which took place in Edinburgh, the International Society for Burn Injuries was formed, and the secretary A. B. Wallace, now has his secretariat at the College of Surgeons in Edinburgh. We have now national representatives in 47 countries. This society is based on individual membership. Any physician, surgeon and scientist can become a member if he is engaged in the care of any aspect of the burn patient.

*The portion of forward flap planned for the alar margin was lined with the composite auricular graft, before ~~the~~ the flap was transferred to shape and support the new nostril.