THE USE OF SMALL DEEP SKIN GRAFTS

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The object of this paper is to call attention again to the value of very small grafts, especially to those which contain more of the true skin than the superficial grafts advocated by Reverdin. I have called these grafts "small deep grafts."

The hastening of the healing of granulating wounds by the use of small detached bits of skin was first demonstrated by J.-L. Reverdin.¹ His report to the Société Impériale de Chirurgie, Dec. 8, 1869, caused universal interest.

He showed a patient on whom he had practiced "epidermic grafting," and described the grafts as consisting of the epidermis only. He says, "I raised with the point of a lancet two little flaps of epidermis from the right arm, taking care not to cut the dermis."

Grafts obtained by Reverdin's method are usually

in character than when the thinner grafts are used (Fig. 1).

It is interesting, when we consider that Reverdin developed his method of grafting before the introduction of antiseptics and asepsis in surgery, and that his is probably the only type of graft which could have given satisfactory results under such conditions.

The favorable results obtained by other surgeons in England, America, Germany and France, following the use of Reverdin's method, undoubtedly stimulated further investigation along this line.

The tiny grafts of Reverdin were gradually superseded by much larger grafts of the same thickness, advocated by Ollier³ in 1872, and later by Thiersch⁴ in 1886. After a few years the value of the Reverdin method seemed to have escaped the attention of most surgeons, and one might be about a surgical clinic for years and never see this type of graft employed.⁵

USE OF SKIN GRAFTS

As there is little difference, except in thickness, between the "small deep grafts" and Reverdin grafts,

Fig. 1.—Photomicrographs of the same magnification showing the comparative thickness of a small deep graft and a Reverdin graft; A, a small deep graft cut to include a considerable thickness of the true skin; in the section the edges of the graft are curled inward; B, a Reverdin graft cut to include as little of the dermis as possible; there is a thin layer of the dermis throughout, which is thickest in the center.

thought of as pure epidermic grafts, and in his articles Reverdin always spoke of them as *greffe épidermique*; but in his exhaustive paper on the subject,² published in 1872, he says in part, "The title 'epidermic grafts' is not perfectly correct, as the transplanted bit is composed of the whole epidermis and a very little of the dermis."

Reverdin also said that if the epidermis alone could be transplanted, the same result would be obtained as when a part of the dermis was included. This, of course, is true as far as the epithelium is concerned, but it has been my experience in a large number of cases that the grafts which are somewhat deeper and contain more of the true skin give a more stable healing, and the final result is more like the normal skin

the following methods of preparation, etc., will be found applicable for either type.

Surface on Which Grafts May Be Placed.—The grafts may be placed on fresh wounds, but are usually applied to granulating surfaces. The success of small grafts depends to a large extent on the condition of the granulating wound, and it is most important that the granulations be clean, firm, rose pink in color, and not exuberant. Time is saved in the end by careful attention to this point. It is of advantage to place

3. Ollier: Bull. de L'Acad. de méd., 1872, i, 243.

4. Thiersch: Verhandl. d. deutsch. Ges. f. Chir., Berlin, 1886, xvii.

5. In a study of the first 550 cases grafted in Dr. Halsted's clinic at the Johns Hopkins Hospital, between 1889 and 1909, I found that Reverdin grafts were used in only two cases, and then in conjunction with Thiersch grafts. Since that time, however, the small grafts have been frequently used (Davis: Johns Hopkins Hosp. Rep., xvi). In 1909, Ehrenfried and Cotton, in an excellent and timely paper, again brought to the attention of American surgeons the value of Reverdin's method. In this paper there is also a complete historical review of the subject (Ehrenfried and Cotton: Boston Med. and Surg. Jour., Dec. 23, 1909, p. 911).

1. Reverdin, J.-L.: Greffe épidermique, Bull. de la Soc. impériale de chir. de Paris, Dec. 8 and 15, 1869, pp. 493, 511.

2. Reverdin, J.-L.: De la greffe épidermique, Arch. gén. de méd., 1872, pp. 276, 555, 703.

these grafts on a granulating surface, as there is no pain in the preparation of the surface; no danger of stirring up infection, and no loss of blood, which is an important point in cases already much depleted.

I will not consider at this time the various methods of bringing a granulating surface into healthy condition.

Method of Preparing Healthy Granulations to Receive Grafts.—On the day preceding the operation, all secretions and crusts are removed. The granulations are painted with tincture of iodine and dressed

ready to apply the grafts. It is most important that the surface to be grafted should be perfectly dry, as the grafts adhere much better to a dry surface, and are less liable to be subsequently displaced.

The Source of Grafts and Area from Which They Are Obtained.—Autografts are almost uniformly successful when placed on a granulating surface which is in proper condition.

Isografts are also successful in many instances, but there are wounds which have come under my observation on which no isograft would take, even after

Fig. 2.—A, the straight intestinal needle, held in an artery clamp, with its point engaged in the skin. The skin is raised up in a little cone. B, the scalpel cutting through the base of the cone. C, placing the graft on a granulating surface. A large opened-out safety-pin is very useful in detaching the grafts from the needle. In this photograph none of the grafts have as yet been pressed down on the wound, and the edges are still curled under.

either with balsam of Peru and castor oil, 1:3, or with moist boric or salt gauze. The dressings are removed at the time of operation, and the wound washed carefully, without causing bleeding, with sponges dipped in warm salt solution. The surface is dried thoroughly and a pad of dry gauze placed over the wound; it is pressed down firmly on the granulations, and removed only when the operator is

Fig. 3.—A, the actual size of a small deep graft with its edges curled under. When this graft is pressed down on a wound the edges flatten out, thus making the graft about one-third larger. B, the punched out defects left by cutting the grafts. Some are filling up with blood in spite of the epinephrin in the local anesthetic. Note the depth of the pits and the rim of undisturbed skin between them. C, a close view of an area grafted with small deep grafts. The grafts themselves are of normal-appearing skin, which is soft and flexible. Between the grafts is scar tissue, which is slightly depressed. The scaly appearance of this area is due to desquamation of epithelium. Photograph was taken six months after grafting.

repeated trials from many donors. Autografts on the same wounds healed promptly.

The grafts may be obtained from almost any portion of the skin. It is considerably easier to cut them from a region such as the front of the thigh (where

the skin is quite taut), than where it is lax, as for instance on the abdomen.

The region from which the skin is taken has little, if any, effect on the success or failure of the grafts.

A large number of these grafts can be obtained from a comparatively small area, thus making it possible to use small grafts on extensive wounds without any severe tax on an ill patient.⁶

Preparation of Area from Which the Grafts are Taken.—A satisfactory method of cleaning the skin before removing the grafts is to shave, and then wash thoroughly with green soap and water. Rinse with sterile water and sponge with ether, followed by alcohol; finally rinse with normal salt solution and dry. It is better to use no antiseptic in the preparation of this area, although very satisfactory results follow the use of iodine technic.

Anesthesia.—As these grafts are obtained with little pain and are usually applied to undisturbed granulations, general anesthesia is unnecessary, unless the patient is a young child, or in a highly nervous condition. It is as a rule desirable to inject 1 per cent. quinine and urea hydrochlorid solution, or 0.5 per cent. novocain, with a small amount of epinephrin, and take the grafts from the anesthetized area. The infiltration seems to have no hindering effect on the healing of the grafts.

TECHNIC

The simplest way to obtain these grafts is to pick up a bit of the epidermis with a straight intestinal needle held in an artery clamp⁷ (Fig. 2). It is raised so that a little cone is formed and the base of the cone is cut through by depressing the blade of the knife.⁸ (The thinner Reverdin grafts may be obtained by cutting off the tip of the cone.) The graft, still on the needle, is transferred to the wound, with raw surface downward. The grafts are placed in rows, a space of not more than 5 mm. being left between the grafts.⁹ When two rows are in place, a strip of dry sterile rubber protective about 1.5 cm. wide is applied over them, so that the lower edge of the protective just covers the lower row of grafts. Then the protective is pressed down over the grafts firmly with a gauze pledget, and the edges of the grafts will uncurl and spread out evenly on the wound. The next row of grafts is placed close to the edge of the protective, and after two or three rows are applied, they are covered with a second strip of protective, which overlaps the first piece about one-half its width. The protective is pressed down firmly, and the procedure is continued in this manner until the whole wound, or the part selected, is covered.¹⁰ The ends of the protective strips which extend beyond the wound edges may be fastened securely to the normal skin by means of a

few drops of chloroform.¹¹ Moist salt gauze over the protective strips secured by a bandage is a satisfactory dressing. The part should also be immobilized as far as possible.

The area from which the grafts are taken may be dressed with boric ointment spread on a sheet of rubber protective, which is snugly strapped over the wound, or with silver-foil and dry gauze.

The grafts are either round or irregularly oval. They vary between 2 and 4 mm. in diameter (Fig. 3), and should seldom be larger than 4 mm. They are thickest in the center and taper off toward the edges. With a sharp knife the size, contour and depth can be judged quite accurately.

The wounds left by the removal of the grafts have the appearance of small pits punched in the skin, there being a rim of untouched epithelium between the pits. Fat may be seen in the bottom of some of the pits, which shows that a considerable depth of the skin is used.

Fig. 4.—A, the development of keloid on the thigh in the wounds from which small deep grafts were cut. All of these grafts were cut at one operation. There was no keloid formation around the grafts. Photograph was taken one year later. B, keloid formation around small deep grafts. The grafts, which are soft and in good condition, can be seen at the bottom of little pits. The development of the keloid around the grafts followed a perfectly flat and apparently normal healing. There was no keloid growth in the scars from which the grafts were cut. Photograph was taken nine months after grafting.

There is more bleeding following the removal of these small deep grafts than when the Reverdin grafts are cut, and the resulting scars are also somewhat more pronounced.

Sometimes when the grafts are small, and the skin blood-stained, it is difficult to determine which is the raw surface. This difficulty is obviated when the grafts are obtained from a negro or when iodine technic is employed.

When a large number of these grafts have to be applied the process is very tedious, but this may be mitigated to a certain extent by having two men cutting the grafts, while one man places them, or vice versa.

6. In a number of instances I have applied several hundred of these grafts at a single operation.

7. Agnew, D. H. (Med. and Surg. Rep., 1874, xxxi, 424), first suggested the use of the needle to raise the bit of skin to be cut in obtaining Reverdin grafts.

8. The use of forceps and scissors in obtaining small grafts is not desirable, as the skin is thereby traumatized unnecessarily.

9. The grafts will spread over a considerably larger area, but I believe that more stable healing is produced when the grafts are placed quite close together than when they are planted with greater intervals between.

10. The overlapping strips of protective allow the escape of any secretions from the wound into the overlying dressings.

11. C. A. Porter of Boston uses crape lisse and collodion to hold grafts in place on small wounds.

POSTOPERATIVE TREATMENT

The patient should be kept in bed for a longer or shorter period, depending on the size and location of the grafted area. The part grafted should be immobilized and protected from injury.

The dressings should be removed on the second or third day, and any wound secretions carefully mopped up, or washed off with a gentle irrigation of normal salt solution.

It is possible, even as soon as this, to tell whether or not the grafts have been successful, and in many instances a narrow ring of new epithelial growth can be seen surrounding each graft.

Some bland ointment on old linen is then applied, and if after a day or two the epithelial growth from

with a dry powder, such as zinc stearate, and exposed to the air.

I have not found the open treatment of these grafts just after application to be satisfactory.

The grafted area should be protected from injury for several weeks. Gentle massage is advisable after about three weeks, and should be continued until the grafted area is as freely movable as the normal skin around it.

There is a marked desquamation of the grafted surface when it dries out, especially between the grafts, which is evidently due to epithelial overproduction, but this scaliness can easily be controlled by the application of olive oil or oil of theobroma (butter of cacao).

Fig. 5.—*A*, ulcer, seven months' duration, following a streptococcus infection. *B*, one week after grafting with small deep grafts. Note the close proximity of the grafts to each other. Many of them have grown together and also have joined the stimulated skin edges. Shrinkage in the size of the wound is noticeable. *C*, the same wound two weeks after grafting, entirely healed. *D*, the grafted area two years and three months after operation. The individual grafts can be plainly seen and are sharply differentiated from the surrounding scar tissue.

the grafts is not as vigorous as desired, it is well to alternate the bland ointment with scarlet red, 8 per cent., in petrolatum or zinc ointment, or to use some other epithelial stimulant.

The surface from which the grafts are taken should be dressed in three or four days if protective is used, and the area dusted with a dry powder. If silver-foil is used it should not be disturbed for ten days, after which time all dressings may be removed.

As soon as the new epithelium has filled the gaps between the grafts and joined the epithelium from the wound edges, the grafted area may be dressed

UNTOWARD POSSIBILITIES

There are certain untoward possibilities which must be considered. On account of the simplicity of the operative procedure we are accustomed to regard the use of small grafts as attended with no danger and with but few bad results. Aside from contraction, which may occur, we must consider the danger of carrying infection from the granulating surface to the wounds from which the grafts are cut. It is a difficult matter to convey a graft on a needle, or any other instrument, to a granulating wound without occasionally touching the granulations with the instru-

ment. In order to avoid this chance of contamination it is best either to use a fresh needle for each graft, or to have several needles, so that one can be "flamed" while the other is in use.¹²

Another disagreeable occurrence is the formation of keloid (Fig. 4). Occasionally a massive keloid growth will form in the grafted area, and the grafts themselves can be seen at the bottom of little depressions in the keloid. This keloid growth would probably occur in these wounds whether they were grafted or not. Again, keloid may develop in the scars of the wounds from which the grafts are taken. We know that in certain persons there is a tendency to the development of keloid following almost any wound. This is of course especially true among negroes. It has been my experience that keloid develops in white persons, either in the wound itself or in the areas from which the grafts are taken, much more frequently in burns than in large wounds from other causes. Burns caused by acids seem especially prone to be followed by keloid.

COMMENTS

The age of the patient has apparently little effect on the healing of small grafts. The general health should be carefully looked after and when necessary a vigorous building-up treatment inaugurated. Small grafts will often succeed on granulating surfaces under conditions in which no other type of graft could live. There is almost invariably a marked stimulation of the epithelium of the wound edges following the application of these grafts, even though the grafts be unsuccessful.

The shrinkage in the size of the wound after grafting with small grafts is in some cases quite remarkable. Contraction may occur under a grafted area, but it is not nearly so likely as when grafting is not done. If the grafts are placed close together, contraction may be to a large extent prevented. Healing is very much expedited by the use of these grafts, and resulting cicatrix is solid and resistant.

Small deep grafts are apparently not replaced by scar tissue, as they can be demonstrated as definite areas of normal-appearing skin surrounded by scar tissue even after several years (Fig. 5).

A wound grafted with these small grafts, placed at intervals, has a dotted appearance, and the cosmetic result is not so satisfactory as when either large Ollier-Thiersch, or whole thickness grafts, are used. For this reason it is better not to use them on the face, unless especially indicated. However, if the grafts are placed close together, so as to touch each other, the appearance of the grafted area is very much improved.

A brownish pigment sometimes appears in the grafts themselves, as well as in the cicatrix between them. The scars left by the removal of these grafts is after a time scarcely noticeable, except in those instances in which pigmentation occurs.

The sensation of an area grafted with small deep grafts gradually comes in from the periphery, and not from the underlying tissues.

12. The importance of this point was impressed on me by the following incident: A very resistant ulcer of the groin of long standing, the etiology of which could not be definitely determined, was grafted with small grafts. The wounds from which the grafts were taken on the thigh became infected, and when I was called to see the patient a week afterward, an ulcer similar to that in the groin had developed. This ulcer also resisted every method of treatment used, and it was finally necessary to excise the entire area with a liberal margin. The defect, which was 11 cm. in diameter, and down to the deep fascia, was immediately grafted with a Thiersch graft and healed promptly.

The procedure is by all odds the simplest method of grafting. It requires little preliminary preparation after the granulations are in condition, and unless the area to be grafted is large, the grafting can be done in the patient's room. Enough autografts can be obtained from a small area to cover a large wound without causing any appreciable injury to a patient already in a serious condition.

Several patients have come under my care whose lives have undoubtedly been saved by the successful use of these small grafts.¹³

The difference in the ultimate result between small superficial grafts and small deep grafts placed close together is almost as marked as the difference in results between Ollier-Thiersch grafts and whole thickness grafts.

INTRINSIC CANCER OF THE LARYNX

COMPLETE EXCISION APPARENTLY EFFECTED BY ENDOLARYNGEAL OPERATION

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The treatment of intrinsic cancer of the larynx by laryngofissure is remarkably satisfactory. It is doubtful if the results of operation for cancer in any other part of the body can surpass those which I have already reported.¹ Since giving full particulars and showing cases before the Medical Society of London in 1912, I have continued to obtain the same results; that is, no patient has been lost by operation, and 80 per cent. have remained free from recurrence. This freedom from recurrence dates back in some cases for ten years.

The same proportion of lasting cures was obtained by Semon, who did much to popularize laryngofissure in these cases, and similar records were secured by Butlin, who revived the operation after it had been quite discredited both in this country and abroad. Possibly it is because these excellent results were first obtained in England that we, in this country, have come to look askance at any other route for removing an endolaryngeal cancer except that obtained by splitting the larynx. We are even a little skeptical in accepting the records which claim permanent cures by operating through the mouth; yet reports of such cases have been published by several eminent authorities.²

Among my recent cases it has been my good fortune to obtain, in a curious way, the definite proof that an intrinsic cancer of the larynx can be completely removed *per vias naturales*. But I hasten to add that the completeness of removal was unintentional and that I do not for a single moment suggest that excision

13. I have in mind an illustrative case. A child, aged 12, was severely burned over the pelvis, thighs and legs. She came under my care nearly a year after the accident, during which period she had been repeatedly grafted without success. Her condition was desperate. She was delirious, extremely emaciated and generally depleted by the pain, and by the long-standing suppurating wounds. As a last resort the wounds were grafted with small deep, autografts, which were successful, and within a few days the change in her condition for the better was astonishing. A prompt recovery followed. No other type of autograft could have been successful in this case, on account of the condition of the granulations.

1. Thomson, St. Clair: Brit. Med. Jour., Feb. 17, 1912, p. 355.

2. Fraenkel, B.: Deutsch. med. Wchnschr., xv, 1; Arch. f. Laryngol., 1897, vi, 361. Arslan: Arch. Ital. di Otol., 1901, xii, Part 2; Ann. des mal. de l'oreille, 1904, xxx, 130. This gives an analysis of recorded cases. In two personal cases, confirmed by the microscope, the patients remained well after four years and twenty months, respectively. Funder: Jour. Laryngol., 1910, xxv, 602.